SLEEP

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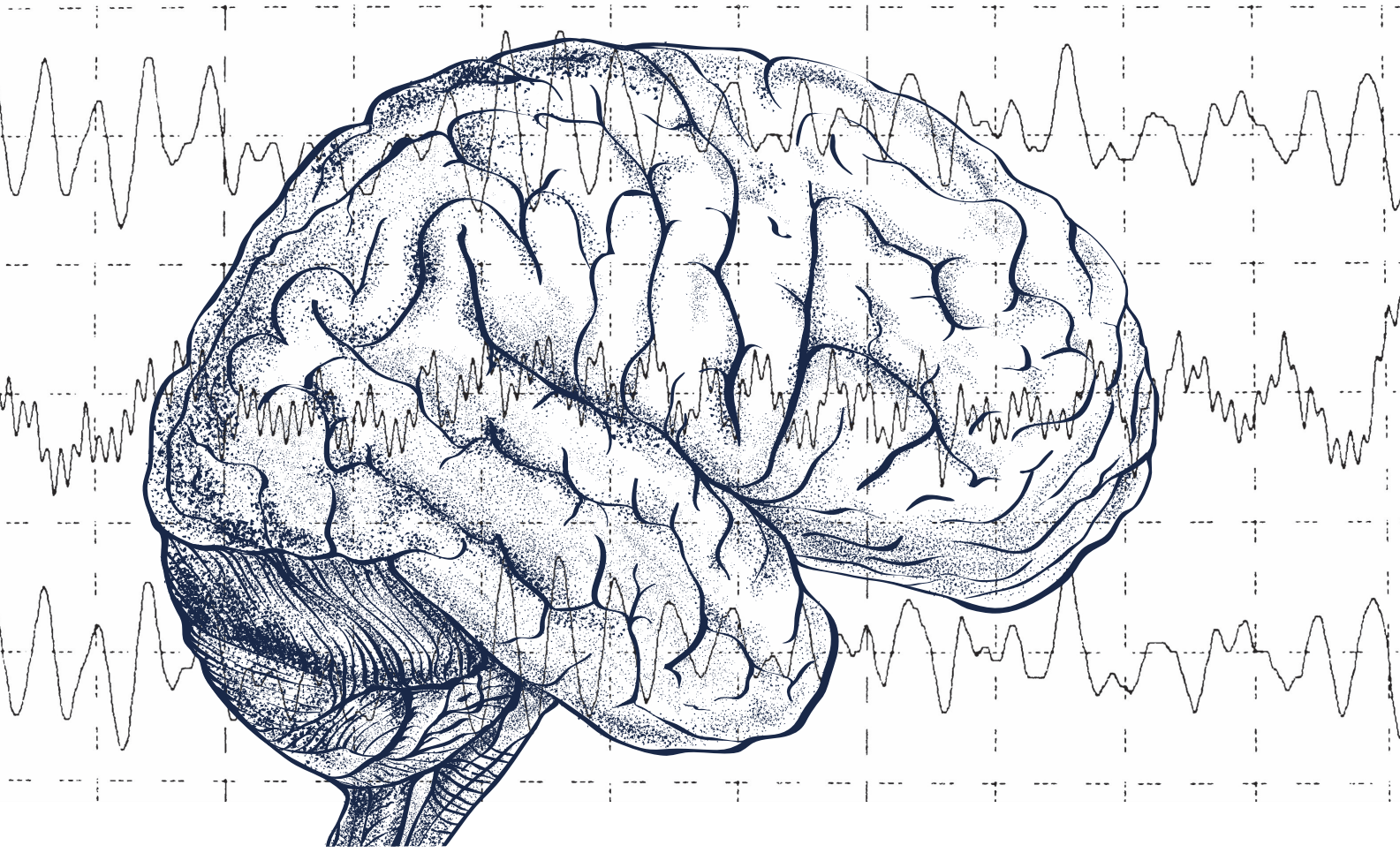

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SLEEP

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Welcome to your preview of SLEEP 2017, the 31st Anniversary Meeting of the Associated Professional Sleep Societies, which will be held in Boston, Massachusetts on June 3-7, 2017.

This abstract supplement unites the journal *SLEEP*, and the science of SLEEP 2017. All abstracts presented at SLEEP 2017 are included in this special issue. This year, 1,209 abstracts will be presented at the meeting. 196 will be presented in an oral presentation format, and the remainder will be presented in a poster format. Many authors of oral presentations will also be presenting their science in the poster hall, providing additional dedicated time to network with the authors of these important studies. In addition, this abstract supplement contains case reports submitted by individuals in Sleep Medicine Fellowship and other training programs.

Abstracts in this supplement are divided between basic and clinical sleep science and then assigned to one of 18 subcategories. Each abstract has a unique four-digit number to facilitate identification and location both within this issue and at SLEEP 2017. The four-digit number in the abstract supplement matches the four-digit code published in the SLEEP 2017 Mobile App.

The SLEEP meeting fosters an environment in which members and attendees learn about the latest basic, translational and clinical science and technologies, promoting the continued growth of the field through the dissemination of new knowledge. We look forward to sharing in the success of this pivotal event and hope you consider joining the American Academy of Sleep Medicine and Sleep Research Society in Boston, Massachusetts in June.

Ronald Szymusiak, PhD
Editor-in-Chief

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0001

GENOME-WIDE ANALYSES OF SLEEP SPINDLES IN THE NATIONAL SLEEP RESEARCH RESOURCE

Panagiotaropoulou G[1], Cade B[2], Mariani S[2], Demanuale C[1], Cox R[3], Saxena R[1], Pan J[4], Smoller J[1], Stickgold R[3], Manoach D[1], Redline S[2], Purcell SM[2]

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Introduction: Sleep spindles are associated with various aspects of learning and memory and are potential biomarkers of neuropsychiatric disease. Although twin studies indicate that spindle activity is partially heritable, specific genes are yet to be identified. Here we detect and characterize spindle phenotypes in 11,630 individuals (aged 5 to 95), confirm their heritable basis and initiate genome-wide association analyses to map individual genes.

Methods: We compiled whole-night polysomnography, demographic and medical data from the US National Sleep Research Resource (NSRR), applying automated artifact rejection and wavelet analyses to detect spindles from two central electrodes. Univariate heritabilities and genetic correlations were estimated using within-family intraclass correlations and variance components models for the genome-wide single nucleotide polymorphism (SNP) data.

Results: Spindle and spectral phenotypes demonstrated high test-retest reliabilities (r>0.8), based on over 4,000 individuals with repeated polysomnograms. We identified and corrected potential confounders that might impact genetic studies, including body mass index (mediated by cardiac interference in the EEG) and age. In 730 individuals from the Cleveland Family Study, spindle density was highly heritable in both white ($h^2 = 0.45$, $p = 8x10^{-6}$) and black individuals ($h^2 = 0.43$, $p = 3x10^{-6}$), adjusting for age and sex. Spindle density in stage 3 sleep (N3) had a high genetic overlap ($r_G = 0.89$, $p = 2x10^{-4}$ in whites, $r_G = 0.88$, $p = 1x10^{-5}$ in blacks) with N2 spindles. In contrast, fast (15Hz) and slow (11Hz) spindles showed significant heritabilities but no genetic overlap (r_G = -0.15 and 0.16, p = 0.31 and 0.18 for whites and blacks respectively), suggesting distinct genetic architectures. These results will help in the optimal selection of independent phenotypes for ongoing genome-wide association analyses, the results of which are expected early 2017.

Conclusion: We observed evidence for robust genetic influences on spindle phenotypes, controlling for a range of demographic and clinical covariates. This work can inform future genetic studies that aim to understand better the genetic architecture of spindles and their relation to health and disease.

Support (If Any): NIH grants MH108908 (Purcell), MH107579 (Manoach), HL114473 (Redline & Mariani), HL45369 (Redline), HL113338 (Redline) and MH48832 (Stickgold).

0002

FINE MAPPING GENOME-WIDE ASSOCIATION IN NARCOLEPSY DEFINES NOVEL DISEASE MECHANISMS

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Introduction: Type 1 narcolepsy is characterized by sleepiness, REM sleep abnormalities and loss of muscle tone triggered by positive emotions (cataplexy). The cause of type 1 narcolepsy is a loss of neurons producing the hypocretin/orexin peptide likely of autoimmune origin. Our aim was to discover novel genetic variants in narcolepsy and fine map the potentially causative variants using our transethnic sample and cellular models.

Methods: A worldwide narcolepsy collaboration was built over the last two decades. Within this consortium, we examined genetic variants using a transethnic GWAS in Asian, African American and Caucasian samples (N=5,500 cases and 30,000 controls). The function of leading variants was examined using eQTL analysis in dendritic and T cell models, data from the ENCODE and GTEx consortiums and by examining the effect of individual variants on flu vaccination response. In addition the effect of genetic variants on immune cell development was examined using mass cytometry.

Results: We confirmed existing risk associations (TRA, TRB, IFNAR1, CTSH and P2RY11) and discovered novel loci that predisposed individuals to narcolepsy in CD207, SIRPG, PPP2R2C, ZFAND2A, FLT3, LPP and PRF1. Fine mapping of association suggests a functional polymorphism in position A91V in PRF1, a variant that is directly affecting T and NK cell mediated cell killing. Furthermore, leading variant in IFNAR1 affected IFNAR1 expression after flu infection in dendritic cells suggesting causality for the development of narcolepsy through changes in dendritic cell phenotype.

Conclusion: The results further stress the effect of T cell-dendritic cell interactions in the development of narcolepsy and find causal disease pathways. The novel loci may explain how hypocretin cells are destroyed and support a T cell mediated autoimmune attack in narcolepsy susceptibility.

Support (If Any): World Wide Narcolepsy Consortium, European Narcolepsy Network, Sigrid Juselius Foundation, Finnish Cultural Foundation.

0003

DAT1 GENOTYPE MODULATES THE TIME-ON-TASK EFFECT ON THE PVT DURING TOTAL SLEEP DEPRIVATION

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Introduction: Previous research has shown that the magnitude of the time-on-task (TOT) effect, which is the increase in response variability across the duration of a demanding sustained performance task, is affected by a variable number tandem repeat (VNTR) polymorphism in the Dopamine Transporter SL6CA3 gene (DAT1). Sleep deprivation also induces response variability in such tasks, and amplifies the TOT effect, which suggests shared underlying mechanisms. To explore one possible shared mechanism, we investigated whether DAT1 genotype affects the interaction between the TOT effect and total sleep deprivation (TSD).

Methods: 82 healthy adults (27.0±4.7y; 43 females) participated in one of three laboratory studies. Following a baseline period, subjects underwent at least 38h of TSD. A 10-min psychomotor vigilance test (PVT) was administered 12 times throughout the 38h TSD period. For each test bout and each subject, response times were aggregated into 1-min bins. DAT1 was assayed from blood using PCR and visualized by gel electrophoresis. 79 subjects had the 9- or 10-repeat alleles of DAT1. Another 3 subjects had the rare 8- or 11-repeat variants; they were not used for analysis.

Results: Mixed-effects ANOVA, controlling for study, showed a significant interaction between 1-min bins and DAT1 genotype ($F_{9,87000}$=3.07, P=0.001). As observed previously, the TOT effect was reduced in subjects homozygous for the 10-repeat allele. There was also a significant interaction of 1-min bins, time awake, and DAT1 genotype ($F_{99,87000}$=1.35, P=0.011). Subjects homozygous for the

10-repeat allele showed less amplification of the TOT effect during TSD than subjects with the 9-repeat allele.
Conclusion: DAT1 genotype modulates the TOT effect on the PVT during TSD. DAT1 is preferentially expressed in the striatum, where genotype affects DAT1 expression and dopamine availability. This suggests a role for striatal dopamine in shaping the impact of TOT and sleep deprivation on performance as measured with the PVT.
Support (If Any): ONR grant N00014-13-1-0302, NIH grants R21CA167691 and R01HL105768, FAA grant DTFAAC-11-A-00003, CDMRP grant W81XWH-16-1-0319.

0004

GENOME-WIDE ASSOCIATION STUDY FOR SNORING IDENTIFIES NOVEL GENETIC FACTORS AND BIOLOGICAL LINKS TO SLEEP APNEA AND OBESITY

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Introduction: Snoring is a common condition, affecting roughly 90 million adults in the U.S. Snoring is associated with lower sleep quality, strain on the heart, low blood oxygen levels, obesity, and chronic headaches. Although lifestyle factors play a role, a familial history of snoring increases snoring risk 3-fold. Identifying the genetic basis for snoring should lead to a better understanding of the factors that control breathing during sleep and causal relationships with disease outcomes.
Methods: We performed genome-wide association analyses of self-reported snoring in >100,000 subjects of European ancestry in the UK Biobank. We measured heritability and performed association tests adjusting for age, sex, body mass index, genetic ancestry and genotyping array (>39 million variants). We performed follow-up analysis stratified by sex or obesity status. Pair-wise genetic correlation analyses to 19 traits, including sleep apnea, were also performed.
Results: We identified three genome-wide suggestive ($p<5x10^{-7}$) loci associated with snoring (near *FBXL4, GALNT12/COL15A1* and *NPLOC4*). In analyses stratified by obesity status, we identified suggestive association with an increased risk of snoring in obese subjects only (rs183549235 A allele: BMI<30 (p=0.56); BMI≥30, OR [95%CI] 2.14 [1.60–2.85], $p= 2.04x10^{-7}$; $p_{interaction}=1.05x10^{-6}$) and a second locus with suggestive association to increased risk of snoring in non-obese subjects only (rs550052742 C allele, BMI<30, OR [95%CI] 1.44 [1.26–1.65], $p= 1.18x10^{-7}$; BMI≥30, $p= 0.10$; $p_{interaction}= 3.28x10^{-5}$). We also found a sex specific locus conferring an increased risk of snoring in females only (rs138233508 T allele, Females OR [95%CI] 1.23 [1.14–1.33], $p=1.74x10^{-7}$; Male p=0.59; $p_{interaction}=1.35x10^{-4}$). Lastly, we tested for traits with a significant biological link to snoring. Significant genetic correlation was observed between snoring and obstructive sleep apnea (r_g=0.55, $p=5.59x10^{-4}$), BMI (r_g=0.20, $p=9.15x10^{-7}$), anorexia nervosa (r_g= -0.37, $p=1.44x10^{-5}$), and years of education (r_g= -0.27, $p=2.03x10^{-5}$).
Conclusion: These results provide initial biological insights into the genetics of snoring and reveal shared underlying biology with health and disease.
Support (If Any):

0005

THE PERK PATHWAY IS AN INTRACELLULAR REGULATOR OF SLEEP AND WAKE

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Introduction: The Unfolded Protein Response (UPR) is a cellular process that regulates protein homeostasis in response to endoplasmic reticulum (ER) stress. UPR activation occurs when misfolded proteins accumulate in the ER and leads to the downregulation of protein synthesis, upregulation of molecular chaperones, and increased protein degradation. Previous work from our lab has demonstrated that the UPR chaperone BiP promotes sleep in the fly. However, the involvement of other UPR molecules in regulating sleep has not been explored. In the following study, we examined the role of the UPR sensors protein kinase R (PKR)-like endoplasmic reticulum kinase (PERK) in regulating sleep and wake behavior in *Drosophila melanogaster*.
Methods: Using both pharmacological and genetic approaches, we examined the sleep effects of inhibiting PERK activity in *Drosophila melanogaster*. For the pharmacological experiments, wildtype flies were administered food containing either vehicle or the PERK inhibitor GSK2606414. PERK RNAi was conditionally expressed in neurons using an RU486-inducible GeneSwitch.
Results: Following food administration of GSK2606414, wildtype flies display significantly reduced nighttime sleep during the night in wildtype flies. Additionally, RU486-induced expression of PERK RNAi in neurons mimicked the effect observed after PERK inhibitor administration. Molecular analyses of flies treated with PERK inhibitor or expressing PERK RNAi in neurons demonstrates that BiP expression levels are positively correlated with sleep time.
Conclusion: The results from this study suggest that the UPR protein PERK promotes sleep in *Drosophila*. It is possible that during wake, upregulated protein synthesis in the brain leads to a gradual increase in UPR activation that may represent a cellular sleep-promoting signal. Both dysregulated sleep and sustained UPR activation have been implicated in the pathophysiology of numerous neurodegenerative diseases. Thus, there is strong translational incentive to understand the mechanisms underlying UPR-mediated sleep regulation.
Support (If Any): R01GM123783.

0006

GLUCOCORTICOID SIGNALLING PATHWAYS ARE AFFECTED BY MISTIMED SLEEP, DESPITE CORTISOL REMAINING RHYTHMIC

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Introduction: The 24-hour production of cortisol is strongly circadian, being driven, in part, by a rhythmic signal from the suprachiasmatic nuclei via the hypothalamic-pituitary-adrenal axis. In forced desynchrony protocols where sleep is mistimed relative to the central clock, as occurs during shift work, cortisol remains rhythmic, although amplitude can be reduced. Cortisol drives the glucocorticoid receptor signalling pathways, which regulate expression of thousands of genes in peripheral tissues by both direct DNA binding and indirectly by modulating transcription factors. These pathways regulate many processes including peripheral circadian clocks, metabolism, cell development, immune responses and inflammation.
Methods: In a forced desynchrony study, we collected seven, four-hourly blood samples from 22 volunteers across a 28-hour day while they slept both in-phase and subsequently out-of-phase with their biological clock. We performed whole-genome transcriptome analyses on RNA extracted from these samples and compared expression profiles of components of the glucocorticoid signalling pathways during both sleep conditions using mixed-model ANOVA.
Results: During forced desynchrony, the phase of the central circadian clock, as indexed by the plasma melatonin and cortisol rhythms, remained largely unchanged by sleeping out of phase. However, when we examined the expression profiles of genes involved in both the direct and indirect glucocorticoid signalling pathways, we observed significant temporal disruption of many components (e.g. HSP70,

HSP90, P300, CBP, NCOR1, ERK2, P38, NFKB2) but not all (e.g., SRC, PCAF, ELK1, FKBP4). By contrast, in a separate study where RNA samples were collected during 40h of total sleep deprivation with or without one week of prior sleep restriction, the temporal organisation of these components was not affected.
Conclusion: This shows that the transcripts associated with glucocorticoid signalling pathways are more sensitive to the temporal disruption caused by mistimed sleep compared to the cortisol rhythm, which remains largely unchanged. Thus, a simple measure of cortisol rhythmicity in, for example, shift workers would not reveal underlying disruption to molecular pathways associated with glucocorticoid signalling. Because glucocorticoid signalling is associated with biological pathways linked with health, this has implications for the increasing numbers of shift workers.
Support (If Any): BBSRC (UK; BB/F022883, BB/N004981), AFOSR (USA; FA9550-08-1-0080).

0007

CIRCADIAN AND WAKE-DEPENDENT CHANGES IN THE HUMAN PLASMA METABOLOME

Grant LK[1,2], Ftouni S[1,2], Nijagal B[3], De Souza D[3], Rajaratnam SW[1,2,4,5], Lockley SW[1,2,4,5], Anderson C[1,2,4,5]
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Introduction: Several studies, using group level analyses, have identified plasma metabolites that display 24-hour rhythms and/or change with time awake. Inter-individual differences in these patterns have not been examined in detail, however. The aim of the current study was to assess endogenous self-sustained circadian rhythms and wake-dependent changes in the human plasma metabolome under highly controlled conditions.
Methods: Thirteen healthy participants aged 20–32 years (9 males) were studied during a 40h constant routine (CR). Four-hourly plasma samples were analyzed using hydrophilic interaction liquid chromatography coupled with mass spectrometry (HILIC/MS) in order to conduct an untargeted analysis of polar metabolites. Data were fitted with a non-linear regression model which consisted of a cosinor function with a linear component.
Results: We found that ~40% of metabolites (~700) showed a significant circadian rhythm at the group level. Of these, ~25% had an acrophase (peak time) that occurred during the biological night. Approximately 10% of metabolites (~140) had a significant linear component, and of these ~35% increased with time awake. Overall, ~60 metabolites (3%) showed both a significant circadian and wake-dependent component. Between individuals, there was only a modest overlap in the consistency of metabolite patterns; none of the metabolites showed significant changes across all participants and only a small proportion of metabolites were consistently rhythmic (~130, ~10%) or wake-dependent (~40, ~2%) in approximately half of the group.
Conclusion: These findings extend previous work identifying circadian- and wake-dependent changes in the human plasma metabolome. Once individual metabolites and their metabolic pathways are identified, we will test their utility in predicting the impact of circadian phase and sleep loss. Understanding the role of the circadian clock and the effects of sleep deprivation on the human metabolome, particularly at the individual-level, will be an important step in understanding the relationship between sleep and circadian disruption and metabolic health outcomes.
Support (If Any): The study was supported by the Cooperative Research Centre for Alertness, Safety and Productivity.

0008

CHEMOGENETIC STIMULATION OF THE HYPOGLOSSAL NEURONS IMPROVES THE UPPER AIRWAY PATENCY

Fleury Curado TA[1], Fishbein K[2], Pho H[3], Brennick M[3], Dergacheva O[4], Pham L[3], Ladenheim E[3], Spencer R[2], Sennes LU[5], Schwartz A[3], Polostky V[3]
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Introduction: Obstructive sleep apnea (OSA) is characterized by recurrent upper airway obstruction during sleep. OSA leads to high cardiovascular morbidity and mortality. The pathogenesis of OSA has been linked to a defect in neuromuscular control of the pharynx. There is no effective pharmacotherapy for OSA. The objective of this study was to determine whether upper airway patency can be improved using chemogenetic approach by deploying designer receptors exclusively activated by designer drug (DREADD) in the hypoglossal motorneurons.
Methods: Male C57/BL6J mice were treated with an adeno-associated viral vector carrying DREADD (rAAV5-hSyn-hM3(Gq)-mCherry) (n=13) or control (rAAV-hSyn-GFP)(n=6) stereotactically delivered to hypoglossal nucleus of the medulla. After six weeks (expression period) genioglossus EMG and dynamic MRI of the upper airway were performed before and after administration of the DREADD ligand clozapine-N-oxide (CNO) or vehicle (saline).
Results: CNO activated the genioglossus muscle and markedly dilated the pharynx throughout the respiratory cycle. Control virus treated mice or saline infusion in DREADD treated mice resulted in no change in genioglossal activity and had no effect on upper airway patency.
Conclusion: Chemogenetic approach allowed us to control **hypoglossal motorneurons** remotely improving upper airway patency. Our results suggest that chemogenetic approach can be considered as a treatment option for OSA and other motorneuron disorders.
Support (If Any): American Heart Academy (AHA) 16POST31000017, NIH grants R01 HL128970, R01 HL133100, P50 ES018176 American Sleep Medicine Foundation grant #133-BS-15.

0009

AUTOMATED TRACKING AND QUANTITATIVE GENETIC ANALYSIS OF REST AND ACTIVITY BEHAVIOR IN DROSOPHILA LARVAE

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Introduction: Drosophila melanogaster is an ideal model system for the study of sleep as it exhibits the characteristics of mammalian sleep and is amenable to systems genetics approaches. Although many studies have identified novel genetic and pharmacological features of sleep in adults, little is known about rest and activity during the early

developmental stages of the fly. Specifically, it is not known whether larval rest and activity behaviors are correlated with sleep in the adult stage.
Methods: We used video monitoring and automated machine vision tracking to continuously measure kinematic parameters in third instar larvae during the first four hours of the dark cycle. Our system tracked and quantified movement in 12 larvae at a time. From the tracking data, we constructed behavioral ethograms of individual larvae and calculated total rest time, numbers of rest bouts, average rest bout length, average velocity, and distance traveled. We applied this tracking method to larvae from the Drosophila Genetic Reference Panel (DGRP) in order associate polymorphic variants with underlying larval rest and activity traits.
Results: Preliminary results revealed significant genetic variation in the DGRP for all activity and rest measurements. Larvae were very active during the first four hours of the night and had very short pauses in activity. Some larvae were far more active than others, and explored their chamber to a greater extent during the monitoring period. Larvae had high numbers of rest and activity bouts which differed profoundly from the consolidated periods of rest shown in adult flies; yet some behaviors were partially correlated.
Conclusion:
Support (If Any):

0010

CHARACTERIZING THE INFLUENCE OF THE MOLECULAR CIRCADIAN CLOCK ON SLEEP ARCHITECTURE IN DROSOPHILA MELANOGASTER

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Introduction: The daily timing of sleep is controlled by a circadian clock, the disruption of which is physiologically and psychologically detrimental. While an identified network of circadian clock neurons controls the timing of sleep, a comprehensive understanding of how each of the components of the molecular clock affect sleep architecture is lacking. Though the loss of the circadian clock does not prevent sleep, it results in drastic changes in the quality of sleep. To better understand the ways in which the circadian clock governs sleep, we sought to systematically characterize the impact of loss of function mutations in Clock, cycle, period, and timeless on the sleep rhythm and sleep architecture in Drosophila under both entrained and free-running conditions and to investigate the role light plays in in the regulation of sleep in wild-type and mutant flies.
Methods: Using the Drosophila activity monitoring system, we measured sleep in flies bearing loss of function mutations in the Clock (Clk^{jrk}), cycle (cyc^{01}), period (per^{01}), and timeless (tim^{01}) genes. Sleep was measured in under a 12:12h Light/Dark cycle, constant darkness, and constant light. To assess the impact of light on sleep, sleep was measured under various wavelengths and intensities.
Results: Our analysis of sleep in these lines reveals that all four mutations caused fragmented sleep. Loss of function mutations within the negative limb of the clock (i.e., per^{01} and tim^{01}) resulted in altered daytime sleep architecture but no changes in total sleep time for over the diurnal or circadian cycle. Loss of function mutations in the positive limb of the circadian clock (i.e., Clk^{jrk} and cyc^{01}) result not only in significantly decreased sleep but also reveal a sleep promoting effect of light.
Conclusion: We found that loss of function mutations in circadian clock genes resulted in significant effects on sleep quality with mutations in the negative and positive limb genes producing remarkably different phenotypes.
Support (If Any): none.

0011

ARTIFICIAL SELECTION FOR LONG AND SHORT SLEEP DURATION IN DROSOPHILA MAPS TO BROAD DEVELOPMENTAL AND SIGNALING PATHWAY GENES

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Introduction: Although many candidate genes have been identified for sleep, the extent to which naturally occurring polymorphisms can alter sleep duration is unknown. Here we applied an artificial selection scheme to a natural population of flies in order to determine how far night sleep duration could be driven up or down.
Methods: We created an outbred population from ten Drosophila Genetic Reference Panel lines with variable sleep duration. From this outbred population, we created two short and two long-sleeping populations. We measured sleep in 100 males and 100 females of each population every generation, choosing the most extreme 25 sleepers of each sex as parents for the next generation. We maintained two additional populations as unselected controls. We used whole-genome sequences across seven generations to identify allelic variants responsible for the phenotypic changes.
Results: After 13 generations of selection, long sleepers averaged 9.97 hours more nightly sleep than short sleepers. Mean 24-hour sleep was 198.9 ± 9.5 minutes in short sleepers, comparable to severe short-sleeping flies engineered with single-gene mutations; yet these flies were created from combinations of naturally occurring alleles. Selection for night sleep altered other sleep traits such as day sleep duration and night average bout length, but the numbers of night bouts were reduced in both long and short sleepers, increasing the consolidation of sleep. Flies from these populations also had normal lifespan, suggesting that there is little physiological consequence to being a natural long or short sleeper. Whole-genome sequences revealed thousands of changes in polymorphic allele frequencies between any two generations of selection. However, regressing allele frequency change across generations reduced the number of candidate polymorphisms to 126, implicating 80 candidate genes. Many of these genes could be connected via known physical and genetic interactions with several conserved developmental and signaling pathways such as the EGFR and Wnt pathways.
Conclusion: Sleep duration can be driven to very high or low levels, suggesting that extreme short or long sleepers may exist in nature. Highly conserved broad developmental and signaling pathways influence natural variation in sleep duration.
Support (If Any): Intramural Research Program, National Institutes of Health, NHLBI.

0012

A SLEEP-LIKE STATE INDUCED BY NEURONAL HYPERACTIVITY

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Introduction: The control of sleep and wakefulness is a fundamental biological process that ensures health and cognitive performance across species. The need to sleep (sleep pressure) is determined by two processes: the circadian clock, which modulates behaviour around the 24-hour day, and a homeostatic process, which measures prior wakefulness. Compared to the circadian drive for wakefulness, the molecules and neurons regulating sleep homeostasis remain elusive. To dissect the neuronal underpinnings of sleep homeostasis, we

have developed a novel pharmacological sleep deprivation assay in zebrafish larvae.
Methods: Five-seven day old zebrafish larvae are tracked in a 96-well plate format before, during, and after a short-term (one hour) exposure to a dilution series of wake-promoting drugs, including caffeine. To identify potential mediators of rebound sleep, we also performed an RNA sequencing and in situ hybridization time course before and during drug-induced sleep rebound.
Results: Immediately following sleep deprivation induced by multiple wake-promoting drugs, zebrafish larvae show sustained, dose-dependent increases in rebound sleep that recover to normal sleep levels on subsequent days. Total sleep rebound did not correlate with the extent of physical activity or total wakefulness during the deprivation period. Instead, rebound sleep strongly correlated with the amount of neuronal activity measured by quantitative PCR of the expression of the immediate early gene, c-fos, a readout of neuronal activity. RNA sequencing on samples collected during and after sleep deprivation identified numerous increases in the expression of hypothalamic neuropeptides, including the putative sleep promoting peptide, galanin, among others. Interesting, the level of galanin transcriptional induction strongly correlates with the amount of global c-fos induction as well as the amount of rebound sleep induced by wake promoting drugs.
Conclusion: Our data indicates that sleep pressure is dose-dependently regulated by brain-wide neuronal activity. We hypothesise that this leads to the accumulation of a not yet identified somnogen, which in turn engages the sleep homeostat and increases sleep drive by inducing the expression of the sleep-promoting neuropeptides such as galanin in hypothalamic neurons.
Support (If Any):

0013

THE ASTROCYTIC FABP7 GENE REGULATES SLEEP ACROSS PHYLOGENY

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Introduction: Sleep is found widely in the animal kingdom. Despite this, few conserved molecular pathways that govern sleep across phyla have been described. The mammalian brain-type fatty acid binding protein (*Fabp7*) is expressed in astrocytes, and its mRNA oscillates in tandem with the sleep-wake cycle. In this study, we examined whether Fabp7 is necessary for normal sleep/wake behavior in phylogenetically diverse species, including humans, mice, and the fruit fly, *Drosophila melanogaster*.
Methods: Adult 2–4 month old male C57BL/6J wild-type (WT, N=7) mice were compared to age-matched isogenic Fabp7 knockout (KO, N=8) mice using standard EEG/EMG techniques to examine sleep. Actigraphy measures of sleep in human adult male Fabp7 T61M mutant carriers (N=29) were compared to age-matched male non-carriers (N=265). The 7 day sleep profiles were assessed from the actigraphy records in conjunction with sleep diaries, and genotypes were blinded for the analysis. In order to test whether an astrocyte-specific functional Fabp7 is required for normal sleep in *Drosophila*, we generated transgenic flies that express either the human FABP7 WT (FABP7.WT, N=32) or FABP7 T61M (FABP7.T61M, N=27) under UAS-control, and used the Astrocyte-specific Alrm-GAL4 driver to control transgene expression. We measured sleep using the Drosophila Activity Monitoring System, and standard sleep scoring analytics.
Results: Fabp7 KO mice showed decreased average dark-phase NREM sleep bout duration ($p<0.05$) and an increase in the frequency of dark-phase NREM sleep bouts ($p<0.05$) compared to control mice. Increased frequency of dark-phase REM sleep bouts ($p<0.05$) was also observed. Humans which carry a Fabp7 Thr61Met missense mutation showed a decrease in average 7 d sleep bout duration ($p<0.01$) and an increase in the frequency of sleep bouts ($p<0.05$) compared to non-carriers. Similar to human FABP7 T61M carriers, the effects of FABP7.T61M in flies show increased sleep fragmentation compared to FABP7.WT flies. The FABP7.T61M flies had shorter bout durations ($p<0.05$), a reduction in the maximum sleep bout duration ($p<0.05$) and an increase in the frequency of sleep bouts ($p<0.05$).
Conclusion: These results provide novel evidence for the astrocyte-specific gene, Fabp7, in regulating sleep across phylogenetically diverse species.
Support (If Any): MEXT KAKENHI 221S0002, NIH-HL007713, NIH-HL111725, NIH-MH099544, and ONR-N00014-13-1-0302.

0014

TRACE AMINE-ASSOCIATED RECEPTOR 1 REGULATES WAKEFULNESS, BEHAVIORAL ACTIVATION AND EEG SPECTRAL COMPOSITION

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Introduction: Trace amines (TAs) are endogenous amino acid metabolites that are structurally similar to the biogenic amines. TAs are endogenous ligands for trace amine-associated receptor 1 (TAAR1), a GPCR that modulates dopaminergic, serotonergic, and glutamatergic activity. Selective TAAR1 agonists have been shown to have pro-cognitive, antipsychotic-like, anti-addiction, stress-reducing, weight-reducing, glucose-lowering and wake-promoting activities. We used Taar1 knockout (KO) and over-expressing (OE) mice and TAAR1 agonists to elucidate the role of TAAR1 in sleep/wake.
Methods: EEG, EMG, body temperature (Tb) and locomotor activity (LMA) were recorded in Taar1 KO, OE and WT mice. Following a 24h recording to characterize baseline sleep/wake, mice were sleep-deprived (SD) for 6h. In separate experiments, mice were given three doses of the TAAR1 partial agonist RO5263397, caffeine, modafinil or vehicle p.o.
Results: Baseline wakefulness was modestly increased in OE compared to WT mice. Baseline theta (4.5-9Hz) and low gamma (30-60Hz) activity was elevated in KO compared to OE mice in NREM and REM sleep. Following SD, both KO and OE mice exhibited a homeostatic sleep rebound. In WT mice, RO5263397 increased waking and reduced NREM and REM sleep, decreased gamma power during wake and NREM, and decreased Tb without affecting LMA; these effects were absent in KO mice and potentiated in OE mice. By contrast, caffeine increased wake time, NREM gamma power, and LMA in all strains compared to vehicle; this effect was attenuated in KO and potentiated in OE mice. Subsequent studies confirmed that motor activation and gamma band activity increases induced by caffeine or modafinil are attenuated in KO mice compared to WT.
Conclusion: TAAR1 overexpression increases wakefulness whereas TAAR1 partial agonism strongly increases wakefulness and reduces NREM and REM sleep. These results indicate a modulatory role for TAAR1 in sleep/wake and cortical activity and suggest TAAR1 as a novel target for wake-promoting therapeutics.
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0015

ARC GENE FUNCTION IN SLEEP

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Introduction: mRNA and protein expression of activity-regulated cytoskeleton-associated protein (Arc) is known to be correlated to sleep need. Prolonged sleep increases and recovery sleep decreases its expression. Additionally, the homeostatic sleep hypothesis claims that sleep downregulates synaptic plasticity reinforced during waking duration. This would predict Arc's critical roles in sleep. However, the detail has largely unknown. In this study, we used wild type (WT) and Arc KO mice and compared its sleep phenotype, and responses to homeostatic sleep regulation.
Methods: EEG/EMG electrodes were implanted on WT and Arc KO mice aged older than 8-week for sleep/wake observation. Total and selective REM SD was employed from ZT0-4 following 24-h baseline. For biochemical analysis, control, 4-h total SD, and 2-h recovery sleep brain samples were collected at ZT4 or 6. Quantitative-PCR was carried out for SD-induced gene expression using frontal cortex samples. Arc subcellular localization was detected by immunofluorescence and Dapi staining.
Results: First, in baseline, Arc KO mice showed increased time spent REM sleep, especially during the light phase without any changes of EEG spectra. Second, Arc KO mice showed less sleep rebounds to both total sleep and selective REM sleep deprivation. However, delta power rebound to total sleep deprivation was similarly increased to WT. Third, Arc protein subcellular localization is modulated by sleep/wake status. In WT, SD induces Arc nuclear localization, and recovery sleep promotes cytoplasmic relocalization of Arc. Fourth, this nuclear Arc induced by SD is likely involved in regulation of SD-induced gene expression, especially activity-regulated genes, in both SD and recovery sleep conditions. Since, without Arc, SD-induction of these genes was absent and the same genes were reversely up-regulated at 2-h recovery sleep. Finally, our data provide the possibility that cytoplasmic Arc induced by recovery sleep would reverse synaptic strengthening through decreasing AMPA receptor expression, as its well-known function.
Conclusion: Thus, Arc provides novel behavioral and molecular functions in sleep, and supposedly plays an important role in response to the homeostatic sleep regulation.
Support (If Any): NS075545.

0016

QEEG AND SLEEP/WAKE PHYSIOLOGY DISRUPTED IN NEUROLIGIN-3 KNOCKOUT RAT MODEL OF ASD

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Introduction: The core features of autism spectrum disorder (ASD) include impaired social communication and restricted/repetitive behaviors, however, ASD can be further characterized by a range of associated dysfunctions including sleep disruption (e.g., irregular sleep, frequent night awakenings, prolonged awakenings). Few studies have investigated the sleep/wake system in animal models of ASD. Neuroligin-3 (Nlgn3) is one of many genes associated with ASD, and the Nlgn3 knockout (KO) rat has been proposed as a rat model for studying ASD. The present study assessed sleep/wake physiology and quantitative electroencephalography (qEEG) in the Nlgn3 rat model of ASD.
Methods: Male Nlgn3 KO and wild-type (WT) rat behavior was assessed in a test battery for ASD-related behaviors. Rats were implanted with telemeters to record EEG, EMG, body temperature, and locomotor activity. 24-h EEG recordings were analyzed for sleep/wake states and spectral composition.
Results: Nlgn3 KO rats were hyperactive, spent less time in NREM sleep, and more time in REM sleep. KO rats exhibited elevated theta (4–9 Hz) power during wakefulness and REM sleep as well as elevated delta (0.5–4 Hz) power during NREM. Conversely beta (12–30 Hz) and gamma (30–50 Hz) power was suppressed in the KO across all three vigilance states.
Conclusion: These results demonstrate that sleep disturbances are observed in a rat model of ASD and highlight the utility of EEG as a translational research tool that can provide valuable insight into the pathogenesis of ASD.
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0017

ABNORMAL SLEEP SPINDLE RHYTHMOGENESIS IN MICE BEARING A SCHIZOPHRENIA ASSOCIATED CODING VARIANT IN THE CACNA1I GENE

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Introduction: Sleep-spindles are waxing and waning EEG oscillations (10 - 15 Hz), that are characteristic of NREM-sleep. Sleep-spindles are generated when GABAergic reticular thalamic nucleus (TRN) neurons release a barrage of inhibition onto thalamocortical neurons. This inhibitory barrage is caused by 'rebound bursting' of the TRN neurons and is mediated by low-threshold 'T-Type' Ca channels. CACNA1I encodes CaV3.3 T-type calcium channels and its expression is enriched in TRN. Sleep-spindles are associated with cognitive deficits of schizophrenia (Wamsley et al., 2013). CACNA1I is a schizophrenia risk gene, and de novo missense variations (R1346H) has been identified in schizophrenia proband in trio sequencing. Rebound bursting and sigma power (the frequency band of sleep-spindles) during NREM-REM transitions is diminished in mice lacking CaV3.3 (Astori et al., 2011). R1346H is expected to alter sleep EEG patterns akin to the Cav3.3 knock-out animals because R1346H reduces the whole-cell current density of CaV3.3 channels in vitro, likely by impairing trafficking of the channel to the membrane surface (Andrade et al., 2016). However, the effect of this mutation on sleep spindles has yet to be assessed. We have produced mouse models and recorded EEG in CaV3.3-KO mice, R1305H knock-in mice (homologous to the human R1346H) and their wild-type littermates.
Methods: We here report our initial characterization of these mice in sleep architecture, sleep-spindle density and sigma power during NREM-REM transition.
Results: Cav3.3-KO and R1305H-Cav3.3 mice displayed abnormalities in sleep-spindle density compared to WT. The time spent in NREM-sleep did not differ between WT, Cav3.3-KO or R1305H-Cav3.3 mice.
Conclusion: The schizophrenia risk gene CACNA1I may play a role in a specific aspect of sleep physiology that is known to be impaired in schizophrenia.

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0018

DATA MINING OF MULTIPLE GENOMICS DATASETS UNCOVERS CONVERGENT GENE NETWORKS INTEGRATING CIRCADIAN TIMING AND HOMEOSTATIC DRIVE FOR SLEEP REGULATION

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Introduction: The timing and propensity of sleep are regulated by two interactive processes: circadian rhythmicity and sleep homeostasis. It has been demonstrated that the two processes are likely to converge at molecular levels, involving networks of genes including the molecular circadian clock machinery. However, since the molecular pathways involved in sleep homeostasis are still elusive, it is unclear how the circadian and homeostatic signals integrate to regulate sleep beyond a handful of clock genes.
Methods: In ~200 (C57BL/6J x 129S1/SvImJ) F2 mice, we collected a comprehensive dataset containing: 1) phenotypic data of affective behaviors and sleep (including baseline, recovery after 6-h sleep deprivation, and sleep after restraint stress), 2) genotypic data across the genome, and 3) microarray data in the prefrontal cortex, hippocampus, midbrain-thalamus, and hypothalamus. We reconstructed gene networks in each of these brain regions. We also integrated this dataset with multiple circadian and sleep genomics datasets that are publicly available, in order to identify convergent networks that link both circadian and sleep homeostatic processes.
Results: Using our mouse dataset, we uncovered brain-region-conserved, as well as brain-region-specific, gene networks that are associated with sleep phenotypes. These sleep gene networks are cell-type specific and can be functionally annotated with specific cellular processes, revealing molecular pathways key to sleep function and regulation. Via Integrated analysis with publicly available datasets, we identified a number of gene networks that are enriched with differentially expressed genes responding to sleep loss and cycling genes peaking at particular times of the day. Particularly, our analysis in the prefrontal cortex highlights a Clock-driven network and a sphingolipid-metabolism network, whose overall network gene expression are cycling with opposite phases and are affected by sleep deprivation in opposite directions.
Conclusion: This analysis of molecular networks important to sleep regulation reveals novel insights into convergent pathways that integrate circadian timing and homeostatic signals in the regulation of sleep.
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0019

NICOTINE ADMINISTRATION AND WITHDRAWAL ALTERS SLEEP AND PREPRO-OREXIN LEVELS IN MICE

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Introduction: It is estimated that sleep disturbances occur during 39% of smoking cessation attempts and are a major contributor to relapse. Despite this knowledge, there is no literature on the effect of nicotine withdrawal on sleep in an animal model. This study used mice to characterize sleep and wakefulness during nicotine administration and withdrawal and measure prepro-orexin levels at ZT0.
Methods: In experiment one (n=10), mice were implanted with EEG and EMG recording electrodes. EEE/EMG data were recorded continuously for 4 weeks. During baseline, mice had ad libitum access to food and a .2% saccharin drinking solution. To induce nicotine dependence, 200µg/ml of nicotine was added to the .2% saccharin drinking solution. Withdrawal was induced by excluding the nicotine from the drinking water on day 14. EEG/EMG was scored for two consecutive baseline days, nicotine treatment days 1, 4, 8, and 12, and withdrawal days 1, 2, and 5. EEG/EMG scores for baseline and nicotine treatment days were averaged. In the second experiment, nicotine administration and withdrawal protocols were as previously described. Real-time qPCR was used to assess hypothalamic prepro-orexin levels at ZT0 during baseline, days 1, 8, and 13 of nicotine administration, and day 1 of withdrawal.
Results: Relative to baseline, sleep was decreased during the nicotine period. This effect was greatest during the active period. Relative to nicotine treatment, sleep during withdrawal decreased during the inactive period and increased during the active period. Further, sleep bout duration was significantly decreased and frequency was significantly increased during withdrawal. Preliminary data also indicate that nicotine administration leads to an increase in prepro-orexin at ZTO, an increase that was sustained throughout the period of nicotine treatment and greatest during the first day of withdrawal.
Conclusion: The current data suggest that nicotine administration and withdrawal affect sleep and wakefulness, potentially through elevation of prepro-orexin levels.
Support (If Any): DA015663, t5T32DA017637-12, Discretionary Funds.

0020

SHORT TERM SLEEP DEPRIVATION VERSUS CHRONIC CAFFEINE CONSUMPTION: IMPACT ON THE ADENOSINE A_{2A} RECEPTOR IN THE RAT BRAIN

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Introduction: The arousal effect of caffeine is partly mediated by cerebral A2A adenosine receptors (A2AARs). The present study examined changes in A2AAR protein levels in different regions of the rat brain: a) throughout the circadian cycle and b) after sleep deprivation in control and chronically caffeine-treated rats.
Methods: Adult, male Sprague-Dawley (n = 196) rats were assigned to four groups: control, caffeine, 24 h sleep deprivation and caffeine + sleep deprivation. Animals in the caffeine groups received caffeinated tap water (29.64 ± 0.77 mg/kg bodyweight/per day) for 12 weeks. At

the end of the treatment sleep deprivation animals were sacrificed at 6 h-intervals (n = 7/ group) during and after sleep deprivation (24 h recovery). Non-sleep deprivation rats were sacrificed at the same diurnal times. A2AAR protein levels in neocortex, hippocampus and thalamus were determined by Western blot (normalized fluorescence intensity A2AAR to alpha tubulin ratio).

Results: No significant circadian changes in A2AAR protein levels were found in all investigated regions. Chronic caffeine treatment enhanced protein level significantly by ~ 30% (n = 49) in hippocampus and neocortex. Moreover sleep deprivation increased cortical A2AAR protein level significantly in comparison to controls (SD 35 - 45%, $p < 0.05$ (3 x n = 7). The increased A2AAR protein level remained significantly elevated after 24 h recovery sleep. The combination of caffeine + sleep deprivation led to no significant alterations compared to the control group. No significant differences were found in the thalamic region.

Conclusion: Enhanced A2AAR protein levels in cortex and hippocampus were found both after chronic caffeine and 24 h sleep deprivation. The combination of sleep deprivation with preceding and continuing chronic caffeine administration seems to cancel out the sole effects.

Support (If Any): none.

0021

SLEEP DEPRIVATION ACTIVATES NLRP3 INFLAMMASOMES IN NEURONS AND GLIA

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Introduction: The nucleotide-binding domain leucine rich family pyrin containing 3 (NLRP3) inflammasome is a protein complex that activates the somnogenic pro-inflammatory molecule interleukin-1 beta (IL-1β). Upon activation, NLRP3 recruits the apoptosis-associated speck-like protein containing a carboxyl-terminal caspase-recruitment domain (ASC) to activate the enzyme caspase-1, which converts the pro-form of IL-1β into its active form. We previously found that the gene expression of NLRP3 inflammasome components, caspase-1 activity, and IL-1β protein is enhanced in the cortex after sleep deprivation, although which particular cells are activated remains unknown. Thus, we examined the effects of sleep deprivation on the immuno-reactivity to inflammasome-related markers in neurons and glia.

Methods: Male mice lacking NLRP3 and C57BL/6 wild-type control mice were sleep deprived for 6 h prior to dark onset [Zeitgeber (ZT) 12] using the gentle handling method; or were allowed to sleep *ad libitum*. Immediately after sleep deprivation (ZT 12), mice were perfused and the brains were processed for immunohistochemistry. Cells were double- and triple-labeled with inflammasome-related markers (i.e., anti-NLRP3, anti-ASC, and anti-IL-1β) and neuronal and glial-markers [i.e., anti-NeuN (neuron marker), anti-glial fibrillary acidic protein (GFAP; astrocyte marker), and anti-CD11b (microglia marker)]. We assessed the percent change of immuno-reactive cells to inflammasome-related markers in neurons and glia.

Results: In C57BL/6 wild-type mice, we found significant enhancements in immunoreactivity to anti-NLRP3, anti-ASC, and anti-IL-1β in cells that were also immuno-reactive to anti-NeuN, anti-GFAP, and anti-CD11b after sleep deprivation compared to *ad libitum* sleep. However, the pattern of enhancement differed between cell types depending upon cortical and subcortical brain regions. Mice lacking NLRP3 did not show significant increases in immuno-reactivity to inflammasome-related antibodies, including IL-1β, in neurons and glia.

Conclusion: These data indicate that sleep deprivation activates the NLRP3 inflammasome in neurons, astrocytes, and microglia, although this activation varies depending upon the brain area.

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0022

MICRORNAS ARE CROSS-SPECIES MARKERS OF SLEEP LOSS IN HUMANS AND RATS

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Introduction: Sleep loss is increasingly associated with diabetes, cancer, cardiovascular disease and Alzheimer's disease. MicroRNAs (miRs), small non-coding RNAs that are important regulators of gene expression, typically repress the expression of their target mRNAs, and play an established role in these diseases. To determine whether miRs are involved in sleep regulation, we examined whether they change as a function of sleep loss and recovery in humans and rats.

Methods: Three laboratory studies were performed, two employing sleep restriction (SR) and one employing total sleep deprivation (TSD). In Study 1, 15 healthy adults (35.0±9.9y; 6 females), participated in a SR protocol: miR blood samples were taken after one 10h time-in-bed (TIB) baseline night; five 4h TIB SR nights; and one 12h TIB recovery night. In Study 2, 15 adult Sprague Dawley rats (d65-70; 8 females) participated in a SR protocol: miR samples were taken after one baseline night, four 4h TIB SR nights, and one recovery night. In Study 3, 12 healthy adults (24.8±5.4y; 6 females), participated in a TSD protocol: miR samples were taken after baseline, one TSD night, and recovery. MiRs from plasma were analyzed via Affymetrix microarrays (Studies 1 and 2) or via RNA-seq (Study 3). Mixed linear models with Z-score log2 fold change cutoffs of ±1.645 and greater (FDR< 0.05) were used for statistical analysis.

Results: Across the studies, 46 miRs showed significant fold changes with sleep loss, with the majority of these returning to baseline after recovery sleep. Notably, 117 gene targeted by miRs (determined from TargetScan) showed overlap across the three studies.

Conclusion: These results provide the first experimental evidence miRs can track sleep loss and recovery dynamics across species and serve as epigenetic biomarkers of sleep debt. This work establishes a potential link between miR expression and known diseases resulting from sleep loss.

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0023

SLEEP DEPRIVATION RESULTS IN INCREASED EXPRESSION OF CANCER-RELATED MIRNAS IN HUMANS

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Introduction: A large and growing body of evidence shows that sleep loss has profound deleterious effects on health and has been specifically linked to the development of several cancers. Despite this obvious health cost, there is almost no current understanding of how sleep loss increases the risk for tumor development. The purpose of the present study was to identify epigenetic mechanisms through which total sleep deprivation (TSD) altered expression of known cancer-related genes (suppressors and promoters). To that end, we tested the effects of TSD on the expression of miRNAs that are associated with tumor development.
Methods: Twenty-three participants (14 males, mean age = 20) underwent actigraphy-verified TSD for 24 hours in a controlled environment. miRNA preparations were extracted from participants' plasma and processed for cDNA synthesis. The resulting cDNA pools were used as templates in qPCR reactions in an effort to estimate differential miRNA expression.
Results: Results indicated that sleep deprivation caused significant differential expression of several specific miRNA tumor-related genes, including miR-15a, miR-96, and miR-296-5p. Accordingly, further tests were focused on these two miRNA species on a subset of participants. Results showed that, there was a significant upregulation of miR-15a ($p < 0.05$), miR-96 ($p < 0.05$), and miR-22 ($p < 0.05$), but not miR-296-5p ($p=0.12$).
Conclusion: Overall, these findings show how even short-term sleep loss can alter cancer-associated pathways. Increased expression of miR-15a and miR-22 have known tumor suppression properties. It is possible that miR-15a and miR-22 exert protective effects in response the TSD-induced disruption to homeostasis. Although miR-96 is a known oncogene, it is also part a complex clock gene signaling pathway with diurnal expression. Accordingly, TSD potentially disrupts the normal diurnal expression pattern miR-96. We are currently following up on these results in a study of people who regularly experience sleep loss (i.e. chronic sleep restriction).
Support (If Any): This work is supported by the Department of Education. Number P120A1400.

0024

INTERMITTENT HYPOXIA PARTIALLY IMPAIRS INSULIN-SIGNALING VIA INCREASES IN CAVEOLIN-1 EXPRESSION: VASCULAR IMPLICATIONS

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Introduction: Insulin resistance and endothelial dysfunction are associated with obstructive sleep apnea (OSA), which is characterized by frequent episodes of nocturnal intermittent hypoxia (IH). However, molecular mechanisms contributing to endothelial dysfunction and insulin resistance in OSA are not completely understood. Caveolin-1 (cav-1) is a membrane protein which negatively regulates endothelial nitric oxide synthase (eNOS) activity and contributes to endothelial dysfunction. The objective of our study was to examine the interactions between IH, cav-1, and eNOS activity in vascular endothelial cells in the context of insulin resistance.
Methods: We used an in-vitro approach to examine the effects of intermittent hypoxia in human coronary artery endothelial cells. Chronic IH was achieved by nine daily cycles of 30 min 0.1% O_2 followed by 30 min 21% O_2 repeated for 3 days. Cells exposed to continuous 21% O_2 were used as normoxic controls.
Results: IH exposure up-regulated cav-1 expression while reducing eNOS activity, as measured by NO generation, in cultured human coronary artery endothelial cells. We demonstrate that overexpression of cav-1 attenuated basal as well as insulin-stimulated endogenous NO synthesis. Furthermore, cav-1 overexpression impaired insulin-dependent activation of AKT and eNOS, while there was no effect on insulin-dependent activation of ERK1/2 and insulin-stimulated endothelin-1 (ET-1) expression.
Conclusion: Our data suggest that IH-stimulated cav-1 expression in OSA may contribute to a vasoconstrictive profile (secondary to attenuated NO generation and increased ET-1 expression), and to pathway-selective vascular insulin resistance, whereby insulin is unable to increase NO bioavailability via increased eNOS activity, but rather continues to increase ET-1 mRNA and protein.
Support (If Any): The study was supported by NIH R01 grant HL65176 to VKS and American Heart Association grant 11SDG7260046 to PS.

0025

ADMIXTURE MAPPING OF SLEEP APNEA PHENOTYPES IN HISPANIC COMMUNITY HEALTH STUDY / STUDY OF LATINOS (HCHS/SOL)

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Introduction: Obstructive Sleep Apnea (OSA) is a common disorder with 20%-40% heritability. Its prevalence and severity vary across ethnic groups. To study the genetic bases of OSA, we applied admixture mapping to identify genetic regions associated with the apnea hypopnea index (AHI) in a large Hispanic/Latino sample, where there is significant variation in ancestral background.
Methods: The study included 11,575 participants from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL), associated with diverse background groups: Central Americans, Cubans, Dominicans, Mexicans, Puerto Ricans and South Americans. AHI was rank-normal transformed. We tested the association of previously inferred local African, European, and Amerindian ancestry counts with AHI while adjusting for, age, age^2, sex, age × sex, BMI, and BMI^2. Population stratification and family structure were controlled using 5 principal components, global ancestry, and kinship coefficient matrix in a linear mixed model. The genome-wide significant threshold was 3×10^{-5}, after accounting for linkage disequilibrium.
Results: The sample has mean age (SD) 46.1 (13.9), mean BMI (SD) 29.8 (6.1), 59 % female, and mean AHI (SD) of 6.4 (12.0). The average local ancestries across study participants were 14.2% (African), 30.9% (Amerindian), and 54.9% (European). We detected one significant region at chromosomes 18: q21 where European ancestry is associated with increasing AHI ($p=2.65 \times 10^{-5}$). Suggestive associations were identified at chromosome 1: p13.3 and chromosome 20: q12 ($p<10^{-3}$).

Conclusion: In this largest admixture mapping study of AHI in Hispanic/Latino Americans, a novel genomic region was identified to harbor OSA related variants. Future association analysis may identify genetic variants that explain sleep apnea susceptibility and its variation across ancestral groups.
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0026

GENETIC LOCI IN PERIODIC HYPERSOMNIA/KLEINE-LEVIN SYNDROME TYPE

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Introduction: Kleine-Levin syndrome (KLS) is a rare sleep disorder that affects ~ 1 person in a million and has been suggested to be more frequent in Ashkenazi Jewish. The disorder typically strikes adolescent males and improves with age, often resolving by age 30. KLS, patients have recurrent episodes sometimes lasting up to several weeks where they sleep nearly 24 hours per day. While awake, patients during episodes experience apathy, cognitive disturbances and occasionally hyperphagia and/or hypersexuality. Between episodes, patients are totally asymptomatic. Our aim was to identify genetic variants that contribute to KLS predisposition.
Methods: We performed GWAS on 650 KLS cases and 15,000 controls as a part of an international collaboration. The sample contained KLS cases and matched controls from United States, Europe and Asia plus additional controls from the GERA consortium. Genotyping was done using Affy 6.0 and Affymetrix Axiom World Array with ethnicity specific platforms that were imputed to 1000 genomes. Analyses were controlled for population stratification and ethnicity (Caucasian, Ashkenazi Jewish, Asians, other). We also have pursued other approaches in understanding KLS by using Whole Exome Sequencing (WES) data and have identified 14 family pedigrees to pursue family association studies. Furthermore, we are also looking into any shared genetic architectures with other neuropsychiatric disorders.
Results: So far we have identified a Genome-wide significant loci near TRANK1. Most interestingly, the leading TRANK1 variant is also reported in other GWAS for bipolar disorder (BD). With this new insight we are looking into identifying any other shared genetic characteristics with BD.
Conclusion: The findings give the first biological evidence for disease mechanisms in KLS. Importantly, these results suggest a partially overlapping genetic composition for schizophrenia and KLS. That these patients are not primarily depressed or psychotic during episodes and completely reverse to normality between episodes could suggest important pathophysiological clues linking sleep and episodic psychiatric conditions.
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0027

A GENETIC LINK BETWEEN SLEEP AND PSYCHIATRIC TRAITS

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Introduction: There is mounting evidence of a relationship between sleep and psychiatric traits. Sleep and circadian disturbances are commonly observed in psychiatric conditions. However, genetic studies linking these traits are limited. To systematically study the genetic links and highlight potential causal relationships, we performed genetic correlation studies of sleep and circadian traits with psychiatric traits.
Methods: Previously we performed genome-wide association studies for a variety of self-reported sleep and circadian traits in the UK Biobank (in up to 115,000 people). To probe the biological links between sleep and circadian traits with psychiatric traits, we performed genetic correlation of our GWAS results with publicly available GWAS for psychiatric traits, including neuroticism, depressive symptoms, and subjective well-being using linkage disequilibrium score regression (LDSC).
Results: We found a significant and strong genetic correlation between insomnia and increased neuroticism (r_g=0.47, p=7.01x10^{-23}) and depressive symptoms (r_g=0.50, p=2.30x10^{-17}). We found neuroticism was also genetically correlated with difficulty getting up in the morning (r_g 0.28, p=4.46x10^{-10}), short sleep duration (r_g=0.29, p=1.31x10^{-6}), and increased daytime sleepiness (r_g 0.21, p=1.25x10^{-5}) and daytime napping (r_g=0.20, p=2.91x10^{-5}). We found no genetic correlation between neuroticism and self-reported chronotype, snoring, or sleep apnea. We also found similar genetic links between our sleep traits and depressive symptoms.
Conclusion: We were able to link the genetic underpinnings of insomnia with those of psychiatric traits, suggesting a strong biological link between sleep and psychiatric traits. Moving forward it will be important to probe the causal links between these traits.
Support (If Any):

0028

SHORTER SLEEP DURATION IS ASSOCIATED WITH SOCIAL IMPAIRMENT AND PSYCHIATRIC COMORBIDITIES IN AUTISM

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Introduction: Insomnia is common in individuals with autism spectrum disorder (ASD) and there is substantial overlap among genetic mechanisms regulating sleep and influencing ASD risk. As studies have observed that sufficient sleep is essential for normal neurodevelopment, the need for effective treatments of insomnia in individuals with ASD is profound. Understanding the mechanisms underlying short sleep duration and ASD severity is a critical step towards mitigating symptoms. We hypothesized that shorter sleep duration would associate with increased severity of ASD-related

symptoms, and that synaptic homeostasis genes modify this relationship.

Methods: We analyzed medical histories and whole-exome sequence data from 2,714 children with ASD. Linear regression was conducted to test if parent-reported sleep duration was associated with symptom severity. Symptoms were compared between children in the lower 5th (extremely short) and upper 95th (extremely long) percentiles of the sleep duration distribution. Eleven algorithms were used to predict deleterious variants in genes related to synaptic homeostasis. Genetic risk scores were calculated, reflecting the number of variants (each weighted based on the likelihood of being detrimental) per individual. Influence of risk scores on the relationship of symptom severity and sleep duration was assessed with interaction tests.

Results: Shorter sleep duration was associated with increased social impairment, increased severity for numerous challenging behaviors and increased reports of attention deficit disorder, depressive disorder, and obsessive compulsive disorder. Most symptoms were more severe in extremely short sleepers compared to extremely long. Increased burden of deleterious variants in synaptic homeostasis genes significantly influenced the relationship of short sleep duration with expression of depressive disorder.

Conclusion: This study represents one of the largest analyses evaluating the effects of sleep duration on ASD severity. Results show a clear relationship between shorter sleep duration and more severe ASD symptoms, demonstrating the importance of identifying sleep problems in this patient population. Future studies should examine whether short sleep duration is a cause or consequence of more severe ASD symptoms, and explore pleiotropic genetic effects influencing sleep duration and ASD symptoms.

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0029

BDNF VAL66MET POLYMORPHISM IMPACTS ALERTNESS AND PERFORMANCE IN SHIFT WORKERS

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Introduction: Night shift work typically occurs under conditions of circadian misalignment and sleep restriction, resulting in impaired performance and alertness. There is inter-individual variability in the degree of impairment consequent to shift work, though little is known about the genetic factors that confer resistance or vulnerability. Brain Derived Neurotrophic Factor (BDNF) is a potent modulator of sleep-wake homeostasis and contains a common functional polymorphism in its pro-domain (val66met). The present study examined whether the val66met polymorphism explained inter-individual variability in shift work tolerance as measured by the psychomotor vigilance task (PVT) and electroencephalographic (EEG) correlates of alertness.

Methods: Forty-eight night shift workers completed an in-laboratory, simulated night shift and were genotyped for the val66met polymorphism (TaqMan assay; rs6265). Participants completed the auditory PVT and the Karolinska Drowsiness Test (KDT) during the shift.

Results: Genotyping of val66met identified 27 val/val homozygotes (19 males; age 32.5±9.5) and 21 met allele carriers (12 males; age 31.3±9.0). Both mean reaction time and attentional lapses increased as a function of time into the simulated night shift, reflecting a general worsening of performance (both $p<0.001$). The val66met polymorphism moderated this effect such that met allele carriers showed larger increases in mean reaction time and attentional lapses across the night shift, relative to the val homozygotes (both $p<0.05$). EEG power spectrum analysis revealed a three-way interaction between val66met genotype, time into shift and EEG frequency ($p<0.001$). Relative to baseline, met-carriers show greater elevation in delta (0.5–4.5Hz) power and a greater reduction in alpha (8.5–12.5Hz) and beta (20-30Hz) power at the end of shift, compared to val homozygotes (all $p<0.001$).

Conclusion: Our results demonstrate a heightened vulnerability to the effects of shift work among met allele carriers, relative to val homozygotes. The ability to predict an individual's vulnerability to shift work from genetic data may be utilised in the targeting of those who would benefit most from alertness impairment countermeasures.

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0030

BRAIN DERIVED NEUROTROPHIC FACTOR (BDNF) MET ALLELE CARRIERS SHOW IMPAIRED PERFORMANCE ON THE STROOP TASK DURING SLEEP DEPRIVATION

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Introduction: Accumulating evidence points to a genetic contribution to explain inter-individual vulnerability to sleep deprivation. A functional polymorphism in the BDNF gene, which causes a valine (Val) to methionine (Met) amino acid substitution, has been associated with cognitive impairment, particularly in populations with impaired frontal functioning. We expected that sleep deprivation, which affects frontal function, may lead to cognitive dysfunction in Met allele carriers. To examine this, we investigated the effects of sleep deprivation on response inhibition in different BDNF genotypes using the Stroop Color Naming Task.

Methods: Thirty healthy, Caucasian adults aged 18–36 years, including 12 (4 women) heterozygous Met allele carriers and 18 (8 women) Val/Val homozygotes, underwent 30-hours of extended wakefulness under constant routine (CR) conditions. A computerised Stroop task was administered every 2 hours during the CR. Mean reaction time (RT) and error rate for all Stroop trials (congruent, incongruent, and

neutral), and an inhibition measure (RT of incongruent trials - RT of neutral trials), were calculated for each test session and analysed using linear mixed model analysis. The difference in performance during the 'biological night', defined as tests occurring after dim light melatonin onset (DLMO), and during the 'biological day', tests occurring before DLMO, was also examined.

Results: Errors and reaction times increased with time awake for all individuals. Participants with the Val/Met genotype made more errors on incongruent trials after 20 hours awake. Val/Met participants also took significantly longer to respond when inhibiting a prepotent response irrespective of time awake. Follow-up analyses, however, showed that this effect was particularly evident during the biological night.

Conclusion: Our study shows that carriers of the BDNF Met allele are more vulnerable to the impact of prolonged wakefulness and the biological night on cognitive dysfunction, as measured by response inhibition on the Stroop task.

Support (If Any): This study was supported by NSBRI HPF01601, HFP00003, and in part by M01-RR02635.

0031

INHERITED VARIATION IN CIRCADIAN RHYTHM GENES AND RISKS OF PROSTATE CANCER AND THREE OTHER CANCER SITES IN COMBINED CANCER CONSORTIA

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Introduction: Circadian disruption has been linked to carcinogenesis in animal models and to breast cancer in humans. However, the evidence for other types of cancer is inconclusive. Variations in genes involved in circadian rhythm provide a tool to investigate such associations.

Methods: We examined associations of genetic variation in nine core circadian rhythm genes and six melatonin pathway genes with risk of colorectal, lung, ovarian and prostate cancers using genome-wide association studies (GWAS) from GAME-ON. The major results for prostate cancer were replicated in PLCO, and for colorectal cancer in GECCO. The total number of cancer cases and controls was 15,838/18,159 for colorectal, 14,818/14,227 for prostate, 12,537/17,285 for lung and 4,369/9,123 for ovary. For each cancer site, we used the SNP summary statistics for the candidate gene regions imputed to 1000 Genomes. Gene-level and pathway-level analyses were conducted using the summary-based Adaptive Rank Truncated Product method (sARTP).

Results: Aggregate genetic variation in circadian rhythm and melatonin pathways were significantly associated with the risk of prostate cancer in data combining GAME-ON and PLCO, after Bonferroni correction ($P_{pathway}<0.00625$). The two most significant genes were NPAS2 ($P_{gene}=0.0062$) and AANAT ($P_{gene}=0.00078$); the latter being significant after Bonferroni correction. For colorectal cancer, we observed a suggestive association with the circadian rhythm pathway in GAME-ON ($P_{pathway}=0.021$), that was not confirmed in GECCO ($P_{pathway}=0.76$) or the combined data ($P_{pathway}=0.17$). No other association was observed for the other cancer sites.

Conclusion: These findings support a potential role for circadian rhythm and melatonin pathways in prostate carcinogenesis. Further functional studies are needed to better understand the underlying biologic mechanisms.

Support (If Any): This study used data of more than 20 studies, which were supported by various funding sources from different countries.

0032

THE MEDIATING EFFECT OF BRAIN STRUCTURE ON SLEEP SLOW WAVE ACTIVITY DURING ADOLESCENCE

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Introduction: One of the most dramatic changes to sleep architecture across adolescence is a reduction in slow wave sleep, a stage of sleep dominated by slow delta (0.3 to <4Hz) waves. Concurrently, the brain undergoes a wealth of changes, including reductions in gray matter volume (GMV) and cortical thickness (CT) with advancing age across adolescence. Here we investigated whether age-related differences in GMV and CT accounted for the typically observed age-related differences in slow wave (delta) activity (SWA) in adolescents.

Methods: 132 participants (59 male, 73 female; age range: 12–22 years) from the National Consortium on Alcohol and NeuroDevelopment in Adolescence (NCANDA) study were included in this cross-sectional analysis of baseline polysomnographic, electroencephalographic (EEG) and magnetic resonance imaging (MRI) data, which were collected at SRI International and the University of Pittsburgh. Mediation models, which controlled for site and supratentorial volume, were used to assess whether age-related differences in cortical brain structure accounted for age-related differences in SWA. We hypothesized that age would have a direct effect on SWA, but that age may also affect SWA indirectly due to its known influence on cortical thinning and gray matter volume decline.

Results: Older compared with younger adolescents had less SWA, smaller GMV and/or CT, as shown previously. The direct effect of age on SWA explained 47% of the variance ($p<0.001$). In addition, significant indirect effects ($p=0.01$-0.001) of age on SWA via CT and GMV were identified for several, predominantly frontal, brain regions, with models explaining 50–54% of the variance.

Conclusion: We identified that the significant association between age and SWA was partially mediated by age-related differences in brain structure. As reductions in GMV and CT may be indicative of synaptic pruning, these results suggest that diminished SWA in adolescence may largely be driven by synaptic pruning within a number of cortical brain regions.

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0033

THE EFFECTS OF SLEEP RESTRICTION ON SLEEP SPINDLES IN ADOLESCENTS

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Introduction: Today's adolescents sleep less than their predecessors. Spindle counts reflect intellectual capacity and are increased during sleep following learning and may be a marker for successful learning. Previous studies indicate that sleep restriction is accompanied by reduced N2 but preserved N3 sleep. Here, we examine changes in spindle count and density during multiple nights of sleep restriction and recovery in adolescents.

Methods: Sleep of adolescents aged 15–19 years was monitored with polysomnography during selected nights in two experiments. Experiment 1 consisted of 3 baseline nights (9h time-in-bed [TIB]), followed by 7 nights of either 5h TIB (sleep restriction group; n=25) or 9h TIB (control group; n=22) and 3 recovery nights of 9h TIB. Experiment 2 (n=52) consisted of 2 baseline nights (TIB=9h), 5 nights of 5h TIB, and 2 recovery nights (TIB=9h), with half the participants receiving a 1h daytime nap opportunity after each sleep restriction night. Automatic spindle detection was completed on C3/C4 artifact-free EEG using previously published methods to derive measures of spindle count and density (number/minute) during N2 sleep. All comparisons were to the final baseline night in each experiment.

Results: In Experiment 1, spindle count was reduced from 424.8±25.5 (mean±SEM) at baseline to between 233.6±12.1 - 241.3±8.5 during sleep restriction ($p<0.0001$), but returned to baseline levels during recovery (459.4±27.8, $p=0.12$). Spindle density remained unchanged from baseline to sleep restriction nights ($p>0.3$), but dropped during recovery (1.8±0.1 vs. 1.5±0.1 nb/min, $p=0.001$]. Experiment 2 showed a similar pattern in nocturnal spindle characteristics during sleep restriction, although daytime napping reduced spindle count and density during recovery nights [nap: 1.6±0.7 vs. no nap: 1.8±0.5 nb/min, $p=0.02$].

Conclusion: Among adolescents, despite a reduction in nocturnal spindle count during sleep restriction, the rate of spindle generation remains intact. Additionally, daytime napping reduces spindle count and density in recovery sleep. These characteristics should be taken into consideration when attempting to relate spindle counts and behavior in future studies.

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0034

DISSOCIATING CIRCADIAN AND HOMEOSTATIC CONTRIBUTIONS TO PAIRED-ASSOCIATES LEARNING IN YOUNGER AND OLDER ADOLESCENTS USING 28-HOUR FORCED DESYNCHRONY

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Introduction: Learning is affected by sleep; less understood is the role of circadian timing. In adolescence, where learning is at a premium, marked shifts occur in both sleep and circadian biology. Understanding the roles these two systems play in learning across adolescence is important for both scientific and policy reasons. To this end, we used a forced desynchrony protocol in which independent and interacting effects of sleep and circadian rhythms can be separated.

Methods: Learning was measured in 18 younger (11F; 9.6–13.4 [11.9±1.0] years) and 18 older (8F; 13.5–15.9 [14.4±0.67] years) adolescents who completed 12 cycles of forced desynchrony with 16.33 hours awake and 11.66 hours sleeping in each cycle to decouple sleep-wake timing from circadian rhythms. Every 2-hours during waking, participants learned 6 randomly presented word pairs and were asked to recall one word of each pair after a 10-minute delay. Memory was scored for successful recall (i.e., hits) and mismatched items (i.e.,

false alarms). Accuracy was calculated as the difference of hit and false alarm rates, indicating robustness of recall. Accuracy scores were z-scored within-participant and tagged for endogenous circadian phase (0°=dim light melatonin onset; 60° bins) and homeostatic load (hours awake; 3.5 hour bins). Accuracy scores were submitted to mixed-effects models assessing independent and interacting effects of circadian phase, homeostatic load, and age.

Results: Independent of circadian phase, memory accuracy deteriorated with time awake ($F(4,2566.01) = 15.57$, $p<.001$); no independent ($F(5,2569.69) = 0.85$, $p = .51$) nor interacting ($F(20,2568.96) = 1.00$, $p=.47$) circadian effects were observed. No main-effect of age was observed, yet a significant interaction of age and time awake ($F(4,2566.01) = 2.49$, $p=.041$) indicated older adolescents had an attenuated decay in the middle hours (~9 hours awake) of the waking day.

Conclusion: These data demonstrate that effects of time awake on learning in adolescents are separable from circadian influences. Younger adolescents were more susceptible to the impact of homeostatic load than older adolescents. These data underscore the importance of considering developmental changes in sleep and circadian rhythms in policy and educational settings.

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0035

DOSE-DEPENDENT HOMEOSTATIC AND CIRCADIAN EFFECTS OF SLEEP RESTRICTION ON SUSTAINED ATTENTION IN ADOLESCENTS

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Introduction: This study aims to determine in adolescents (i) the time course and severity of deficits to sustained attention across three "doses" of sleep and (ii) whether sleep restriction perturbs circadian system in addition to the sleep homeostat, resulting in differing time-of-day effects across the three sleep doses.

Methods: Thirty-three adolescents aged 15 to 17 years spent 10 days and 9 nights in the sleep laboratory of the Centre for Sleep Research. Light was controlled to <50 lux. In between two baseline nights and two recovery nights with 10-hours' time in bed (TIB) per night, participants experienced either moderate sleep restriction (7.5h TIB, *N*=10, 6 male), severe sleep restriction (5h TIB, *N*=12, 6 male), or no sleep restriction (10h TIB, *N*=11, 7 male) for 5 nights. Sustained attention was measured using a 10-minute psychomotor vigilance task (PVT) every 3 hours when awake beginning at 0830, 1 hour after wake. Lapses were response times >500ms. Salivary dim light melatonin onset (DLMO) was calculated at baseline and after 4 nights of each sleep condition. Saliva sampling occurred in dim light (<30 lux).

Results: Circadian phase delays averaged 181m (*SD*=50m) in the 5h condition and 79m (*SD*=49m) in the 7.5h condition, while adolescents in the 10h condition advanced an average of 19m (SD=88m). Linear mixed model analysis showed dose-dependent deficits to sustained attention across consecutive days of sleep restriction; performance deficits were significantly greater in the 5h condition than the 7.5h or 10h conditions, $F(14, 1169) = 6.37$, $p < .001$. Time of day effects also differed between groups, $F(8, 1169) = 2.54$, $p = .01$, with the 0830h test bout containing significantly more lapses of attention than all other times of day in the 5h condition, while individuals in the 7.5h condition recorded significantly more lapses at the 0830h test bout compared to the 2030h test bout, and no time-of-day effects were observed in the 10h condition.

Conclusion: These results suggest that sleep restriction perturbs both homeostatic and circadian systems, leading to dose-dependent and time-of-day dependent deficits to sustained attention.

Support (If Any): Australasian Sleep Association Rob Pierce Grant-in-Aide.

0036

UPPER AIRWAY OBSTRUCTION AND OBSTRUCTION REMOVAL ARE ASSOCIATED WITH ABNORMAL ENERGY METABOLISM AND CHANGES IN GROWTH HORMONE AXIS IN RATS

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Introduction: Adenotonsillectomy in children with sleep-disordered breathing (SDB) has been reported to accelerate body weight and increased risk for obesity despite normalization of sleep and respiration. The mechanisms linking upper airway obstruction (AO) and obstruction removal (OR)-induced sleep and energy metabolism abnormalities are poorly understood. Here, we investigated the effect of AO and OR on diurnal rhythms of ghrelin and its related hypothalamic mediator's factors on sleep, feeding behavior, and hypothalamus-pituitary-growth hormone (GH) axis.

Methods: The tracheae of 22-day-old rats were narrowed (AO); obstruction removal (OR) was performed 2 weeks following surgery on half of the AO group randomly selected, and animals were observed for 7 weeks.

Results: 3D magnetic resonance imaging shows that AO trachea diameter was reduced by 44% and OR trachea diameter was similar to that of controls. Following 7-week observation period AO exhibited fragmented sleep, and reduced NREM, REM duration, and slow wave activity power. AO gained 48% less body weight despite 35% elevation of daily food intake ($p<0.001$). Food intake remained 12% higher ($p<0.01$) in OR despite the normal sleep and respiratory activity. Circulating ghrelin and hypothalamic NPY increased by >140% ($p<0.01$) and >60% ($p<0.01$) in AO and OR groups, respectively. Hypothalamic GH secretagogue receptor 1α protein increased by 40% in AO and OR ($p<0.01$) and cumulative food intake increased by 300% following administration of ghrelin (30 ng/kg i.p.) in all groups ($p<0.001$). Hypothalamic GH-releasing hormone mRNA was down regulated and somatostatin up regulated in AO and OR groups. Total and mean concentrations of GH were reduced by 60% and its pulsatility pattern was almost completely abolished. Both liver and circulating IGF-1 decreased by 50% and 15% in AO and OR, respectively.

Conclusion: Insufficient body weight gain, abnormal sleep, and higher energy intake in AO are related to elevation in circulating ghrelin and its hypothalamic mediator's factors. Following OR gut ghrelin was still higher and animals continue to consume more energy andhave abnormal GH homeostasis. Here, we provide evidence that altered hypothalamus-pituitary hormonal axis lead increased risk for obesity and growth retardation.

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0037

LONG-TERM BEHAVIORAL CONSEQUENCES OF NEONATAL SLEEP FRAGMENTATION

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Introduction: Sleep fragmentation (SF) occurs in many disease states and frequently occurs in both the pediatric and adult intensive care

units. However, it is unclear how sleep fragmentation in the absence of disease effects the neurochemical and behavioral development of the brain. In adults, SF results in daytime somnolence and a reduction in performance in attentional and vigilance tasks. Rodents who experience SF exhibit transient microglial activation and impaired hippocampal learning. The effects of SF on microglial activation and cytokine expression on the developing brain and long-term neurocognitive consequences have not been studied.

Methods: Post-natal day 3 New Zealand White rabbit kits were assigned to one of three conditions: SF, sham, and control. The SF group was placed on an orbital shaker controlled by a timer to induce repetitive on/off cycling set at 100rpm on a 120s cycle (30s on, 90s off) for 72 hours. Shams were placed in an incubator for 72 hours, while the control group remained with the dam. Open field and behavioral milestone testing occurred before, during, and after active fragmentation. Fourteen days after fragmentation kits were challenged with a novel object recognition task. Three weeks after SF, a spontaneous alternation T-maze task was performed. Kits were sacrificed 3–50 days after the last day of fragmentation. Each hemisphere was processed separately for immunohistochemical evaluation and cytokine expression using rt-PCR.

Results: Microglial activation was associated with region specific modulations in cytokine production, and an upregulation of indoleamine 2,3-dioxygenase. Microglia continued to be activated in the SF group 50-days post-fragmentation. During active fragmentation and up to 24-hours post-fragmentation, SF kits displayed a hyperactive phenotype, with a higher velocity and traveled more distance in the open field. Long term, SF resulted in impaired novel object recognition and spent significantly more time completing the T-maze task.

Conclusion: Early sleep fragmentation may lead to chronic immune dysregulation in the immature brain, subsequently leading to diminished long-term performance in cognitive tasks.

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0038

IS EARLY SLEEP CONSOLIDATION ASSOCIATED WITH DEVELOPMENTAL OUTCOMES?

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Introduction: Consolidated sleep is widely considered a developmental milestone that is achieved at about 6 months. However, this typical developmental timeline is not always reached, leading to behavioral interventions at an increasingly younger age. Although the beneficial effects of sufficient nocturnal sleep duration are well documented, the specific contribution of a rapid sleep consolidation on infants' development remains unclear. The aims of the present study are 1) to characterize the proportion of infants sleeping through the night at 6 months in a healthy population and 2) to determine the specific contribution of early sleep consolidation on development.

Methods: These data (n=417 mother-child dyads) were drawn from the Maternal Adversity, Vulnerability and neurodevelopment longitudinal study (MAVAN). A cut-off of 6 hours of consecutive sleep was used to determine if infants were sleeping or not through the night (maternal report, 6 months). Mental and psychomotor developmental indexes (Bayley, 6–36 months) and feeding method (breastfeeding or not at 6 months) were compared between infants sleeping or not through the night, with t-tests or chi-squares.

Results: While 260 (62.4%) of infants were sleeping through the night at 6 months, 157 (37.6%) were not. Both groups did not differ in terms of mental and psychomotor development, neither at 6 nor at 36 months ($p>0.05$). However, infants sleeping through the night were more likely not to be breastfed at 6 months (44% vs 20%, $p<0.0001$).

Conclusion: Sleeping through the night in early infancy is generally considered a gold standard in North America. However, the interpretation of night awakenings as problematic in early development is not unanimous in parents and professionals. Considering that no differences in both mental and psychomotor development were observed between healthy infants sleeping or not through the night at 6 months, and given the well-known benefits of breastfeeding, one may have more nuanced expectations regarding early sleep consolidation.

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0039

PARENTAL RELATIONSHIP DISSOLUTIONS AND CHILD DEVELOPMENT: THE ROLE OF POOR SLEEP

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Introduction: The current study evaluates whether an indirect effect exists from a parental relationship dissolution to child development through the child's sleep quality.

Methods: Fragile Families Study data (FFS; Teitler et al., 2001) were used. When child participants were age 5, mothers reported on their relationship dissolutions in the previous two years and answered questions regarding their child's sleep quality and development. In addition, the child's teacher reported on the child's development. Questions related to poor sleep quality (i.e., sleep duration, variability, routine, and overall trouble sleeping) were summed to create a poor sleep index ("poor sleep"), ranging from 0–4. Latent factors of child development were constructed using mother and teacher report as indicators of child developmental outcomes, including externalizing, internalizing, poor attention, and social competence.

Results: Previous research using this data set found an association between parental relationship dissolutions and increased poor sleep in the child. In the current study, parental dissolutions predicted increased child externalizing ($b=.13$, $p=.05$) and poor attention ($b=.28$, $p<.01$), as well as decreased social competence ($b=-.18$, $p=.08$). We fit a series of structural equation models controlling for socioeconomic status (e.g., mother education), parental cognitive ability, child characteristics (e.g., gender, temperament), and the number of overnights with the father, and used bootstrapping procedures with 5000 bootstraps to test for indirect effects. We found evidence of indirect effects from parental relationship dissolutions to child externalizing ($b=.02$, 95% Confidence Interval [CI] = .00, .05) and attention difficulties ($b = .03$, 95% CI = .00, .06) and decreased social competence ($b=-.02$, 95% CI = -.05, .00) through the child's poor sleep.

Conclusion: The current study provides cross-sectional evidence that children's poor sleep after a parental dissolution may, at least partially, account the negative impact of parental dissolutions on child development.

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0040

CIRCADIAN PHASE PREFERENCE, SLEEP PATTERNS, AND MENSTRUAL CYCLE LENGTH IN FIRST-YEAR UNIVERSITY STUDENTS: PRELIMINARY RESULTS

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Introduction: Circadian disruption and short sleep are associated with fertility problems in women. Menstrual cycle lengths shorter than 25 days or longer than 30 days are more likely to be anovulatory (infertile menstrual cycle). We examined whether 1) sleep patterns and 2) the congruence between circadian phase preference and sleep patterns are associated with menstrual cycle length in first-year university students.

Methods: Women (n= 206, mean age=18.6; SD= 0.5 y) completed on-line sleep diaries for 9 weeks. Each diary included sleep times and menstrual bleeding (yes/no). Menstrual cycle length (MCL) was the interval from the first day of menstrual bleeding to the next first day of menstrual bleeding. Sleep pattern variables derived for each woman across each menstrual cycle included: mean and standard deviation of reported bedtime (BT), wake time (WT), and total sleep time (TST). Circadian phase preference was determined from the Horne Östberg questionnaire (MEQ) completed in week 9 using 5 standard categories. A sleep timing vs. circadian phase preference "mismatch" score was calculated using the absolute difference between WT categories based on quintile split and MEQ categories (possible scores ranged from 0–4). Linear mixed-effect models were used to examine 1) the effects of sleep patterns (i.e., mean and SD of WT, BT, TST) on MCL (278 cycles) and 2) the effects of phase preference vs. WT mismatch on MCL in a subset of 188 women (256 cycles). Each woman contributed between 1–3 menstrual cycles.

Results: Overall, average MCL was 27 days (sd=7.1). A significant association between greater mismatch and shorter menstrual cycle length was found (b=-1.4, se=.57, p=.02). No significant associations were observed between sleep patterns and menstrual cycle length; however, a trend was seen for WT (b=.5, se=.48, p=.09) and BT (b=.75,.45, p=.1) in both of which later timing was associated with shorter MCL.

Conclusion: Sleep patterns alone were not significantly associated with MCL; however, shorter MCL was associated with a poor match between circadian phase preference and wake timing. The mismatch between circadian phase preference and sleep timing highlights a potential mechanism for fertility issues in shift workers.

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0041

PREDICTING TRAIT-LIKE VARIABILITY IN THE COEFFICIENTS OF THE TWO PROCESS MODEL OF PERFORMANCE

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Introduction: Biomathematical models of fatigue are often used to predict alertness degradation as a function of prior sleep-wake history. There are large inter-individual differences in the magnitude of an individual's degradation in response to sleep loss which, if unaccounted for, can lead to significant inaccuracies in model performance. It has been shown that these differences are stable within the individual across variations in sleep history. Current methods of individualization require periodic performance measurement feedback from the user. Here we have developed a method for estimating these stable, trait-like inter-individual differences based solely upon a priori, ambulatory data.

Methods: Seven days of biometric and motion sensor data were collected from 16 subjects under restricted, ambulatory conditions prior to controlled, in-lab collection of performance data across a 28-hour sleep deprivation period. A parameterized two process model of fatigue was utilized to simulate performance degradation under sleep loss. The model coefficients were optimized such that they accounted for inter-individual differences in performance degradation. A proprietary, machine-learning-based algorithm was trained, using 12 of the ambulatory datasets, to predict the optimized coefficients for each individual. The effectiveness of the algorithm was tested on the remaining four datasets.

Results: The maximum percent error in the test set of each of the estimated coefficients was 3.12, 48.55, 33.29, and 18.44, respectively. Conversely, the percent error of a group-aggregate coefficient compared across the optimized coefficients of all subjects was found to be 7.84 ± 7.56, 209.72 ± 193.78, 163.22 ± 162.04, and 124.33 ± 107.04, respectively.

Conclusion: The coefficient estimation algorithm developed is novel, in that it is capable of approximating an individual's trait-like vulnerability in the coefficients of a parameterized two process model of fatigue using only a priori, ambulatory data and has shown significant potential in improving model performance.

Support (If Any): CurAegis Technologies, Inc.

0042

PERFORMANCE OF ADHESIVE WIRELESS PATCH SENSOR FOR SCREENING OF SLEEP ARCHITECTURE IN NORMAL AND APNEA

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Introduction: Sleep is a renowned marker of health. One in three adults endure sleep disorders with out diagnosis due to lack of effective sleep screening technology. The study presents clinical validation of VitalPatch®, a wireless adhesive medical device for screening of sleep architecture in normal and apnea compared to the Polysomnography (PSG).

Methods: 45 volunteers (male/female: 24/21; 42 ± 13 years) were recruited for an overnight PSG study, and attached to 22-channel PSG and a VitalPatch sensor on chest. Simultaneous PSG and patch data were acquired wirelessly during overnight. PSG recordings were scored to obtain 5-stage sleep architecture and apnea-hypopnea index (AHI) per AASM guidelines. Based on PSG's AHI values, the study population was grouped into normal (28), mild apnea (10) and moderate apnea (7). The statistical differences in sleep patterns among 3 groups were assessed using PSG sleep metrics. 3-class hypnograms with wake, non-rapid eye movement (NREM) and REM stages were further derived using VitalPatch recordings and calculated their respective sleep metrics. Performance analyses of VitalPatch's sleep assessment were carried out compared to the PSG.

Results: PSG revealed significant decrease in total REM time (P=0.032) and increase in latency to REM (P=0.005) in apnea than normal. Latency to NREM and wake after sleep onset (WASO) were increased in apnea (P=0.063 and P=0.072, respectively). The accuracy and Cohen's kappa of sleep stage prediction using VitalPatch compared to the PSG were (82.4 ± 8.2, 79.2 ± 4.3 and 72.2 ± 10.0 in %) and (0.57 ± 0.16, 0.54 ± 0.09 and 0.39 ± 0.25), respectively in

normal, mild apnea and moderate apnea groups. VitalPatch's total sleep time, total NREM time and total REM time had highest correlation (R) of 0.93, 0.86 and 0.72 with PSG respectively in normal and relatively lower in apnea groups. WASO was highly correlated to PSG in moderate apnea (0.67) compared to normal (0.47), as the number awakenings and wake duration after sleep onset were higher in apnea than normal.

Conclusion: The study validates good performance of adhesive wireless VitalPatch sensor for sleep staging in normal and apnea compared to the PSG. The unobtrusive disposable patch sensor can be valuable for widespread clinical screening of sleep architecture.

Support (If Any): None.

0043

INVESTIGATION OF THE DEVELOPMENTAL ORIGIN OF FOREBRAIN GABAERGIC NEURONS INVOLVED IN SLEEP-WAKE CONTROL USING A FATE-MAPPING APPROACH

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Introduction: GABAergic neurons located in the basal forebrain (BF) play important roles in promoting wakefulness and cortical activation. The developmental origin of these neurons is unknown. Here we use a fate-mapping approach to investigate BF GABAergic neurons derived from the medial ganglionic eminence (MGE) which express the transcription factor, Lim homeobox 6 (Lhx6).

Methods: Previously validated mice expressing Cre Recombinase (Cre) under the control of the Lhx6 promoter region were purchased from Jackson Laboratories (Bar Harbor, ME). A cross with a Cre-reporter strain expressing the red fluorescent protein, tdTomato, allowed us to investigate the location of MGE-derived neurons. Immunostaining was used to identify parvalbumin neurons. Adeno-associated viral vectors expressing excitatory receptors (hM3Dq) activated exclusively by the designer drug, clozapine-N-oxide (CNO), were injected bilaterally into BF to test the effect on sleep-wake states.

Results: Neurons specified by Lhx6 were widely distributed throughout the BF. They included BF parvalbumin-containing projection neurons involved in promotion of wakefulness and cortical gamma-band oscillations. 575/1071 PV neurons counted in the BF of one Lhx6-Cre-tdTomato mouse contained tdTomato. However, only 13.7 % of tdTomato neurons were PV+, suggesting that Lhx6 also specifies other types of BF GABA neurons. Chemogenetic activation of Lhx6-derived BF neurons strongly increased wakefulness and gamma band power for >1 hr after i.p. injection of CNO (0.3 mg/kg) at ZT2. CNO treated mice had 83 ± 3 % wakefulness whereas saline-treated mice had only 30 ± 1 % (n=2) in the period 20–80 min following injection. Saline-injected mice also had increased wakefulness but only in the 20 min immediately following the injection.

Conclusion: Wakefulness-promoting BF GABAergic neurons are derived from MGE progenitor cells expressing Lhx6. Cortical interneurons implicated in schizophrenia and other neurodevelopmental disorders are derived from the same pathway suggesting a potential involvement of BF Lhx6-derived neurons in the sleep-wake disturbances observed in these disorders.

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0044

DIFFERENTIAL EFFECTS OF PARADOXICAL SLEEP DEPRIVATION ON ADOLESCENT AND ADULT MICE

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Introduction: Sleep insufficiency has become a serious health issue. In the modern society, most of the people, including the adolescence, do not obtain enough sleep. Since adolescence is a critical period for brain development, the consequences of insufficient sleep during adolescence should be concerned. The current study emphasized the effects of 72-hour paradoxical sleep deprivation (SD) on behavioral and morphological aspects in adolescent mice and used adult mice for comparison.

Methods: In this study, we examined the acute effects of 72-hour paradoxical SD. 5 weeks old and 10–12 weeks old male C57/BL6 mice were used. The two time points were chosen to represent the periods of adolescence and adulthood, respectively. SD for 72 hours were conducted using modified multiple platform method. For mice kept in the home cage and on big platforms, sleep time was not limited and used as controls. Mice of SD and control groups were examined in behavioral, neurochemical and histological aspects.

Results: Our results showed that the short-term spatial memory, examined by Y-maze spontaneous alternation test, was affected by 72-hour paradoxical SD in adolescent mice but not in adult mice. The complexity of granule cells in dentate gyrus (DG) was reduced after SD in adolescent but minimal changes were observed in adult animals. There was an increase of spine density in DG granule cell after 72-hour paradoxical SD in adolescent and not in adult SD animals. Hippocampal neurogenesis in the DG was reduced by SD in both adolescent and adult groups.

Conclusion: Results from this study revealed that SD negatively impacted the cognitive function by impairing the spatial working memory in adolescent but not in adult mice. Moreover, the analyses of dendritic complexity and spine density of granule cells in the hippocampal DG also indicated age-related morphological alterations after 72-hour sleep deprivation. Our results indicated the adolescent mice are relatively more sensitive to SD than the adult mice. It is the first study, to our knowledge, that compared the differential effects of SD on adolescent and adult mice.

Support (If Any): None.

0045

A ROLE FOR EARLY LIFE REMS IN COGNITIVE DEVELOPMENT IN RATS

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Introduction: In the young, rapid eye movement sleep (REMS) is initially more highly represented in daily sleep/wake cycles than later in life and is thought to facilitate brain maturation. We have shown that early life REMS disturbances (i.e., ERD) have relatively long-lasting, negative effects on hippocampal synaptic plasticity, including reductions in expression of several glutamate signaling proteins and in long- term potentiation (LTP) stability. Our previous results led us

to hypothesize that ERD preprograms learning and memory deficits later in life.
Methods: Rats were REMS-deprived for four hours at the beginning of their inactive phase between postnatal (P) 16–19. We then tested ERD and control rats in the novel object recognition (NOR) test as young adults (P51).
Results: We found a significant difference between the performance of ERD and control rats (t-test, t= 2.499, df=17, $p < 0.05$). The data showed that ERD animals spent less time investigating the novel object compared to control rats.
Conclusion: Given the effects of ERD on hippocampal LTP stability that were observed in our previous experiments, we predicted that ERD rats would exhibit learning-deficits on the NOR test compared to the control rats. The results from this experiment confirmed our prediction. These data lend additional support for the hypothesis that REMS plays a role in regulating hippocampal development, and, suggests that ERD preprograms functional, cognitive deficits in the young adult rat.
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0046

IMPACT OF EARLY LIFE SLEEP DISTURBANCE ON BEHAVIORAL PARAMETERS IN RATS: POTENTIAL ROLE OF OXIDATIVE STRESS MECHANISMS

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Introduction: Adequate sleep is essential for normal brain function. Many epidemiological and clinical studies have linked early life sleep disturbance (SD) with behavioral and cognitive impairments. However, the mechanisms by which early life SD causes behavioral and cognitive impairments are not fully understood. Extended wakefulness increases cellular metabolism and induces reactive oxygen species formation leading to oxidative stress. And, the brain is considered highly susceptible to oxidative stress because of its high oxygen consumption. Therefore, we suggest that SD at early life stages, by engaging oxidative stress cascades, might adversely affect neuronal development and function leading to behavioral impairment.
Methods: We examined the role of oxidative stress on behavioral impairment caused by early life SD in rats, at postnatal day (PND) 18. Two groups of Sprague Dawley rats (12 per group) were employed, control and sleep disturbed (SD) groups. Rats at PND18 were subjected to SD for 14 days (6-8h/day) using Pinnacle sleep deprivation system. Behavioral tests (anxiety and depression-like behaviors) were performed at PND32, 60 and 90. Blood samples were collected at PND32.
Results: SD rats exhibited anxiety-like behavior at PND32 and 60 but not at PND90 as compared to the control rats. Interestingly, SD rats did not exhibit depression-like behavior at PND32 or 60 but developed depression-like behavior later at PND90, as indicated by increased immobility time in forced swim test compared to control rats. Plasma levels of corticosterone (indicator of stress) and 8-isoprostane (marker of oxidative stress) were significantly increased in SD rats compared to control rats.
Conclusion: Early life SD promotes anxiety-like behavior early in life (PND32 and 60) which in later life transforms into depression-like behavior (PND90). The increase in oxidative stress markers in the blood following SD protocol, is suggestive of a potential role of oxidative stress in later life behavioral impairment.
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0047

EARLY POST-NATAL SLEEP FRAGMENTATION IMPAIRS SOCIAL DEVELOPMENT AND ALTERS PARVALBUMIN INTERNEURON EXPRESSION IN ADULT PRAIRIE VOLES

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Introduction: Consolidated periods of sleep during sensitive time points in development may be necessary for the maturation of the neurobiological systems that underlie species typical cognitive and social behaviors. Prairie voles (Microtus ochrogaster) are a highly social rodent species that form lifelong pair bonds with other individuals, thus providing an ideal rodent model to study how sleep shapes the development of social behavior.
Methods: We selectively suppressed REM sleep in prairie vole pups during a sensitive post-natal period of development (post-natal days 14–21) by fragmenting sleep with gentle orbital shaking. Male and female animals were tested for social bonding and circadian running wheel activity as adults and underwent parvalbumin immunohistochemistry (IHC) followed by cell counting to quantify parvalbumin neurons in the somatosensory barrel fields.
Results: Early life sleep fragmentation prevented pair bond formation in male and female prairie voles and increased voluntary wheel running in males. Parvalbumin IHC revealed increased parvalbumin-immunoreactive cell counts in somatosensory barrel fields of sleep fragmented adults compared to non-sleep fragmented animals. This effect was more pronounced in males.
Conclusion: Continuous sleep fragmentation from postnatal days 14–21 produced an adult behavioral phenotype reminiscent of some features of autism spectrum disorder, including impaired social bonding, hyperactivity, and a male bias in symptom severity. Studies utilizing this unique animal model will enhance our understanding of modifiable risk factors, such as sleep, that may contribute to atypical development of the brain and social behavior.
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0048

CEREBRAL SEROTONIN EXPRESSION PREDICTS DAYTIME SLEEP AND SLEEP DEVELOPMENT IN INFANT RHESUS MONKEYS

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Introduction: Cerebral serotonin expression and sleep share a complex and as yet unclear association in early development. Though serotonin is linked with sleep-wake patterns in early childhood, whether this association emerges during infancy remains to be discovered. We hypothesized that the developing serotonergic system will be associated with the development of sleep-wake patterns.
Methods: We investigated the associations between cerebral serotonin expression and sleep development during the first month of life in 152 nursery-reared infant rhesus macaques (*Macaca mulatta*). Cerebral serotonin expression was determined using cerebrospinal

fluid serotonin metabolite 5-hydroxyindoleacetic acid (CSF 5-HIAA) concentrations, relative to weight, sampled at 2 and 4 weeks post-birth. Sleep-wake states were rated by trained observers every two hours from 0800-2000 hours. Sleep-wake states were scored as awake=1, drowsy=2, or asleep=3. For analyses, daytime sleep-wake states were averaged across the 7 days prior to each CSF sampling. Paired-samples t-test, Wilcoxon signed ranks test, and Spearman's ρ were utilized to explore associations between time points, averages, and change scores (week 4 minus week 2) for both CSF 5-HIAA and sleep-wake states.

Results: Daytime sleep ($t_{(239)}$=17.27, p<.001) and CSF 5-HIAA (Z = -9.9, p<.001) decreased significantly from week 2 to week 4. Higher CSF 5-HIAA was associated with more daytime sleep during the first month of development (ρ=.25, p=.003). Lower week 2 CSF 5-HIAA predicted greater reductions in sleep from week 2-week 4 (ρ=.16, p=.05). Greater reductions in CSF 5-HIAA from week 2 to week 4 predicted lower sleep at week 4 (ρ=-.18, p =.03).

Conclusion: These important findings are among the first to demonstrate that, from birth, daytime sleep-wake patterns are predicted by cerebral serotonin expression. Considering the link between serotonin, sleep, and mood disorders later in life, these results have exciting implications for improving sleep with serotonin interventions.

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0049

SLEEP AND RELATIONSHIP DURING PREGNANCY: ASSOCIATIONS AND MECHANISMS

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Introduction: Pregnancy is a period of relational challenge with the transition to parenthood and reworking of current relationships. Sleep disturbance has been identified as a contributory factor to partner-relationship strain and poor postpartum mother-infant attachment. However, few studies have examined these associations during pregnancy. We examined whether poorer sleep quality operationalised as sleep efficiency, was associated with reduced prenatal infant-attachment quality, and lower partner-relationship satisfaction. We also explored sleep-related mood disturbance and adult-attachment styles as potential underlying mechanisms to any significant associations we observed.

Methods: A community sample of 141 partnered first-time mothers (M_{age} 33.32, SD_{age} 3.27) completed the following questionnaires online between 25–27 weeks' gestation: Consensus Sleep Diary - modified (sleep efficiency), Prenatal Attachment Inventory (mother-infant attachment quality), Dyadic Adjustment Scale (partner-relationship satisfaction), PROMIS Depression and Anxiety Short Forms (negative-mood), and Attachment Styles Questionnaire (adult-attachment). Hierarchical multiple regression, mediation, and moderation analyses were undertaken, controlling for maternal age, mental health history, and planned pregnancies as covariates.

Results: Higher sleep quality was associated with significantly higher partner-relationship satisfaction, explaining 9% unique variance. The significant effect of sleep on partner-relationship was not mediated by mood, but was moderated by adult attachment security. Poorer sleep quality was associated with significantly reduced partner-relationship satisfaction for low-secure, but not high-secure adult-attachment style. The association between sleep efficiency and infant-attachment was not significant.

Conclusion: Findings add to the existing perinatal sleep literature by considering women's sleep and wellbeing in a wider relational context. Results highlight the importance of sleep to partner-relationship quality, and secure adult-attachment style as an underlying mechanism to this association. Low-secure adult-attachment may confer vulnerability, while high-secure adult-attachment may confer resilience in relationship satisfaction in the face of prenatal sleep disturbance. The association between sleep and prenatal infant-attachment requires further research.

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0050

INFANT FEEDING METHODS AND REM SLEEP; IMPLICATIONS FOR HEALTHY BRAIN DEVELOPMENT

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Introduction: Both sleep and breastfeeding impact early development, but whether these are related, or form a common mechanism, is unknown. REM sleep in particular has a significant developmental role in brain maturation and breastfed infants have lower severity of sleep-disordered breathing (SDB). Here, we sought to determine whether breastfeeding might be associated with REM sleep duration.

Methods: Fifty 8–9 month-old infants underwent overnight, standard PSG for suspected SDB at Kosair Children's Hospital in Louisville, KY. Twenty-three parents responded to a follow-up SDB symptoms and infant feeding methods survey ~10 years later. A previously validated SDB risk score was calculated at both ages. Participants were 39% female and 91% white; at the follow-up survey, maternal education was 16.7 ± 2.6 years and household income was $122,000 ± 119,000.

Results: During infancy, breastfeeding duration was negatively associated with proportion of REM sleep (%TST; p=0.006, r=-0.57). Exclusively formula-fed infants had higher snore-related arousal indices during REM sleep (p=0.019) and respiratory arousal indices (p=0.009), though these became non-significant after controlling for smoke exposure and maternal education (p=0.479 and p=0.319, respectively). Exclusively breastfed infants had lower SDB risk scores (p = 0.041) compared to children fed any formula; this parent-report discrepancy was not replicated at the later age.

Conclusion: Previous findings suggest that breastfeeding may be associated with SDB protection; this study adds that breastfeeding may also have a negative association with proportion of REM sleep. Breastfeeding may reduce SDB-mediated REM fragmentation, resulting in more consolidated REM. Potential downstream benefits may account for the known associations between breastfeeding and brain development.

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0051

CIRCADIAN NEUROHORMONE EXCRETION AND OBJECTIVE SLEEP MEASURES IN TODDLERS PRENATALLY EXPOSED TO MATERNAL DEPRESSION AND ANTIDEPRESSANT MEDICATION

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Introduction: Serotonin reuptake inhibitors (SRIs) are prescribed for ~30% of pregnant women with depression and are reported to disrupt sleep architecture. Furthermore, prenatal maternal depression itself is associated with disrupted circadian rhythms and sleep problems in offspring. However, little is known about the effects of prenatal SRI exposure on child sleep and circadian rhythms. We examined the effects of prenatal exposure to maternal depression and SRIs on circadian neurohormone excretion and sleep in 36-month-olds.

Methods: Mothers were originally enrolled during pregnancy into a larger, longitudinal study and were interviewed with standardized instruments for psychiatric diagnoses and treatment status. Mothers-child pairs (n=59) were categorized as: 1) No depression or SRI treatment during pregnancy (NoEXP, N=25); 2) Depression, no SRIs (DEP, N=15); 3) Depression with SRIs (SRI, N=19). Videosomnography and respiration recordings were collected on the children for two consecutive nights at 18 and 36-months post-birth. Recordings were manually scored by a trained rater, who was blinded to group status, for percentage of time in bed in wake, Non-REM, REM, and sleep-wake transitional states as well as sleep onset latency (SOL) and number of behavioral arousals. Overnight and daytime urine samples were obtained to determine melatonin, epinephrine, norepinephrine, and cortisol excretion.

Results: Overnight melatonin levels were significantly lower in the DEP group compared to NoEXP (Wald χ^2=8.2, p<.02). The SRI group had higher cortisol levels overall compared to NoEXP and DEP groups (Wald χ^2=6.6, p<.05). Higher daytime cortisol was related to shorter SOL (β=.87, p<.02) and lower amounts of NREM sleep in the early night period (β=.1.1, p<.03). Higher nighttime cortisol was related to longer SOL (β=1.3, p<.02) and more REM sleep (β=.1.1, p<.02). Higher overnight norepinephrine was related to more REM sleep (β=1.75, p<.02) across groups, while higher daytime norepinephrine was related to longer SOL (β=3.56, p<.01) in DEP and SRI groups.

Conclusion: Prenatal exposure to maternal depression and SRIs affected sleep and neurohormone secretion of the pineal and the sympathetic nervous system in early childhood. The impact of such prenatal exposure on specific aspects of sleep might act via distinct biological pathways.

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0052

THE EFFECTS OF PRENATAL EXPOSURE TO MATERNAL DEPRESSION AND ANTIDEPRESSANT TREATMENT ON SLEEP STATE DEVELOPMENT IN TODDLERS

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Introduction: Prenatal maternal depression has been linked with less optimal sleep development in children. In-utero exposure to selective reuptake inhibitors (SRIs) has also been found to alter sleep state, but no published studies have investigated this relationship past the newborn period. The study examined the differential effects of prenatal maternal depression and SRIs on sleep state development in children 18 to 36 months post-birth.

Methods: 47 mothers and their children were categorized into three groups based on their psychiatric diagnoses and treatment during pregnancy: 1) No depression or SRI treatment (NoEXP, N=21); 2) Depression without SRI treatment (DEP, N=15); 3) SRI treatment for depression (SRI, N=11). Videosomnography and respiration recordings were collected on the children for two consecutive nights at 18 and 36-months post-birth. Recordings were manually scored by a trained rater who was blinded to group status for percentage of time in bed in wake, Non-REM, REM, and sleep-wake transitional states as well as sleep onset latency and number of behavioral arousals. Variables were calculated in the early (before midnight) and late (after midnight) sleep phases. Linear mixed models were used to examine the effects of prenatal group and assessment age on sleep variables.

Results: Children in the DEP group had a lower percentage of non-REM sleep than those in the NoEXP group during the early phase (48% v. 59%, p<.04). The DEP group also had a higher percentage of REM sleep throughout both sleep phases (48%) compared to those in the SRI (40%, p<.006) and NoEXP (39%, p<.005) groups across assessment age. There were no significant group differences in the number of behavioral arousals, wake after sleep onset, or sleep onset latency.

Conclusion: These preliminary results suggest that prenatal exposure to maternal depression rather than SRIs may alter sleep state development in young children by increasing REM and decreasing Non-REM, particularly in the early phase when Non-REM sleep is typically highest. These results will be discussed in the context of concurrent maternal depression severity, sleep quality, and reported child sleep behaviors.

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0053

AGE AND GENDER DIFFERENCES IN SLEEP HYGIENE IN MIDDLE CHILDHOOD

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Introduction: Sleep hygiene refers to behaviors and conditions that are conductive to sleep, including consistent bedtime routine and schedule, dark and quiet environment, promoting reduced physiological arousal, promoting reduced cognitive arousal and being emotionally calm rather than upset at bedtime. Proper sleep hygiene is associated with better sleep, however, few studies have examined age and gender differences in child sleep hygiene. Girls are fairly consistently found to sleep better than boys, differences in child sleep hygiene may explain these differences. As children progress through middle childhood, they transition from parental control to greater self-control of sleep hygiene. Thus, age may be an important variable. The purpose of the current study is to address gaps in research and examine age and gender differences in sleep hygiene.

Methods: 199 families, consisting of both parents and a child (ages 6–12), participated in this study. Mothers completed the Child Sleep Hygiene Scale (CSHS). This questionnaire includes six sub scales: physiological, cognitive, emotional, environmental, bedtime routine, and sleep schedule hygiene.

Results: Data were analyzed using multiple regression. Child age, gender, and the interaction between age and gender were included as predictors of each of the CSHS sub scales. All models controlled for couple income and race. Boys had marginally greater problems with physiological sleep hygiene and bedtime routines, but significantly

fewer problems with emotional sleep hygiene. Older children had marginally greater problems with cognitive sleep hygiene but significantly fewer problems with sleep schedule. Male children have significantly better cognitive sleep hygiene as they age.
Conclusion: There were some cases in which boys did exhibit worse sleep hygiene than girls. This was the case for physiological sleep hygiene and bedtime routines, which may be consistent with high levels of physical activity stereotypical of boys. On the other hand, they had better sleep hygiene in terms of emotional problems; this is consistent with the greater risk of internalizing disorders in girls. The improvements in sleep schedule with age may reflect advances in self-regulation, while increased problems with cognitive arousal may reflect greater involvement in school work and increased access to electronic devices.
Support (If Any):

0054

THE ROLE OF SLEEP ON THEORY OF MIND DEVELOPMENT IN TYPICALLY DEVELOPING CHILDREN

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Introduction: Theory of Mind (ToM), defined as the ability to infer a range of internal mental states (beliefs, intentions, desire, and emotions) of others', is central to the development of appropriate social and emotional processing skills. Children with poor ToM have been shown to have difficulty interpreting situations requiring complex social reasoning and have a greater risk of peer rejection. Although poor sleep has been implicated as a risk factor for poor social and emotional functioning in children, to date, the role of sleep in the successful development of ToM specifically has not been studied. The goal of this pilot study was to determine the relationship between sleep and ToM in typically developing school-aged children. It was hypothesized that longer sleep duration would be associated with better performance on ToM tasks.
Methods: Nineteen typically developing children (M_{age} = 9.6 years, SD = .98) completed two ToM tasks: the Reading the Eyes in the Mind Task (RMET), measuring emotional and facial processing, and the Faux Pas Recognition Task (FPR), measuring complex cognitive understanding of socially acceptable situations. Sleep was measured using the Children's Sleep Habits Questionnaire, filled out by parents.
Results: Sleep duration was negatively associated with poor performance on the RMET but not on the FPR, a task less heavily dependent on facial processing.
Conclusion: The preliminary results of this study are consistent with findings from literature on adolescents' and adults', suggesting that poor sleep is associated with emotional and facial processing. Further research using a larger sample size and objective sleep measures is needed to better understand the implication of sleep as a risk factor in successful ToM development.
Support (If Any):

0055

SLEEP CHARACTERISTICS PREDICTED IMPULSIVITY AND AGGRESSION AMONG CHILDREN OF ALCOHOLICS AND CONTROLS

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Introduction: Recent studies indicate that sleep difficulties and shorter sleep duration are associated with attention and behavioral problems in children. However, it is unclear whether this relationship varies among children of biological alcohol dependent parents (COAs) and controls. In this study, we examined whether the relationship between sleep variables and common behavioral problems are different in these two groups of children.
Methods: Participants were 105 children (61% COAs; 53% girls; mean age=10.21(1.41)). Data on sleep were collected by actigraphy --participants were asked to wear an actigraphy watch and kept a sleep diary for one week. Additional sleep data and behavioral problems were collected by parental ratings of the Child Behavior Checklist (CBCL).
Results: Controlling for age, gender and ethnicity, COAs were more likely than controls to be rated as overtired by their parents (Odds ratio= 9.21, $p<.05$). The two groups were not different on other CBCL sleep variables. Children who were overtired were more likely to be impulsive ($\beta=.32$, $p<.01$), aggressive ($\beta=.29$, $p<.01$), engaged in more rule-breaking behavior ($\beta=.22$, $p<.05$), and had more internalizing ($\beta=.37$, $p<.001$) and externalizing problems ($\beta=.29$, $p<.01$). Additionally, children who had trouble sleeping were significantly more impulsive ($\beta=.26$, $p<.01$), aggressive ($\beta=.32$, $p<.01$), were more likely to break rules ($\beta=.23$, $p<.05$), and had more internalizing ($\beta=.50$, $p<.001$) and externalizing problems ($\beta=.31$, $p<.01$). Actigraphy- measured total sleep time (TST) significantly predicted internalizing problems ($\beta=-.59$, $p<.05$). There were significant sleep time x COA status interactions on rule breaking behavior ($\beta=2.71$, $p<.05$) and externalizing problems ($\beta=2.64$, $p<.05$). A lower TST was associated with more rule-breaking behavior ($\beta=-.50$, $p<.05$) and externalizing problems ($\beta=-.45$, $p<.05$) for non-COAs, but not for COAs (rule-breaking behavior: $\beta=.23$, $p=.07$; externalizing problems: $\beta=.14$, $p=.28$).
Conclusion: Parental ratings of overtiredness and having trouble sleeping, as well as actigraphy-measured TST were associated with common behavioral problems in children. Total sleep time was associated with rule-breaking behavior and externalizing problems for non-COAs only. Implications of these findings on the relationship between sleep problems and substance use among COAs and non-COAs will be discussed.
Support (If Any): NIH Grant R01 AA020364.

0056

EFFECTS OF PRIOR SLEEP DURATION AND AGE ON WAKING ALPHA ELECTROENCEPHALOGRAM POWER IN EARLY ADOLESCENCE

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Introduction: In the waking electroencephalogram (EEG), alpha frequency power increases when eyes are closed, and this increase is diminished following sleep deprivation. Our current longitudinal study varies time in bed (TIB) to determine changes in sleep need across adolescence. Here we report the effects of sleep restriction and age on waking alpha power in early adolescence.
Methods: Seventy seven children, age 9.85 to 14.0 years (mean=12.2, sd=1.2) at the time of first recording, were studied in the first year of this ongoing longitudinal study. A laboratory day of performance and sleepiness testing follows four nights with TIB restricted to 7, 8.5 or 10 hours. Each participant completed all three sleep schedules. Laboratory days entailed 4 test sessions, every 2 hours starting at 0900. Each test session includes recording of waking EEG: 3 minutes with eyes open, followed by 2 minutes eyes closed, followed by 2 minutes eyes open, followed by 2 minutes eyes closed. EEG recorded from O1 and O2 was analyzed with FFT on 5 second artifact free epochs.
Results: Following the 7h TIB schedule, O1 alpha power with eyes open (57 μV^2) increased (by 114 μV^2) when eyes were closed ($p<0.0001$). This eyes closed effect increased by 12 μV^2 for each additional hour of nighttime TIB ($p=0.0002$). There was no age effect on eyes open alpha, on the eyes closed effect, or on the TIB x eyes closed interaction ($p>0.4$ for all). Results for O2 EEG were similar.

Conclusion: In young adolescents, sleep restriction diminishes the eyes closed increase in waking alpha EEG power. This finding raises the possibility that alpha power is a sensitive indicator of sleep recovery and encourages further study over a wider age range and sleep durations. The absence of an age effect contrasts starkly with MSLT findings from the same subjects where sleep extension provided a much stronger decrease in sleep likelihood in younger subjects.
Support (If Any): R01HL116490.

0057

A PRELIMINARY EVALUATION OF ADOLESCENT SLEEP IN THE UK - BASELINE SLEEPING PATTERNS FROM THE OXFORD TEENSLEEP COHORT

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Introduction: The 2014 Sleep in America poll reported that 71% of 12-14-year-olds sleep for less than 8hrs a night. Self-reported sleepiness, poorer sleep quality, and shorter sleep duration are associated with poorer school performance. The Oxford Teensleep pilot study is evaluating how 14-15-year-olds are sleeping in the UK and whether sleep can be improved through a school-based sleep education programme: the largest study of adolescent sleep in the UK.
Methods: Students (age 14–15 years) in ten UK schools participated in two weeks of sleep monitoring which included wearing a wrist actigraph and completing a sleep diary prior to the Teensleep lessons. In addition to sleep variables, students reported on their activities, including media use and caffeine consumption, before bedtime.
Results: Preliminary findings from the initial baseline sleep monitoring period are presented here (n = 55, 37 females, 18 males). Baseline sleep results from the whole cohort will be available in June. Through actigraphy, TST was 7:01(±37.86) on a weekday (Sun-Thu night) and 7:40(±42.57) on a weekend. This was mirrored in the sleep diary with TST's of 7:46(±59.85) and 8:33(±67.99) respectively. Adolescents reported that they would like to have slept an additional 1:47 on a weekday and 1:31 on a weekend, resulting in a desired TST of 9:33 and 10:04 respectively. Actigraphy indicated a WASO of 55.41min(±19.17) (weekdays) and 63.93min(±23.97) (weekends). Before sleep, adolescents engaged in activities that could impact sleep, for example using their mobile phone and consuming caffeinated items.
Conclusion: These preliminary findings highlight how adolescents could benefit from an improvement to their sleep. According to National Sleep Foundation guidelines, average TST was shorter than recommended for this age group. Further, the adolescents wished to have a TST closer to the 8-10hr recommendation.
Support (If Any): Study supported by Education Endowment Foundation (EEF) / Wellcome Trust funding (Espie and Foster). Trial evaluation for the EEF is being conducted by the Centre for Evaluation and Monitoring, Durham University, UK.

0058

THE INFLUENCE OF THE SLEEP ENVIRONMENT ON EXTERNALIZING BEHAVIORS IN AT-RISK ADOLESCENTS

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Introduction: This study examined factors associated with the sleep environment (i.e., ambient sleep disruptions, sleeping in a bed, and sleeping in one's own home) in relation to externalizing behaviors (engagement in delinquency, substance use, arrest history) in a sample of students attending an alternative high school.
Methods: Participants included 97 students (55% female, 87% African American, Mean age = 18.02, SD = 1.52) attending an alternative high school in a large, Southeastern city.
Results: Eighty-two participants reported sleeping in a bed for the previous seven nights and 70 participants slept at their own home for the previous seven nights. Participants reported an average of 2.0 (SD = 1.70) ambient sleep disruptions while trying to sleep in the past week; the most common disruptions included being bothered by room temperature (57%), noise in the house (32%), and caring for a family member while trying to sleep (28%). Linear and logistic regressions were conducted to assess the association between sleeping in a bed for the past seven nights, sleeping in one's own home for the past seven nights, and ambient sleep disruptions with externalizing behaviors. Sleeping in one's own house less than seven nights in the past week and exposure to more ambient disruptions in the past week significantly predicted more engagement in delinquency. Sleeping in a bed for less than seven nights in the past week and more ambient sleep disruptions in the past week both predicted having an arrest history. No sleep environment factors were associated with substance use.
Conclusion: The sleep environment is important to consider when assessing sleep problems, including among youth exhibiting externalizing behaviors. This is particularly relevant to low-income adolescents living in urban environments who may be exposed to environmental stressors that impact their sleep environment. Understanding disruptions within the sleep environment may serve to inform comprehensive sleep interventions, which in turn may influence behavioral health concerns.
Support (If Any): N/A.

0059

EVALUATION OF THE SLEEP REGULARITY INDEX (SRI) AMONG FIRST YEAR COLLEGE STUDENTS: ASSOCIATION WITH ALCOHOL USE, CAFFEINE CONSUMPTION, ACADEMIC LOAD, AND NEGATIVE MOOD

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Introduction: Regularity is an important feature of sleep with associations with important domains of young-adult functioning, including mood, weight gain, and academic performance. Quantifying regularity can be challenging. The Sleep Regularity Index (SRI) compares the sleep/wake state across adjacent 24 hour periods. The index ranges from 0 (random) to 100 (perfect regularity) and is sensitive to abrupt changes to sleep schedules common during young adulthood. We evaluated the SRI among first year college students using daily diary records.
Methods: Between 2009 and 2014, 1328 first year college students completed daily diaries during their first semester of college. Diaries included bedtime (BT), wake-time (WT), total sleep time (TST), sleep onset latency, and wake after sleep onset for the previous major sleep episode, as well as naps, and the number of alcohol and caffeinated drinks. In addition, participants completed a longer survey every two weeks that asked about mood and academic load. Data were aggregated across the two weeks prior to each biweekly survey where at least 50% of the diaries were completed (4275 biweekly periods from 1049 participants, 57% female, M_{age}=18.65).

Results: Incremental value of SRI relative to BT and TST in explaining number of alcoholic and caffeinated drinks, negative mood, and academic load. Average SRI was 74.59 (SD=7.60) and was associated with BT (β=-.07[95% CI=-.11;-.04]) and TST (β=-.09[-.12;-.06]). After accounting for TST and BT, SRI was significantly related to negative mood (β=-.08[-.11;-.04]), alcoholic drinks (β=-.012[-.015;-.008]), caffeinated drinks (β=-.005[-.006;-.003]), and academic load (β=-.006[-.008;-.004]).
Conclusion: The SRI calculated from daily diary records is related to important domains of young-adult functioning including alcohol use, caffeine consumption, academic load, and negative mood. Although the SRI is related to sleep duration and timing across a two-week period in this population, it provides unique information beyond these two measures.
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0060

GENDER DIFFERENCES IN COLLEGE STUDENTS' SELF-REPORTED SLEEPINESS

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Introduction: Previous research shows that women tend to report greater daytime sleepiness as compared to men, which may be due to hormonal influences. Although not well-studied, academic major may also impact sleep. Recent research has shown that students who were science, technology, engineering, and mathematics (STEM) majors reported poorer sleep quality than non-STEM majors. The current study examined the relationship between sleepiness, gender, and college major. It was hypothesized that women would report being sleepier than men. It was also hypothesized that students in STEM majors would report more sleepiness than students in non-STEM fields.
Methods: Participants included 321 undergraduate students (111 men, M=20.54, SD=3.97 years) who participated in an online survey that included questions regarding demographic information, academic major, gender, sleepiness, and general habits. The Epworth Sleepiness Scale (ESS) was used to determine sleepiness level in students.
Results: An independent samples t-test was conducted to examine gender differences in reported sleepiness. Preliminary analyses revealed a statistically significant difference was found between men (M=6.70, SD=4.29) and women's (M=8.19, SD=4.88) self-reported sleepiness, t(303)=-2.67, p=0.008, two tailed. Female students reported being sleepier than male students, which may indicate that women may be getting less sleep or lower quality sleep compared to their male counterparts. A one-way independent-measures ANOVA was also conducted to examine potential differences in types of academic majors and self-reported sleepiness. No significant differences were found between STEM (M=8.01, SD=5.03), non-STEM (M=7.38, SD=4.78), or health majors (M=7.89, SD=4.10), F(2, 309)= .603, p=.548.
Conclusion: Women reported being sleepier than men, which warrants further investigation in order to determine if there are gender differences in sleep duration and quality. Unexpectedly, academic major was not related to self-reported sleepiness in students. However, further analyses examining sleep quality are necessary in determining additional sleep differences.
Support (If Any): None.

0061

INFLUENCE OF SLEEP AND CIRCADIAN PREFERENCE ON EXERCISE AND SUBJECTIVE MOOD IN COLLEGE UNDERGRADUATES

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Introduction: College is a critical developmental time period for establishing long-term health behaviors, including appropriate sleep timing and duration and exercise habits. Understanding how these behaviors interact, and also how they may influence subjective mood, is vital to identifying potential modifiable behaviors that may improve health during adulthood.
Methods: 247 undergraduates (85 females) participated in a month-long protocol. Sleep timing was monitored for 30 days using actigraphy and an online sleep log. Participants completed a daily online questionnaire at night and in the morning to document exercise sessions, duration, and timing. During an overnight laboratory stay (<4 lux), circadian phase was determined using salivary dim-light melatonin onset (DLMO, 5 pg/ml threshold) and subjective mood was determined from hourly visual analog scales (Happy/Sad). Sleep variability was determined using a sleep regularity index (SRI) we developed and chronotype was determined using the Munich Chronotype Questionnaire (MCTQ). Pearson correlations were used to determine associations between sleep and circadian outcomes with exercise and mood.
Results: The percentage of days that participants exercised one or more times was significantly associated with SRI, DLMO, sleep onset and offset, and chronotype (all correlations $p<0.05$), such that less exercise was associated with more variable and later timing of sleep onset and offset, DLMO, and chronotype. Earlier chronotype, sleep onset and offset, and less variable sleep timing (all $p<0.05$) were significantly associated with subjectively happier mood. Percentage of days that participants exercised one or more times was a non-significant trend ($p=0.09$) for subjectively happier mood.
Conclusion: Our findings reveal that time spent exercising in college students is significantly associated with sleep and circadian timing. These factors are also associated with college students' subjective mood ratings. Further work is needed to identify whether modifying sleep, circadian, and exercise behaviors in college students can improve long-term mood.
Support (If Any): NIH (F32DK107146, T32HL007901, K24HL105664, R01HL114088, R01GM105018, R01HL128538, P01AG009975, R21HD086392, R00HL119618) and NSBRI (HFP02802, HFP04201, HDP0006), MIT Media Lab Consortium, Samsung Electronics.

0062

EVENING LIGHT EXPOSURE FROM COMPUTER SCREENS DISRUPTS SLEEP, BIOLOGICAL RHYTHMS, AND ATTENTION ABILITIES

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Introduction: Millions of computers, tablets, and smart-phones are bought worldwide every month and usage time of these devices is increasing constantly. As a result, humans are almost continuously exposed to unintentional artificial light at night (ALAN) from these device screens. We explored the independent and combined effects of two aspects of screen illumination, light wavelength and intensity, on sleep, its biological regulation, and related functional outcomes, including sleepiness, mood, and attention.
Methods: A 2x2 repeated measures design with two independent variables: screen light intensity (low ([LI]: 80 lux and high [HI]: 350 lux) and light wavelength (short [SWL]: 460nm and long [LWL]: 620nm). Nineteen healthy participants (11F; mean age 24.3 [±2.8] years) underwent four experimental light conditions, namely LI/SWL, HI/SWL, LI/LWL and HI/LWL, in counterbalanced order. Each light exposure lasted for 2 hours (21:00-23:00) during which participants performed onscreen tasks. After each exposure, participants underwent an overnight PSG in the laboratory where oral temperature and urine samples (for melatonin analysis) were collected at multiple time points during the night and morning. Each morning participants filled out mood and sleepiness measures and conducted a computerized attention task.
Results: Irrespective of light intensity, SWL illumination significantly disrupted sleep continuity (decreased TST and SE and increased SOL, WASO) and architecture (increased stages 1 and 2 sleep, and decreased SWS). When compared to LWL, SWL also significantly altered biological rhythms by subduing the normal decline in body temperature at night and dampening nocturnal melatonin secretion. Light intensity seemed to independently affect sleep as well, but to a lesser degree. SWL exposure led to greater self-reported sleepiness, when compared to LWL. Light exposure negatively affected morning attention, with SWL reducing response accuracy, while light intensity slowed reaction time (RT). Mood was not significantly affected by light intensity or wavelength.
Conclusion: Light wavelength seems to have a greater influence than light intensity on a wide-range of biological and behavioral measures. Given the widespread use of electronic devices today, particularly in the evening and nighttime, our findings suggest that ALAN may have detrimental effects on our health and daily functions.
Support (If Any): No support.

0063

UNEXPECTED INCREASE IN MELATONIN CONCENTRATIONS DURING DAYTIME SLEEP IN SIMULATED NIGHT WORK PROTOCOL

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Introduction: Melatonin is known to be regulated by two main processes: circadian control and acute light suppression. Models based on this understanding predict that under continuous dim light conditions the circadian control causes melatonin to be high during the biological night and low during the biological day, and that light at night suppresses melatonin production. However, these models have been built using group-averaged data and may not reflect individual differences. In studying 24-h melatonin profiles collected during a highly-controlled simulated night work protocol, we were struck by the observation that melatonin concentrations in some individuals are significantly increased during daytime sleep and substantial interindividual differences exist in the degree of light-induced melatonin suppression.
Methods: Fourteen healthy young adults (mean age ± SD, 28±9 y) underwent two 8-day laboratory protocols: a day shift protocol and a simulated night shift protocol (12-h inverted behavioral and environmental cycles for three shifts). After four adaptation days, light levels were ~90 lux (moderate intensity "room" light) during scheduled wakefulness and 0 lux during scheduled sleep in the last three shifts of both protocols. Hourly melatonin concentrations were assessed for 24 h on the first and third day and night shift.
Results: 11 out of 14 participants had a significant increase in melatonin levels during daytime sleep as compared to that during the same clock time under the day shift, with 2.63±0.27 fold change (mean ± SEM). Moreover, there were large inter-individual differences in the magnitudes of light-induced melatonin suppression during the biological night under simulated night work protocol, ranging from 31% to 98% of suppression.
Conclusion: Our observations raise the question whether sleep can stimulate melatonin production during the biological day. New models of melatonin regulation should take into consideration the possible effect of sleep and large individual differences in acute light suppression.
Support (If Any): National Heart, Lung, and Blood Institute (NHLBI) Grant R01 HL094806 and Brigham and Women's Hospital from the National Center for Research Resources.

0064

DELAYED EATING ADVERSELY IMPACTS WEIGHT AND METABOLISM COMPARED WITH DAYTIME EATING IN NORMAL WEIGHT ADULTS

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Introduction: In humans and rodents, the timing of food consumption is a major contributor to body weight regulation. Sleep-wake cycle disruptions and circadian misalignment due to shifts from a diurnal to nocturnal lifestyle produce abnormal circadian rhythms and metabolic dysfunction. However, the metabolic consequences of a consistent, prolonged delayed eating pattern compared with a daytime one, are unknown.
Methods: 8 healthy adults (age: 26.25±3.2y; BMI: 22.39±1.9 kg/m^2; 4 females) participated in a randomized cross-over study in free-living conditions with 2 phases: 1.) daytime eating (3 meals and 2 snacks consumed between 0800h-1900h); 2.) delayed eating (3 meals and 2 snacks consumed between 1200h-2300h). Energy and macronutrient content were comparable between conditions, and the sleep-wake cycle was held constant at 2300h-0700h (verified by actigraphy), with exercise levels controlled. Participants spent 8 weeks on the first condition,

followed by a 2-week washout period, followed by 8 weeks on the second condition. Weight, adiposity, energy metabolism, and hormonal markers were assessed at 4 points: 1.) baseline; 2.) after the first eating condition; 3.) after the washout period, before the second eating condition began; and 4.) after the second eating condition. General Linear Models were used for statistical analysis, and cosinor analysis determined circadian rhythm amplitude and phase.

Results: Preliminary analyses indicate delayed eating, compared to daytime eating, led to weight gain and increases in respiratory quotient. Insulin and cholesterol levels also were increased and adiponectin was decreased. In addition, the ghrelin phase was delayed with greater amplitude, while the melatonin phase and amplitude remained unchanged.

Conclusion: This study provides the first experimental evidence that prolonged delayed eating promotes weight gain and a negative profile for fuel oxidation, energy metabolism and hormonal markers, in normal weight adults. Our findings suggest peripheral clocks may be affected by delayed timed eating, while the central clock remains entrained to the sleep-wake cycle.

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0065

RESTING ENERGY EXPENDITURE VARIES WITH CIRCADIAN PHASE IN NON-OBESE OLDER ADULTS

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Introduction: Evidence is emerging that circadian misalignment may alter energy expenditure, leading to obesity risk among those with irregular schedules. It has been reported that energy expenditure is affected by the timing of sleep, exercise, and meals. However, it is unclear whether the circadian timing system also modulates energy expenditure, independent of behavioral state and food intake. We used a forced desynchrony protocol to examine whether fasted resting energy expenditure (REE) varies with circadian phase.

Methods: Four healthy older adults (56–69 years; 3 female) participated in a 37-day inpatient research protocol that included 3 weeks of forced desynchrony (FD). Subjects' rest-activity was scheduled on 28-hour "days" with 11.67h in bed in the dark and 16.33h awake. Continuous core body temperature (CBT) was recorded throughout FD. Fasting indirect calorimetry (Vmax Encore system) was performed 45–60 minutes after wake time on the first 6 and last 6 days of FD. Circadian phase was estimated from CBT, and REE was averaged across 4h circadian phase bins. Two-way RM-ANOVA with Holm-Sidak test was used for statistics.

Results: REE varied by circadian phase ($p<0.001$) and was lowest at circadian phase 0° (1268 ± 96 Kcal/day), corresponding to CBT nadir, and highest at circadian phase 180° (1409 ± 82 Kcal/day). Post-hoc tests revealed that REE at circadian phases 180° and 240° was significantly different from REE at circadian phase 0° ($p<0.05$).

Conclusion: There is a circadian rhythm in resting energy expenditure that peaks during the biological afternoon and nadirs at late biological night. This is the first characterization of circadian profile of resting energy expenditure, decoupled from effects of activity, sleep/wake and diet intake, in humans. This circadian rhythm in resting energy expenditure may contribute to weight gain in shift workers.

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0066

DIURNAL REPEATED PHYSICAL EXERCISE PROMOTES SLOW WAVE ACTIVITY AND FAST-SIGMA POWER IN ACCORDANCE WITH CHANGE OF DISTAL PROXIMAL SKIN TEMPERATURE GRADIENT AND CORE BODY TEMPERATURE DURING NOCTURNAL SLEEP

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Introduction: In this study, we focused on an exercise protocol which achieved a sufficient total amount of exercise and examined the effects of physical exercise on sleep structure, changes in core body temperature (CBT), distal-proximal gradient (DPG), and subjective parameters.

Methods: Fourteen healthy male volunteers (23.5 ± 2.9 years) who had regular sleep habits were randomly allocated to the baseline and exercise conditions on a within-subject crossover basis. In the exercise condition, each participant had a 40min workout on a bicycle ergometer for 4 times throughout the day. Participants were instructed to go to bed at 00:00 after electrodes for PSG were attached and to wake up at 08:00. Skin temperature for DPG and CBT were recorded throughout the experimental period. Subjective measures were evaluated at bedtime and after waking in the next morning. PSG data were scored according to standard criteria and power spectral analysis was performed.

Results: The amount of SWS significantly increased in the exercise condition compared to the baseline condition (difference: 27.15 ± 2.62 min, $p=0.005$). Sleep depth, sleep restorativeness, and refreshness significantly increased in the exercise condition ($p<0.05$, respectively). Slow wave activity (SWA) and the fast-sigma/SWA ratio from power spectral analysis significantly increased with the time course in the exercise condition ($p<0.05$, respectively). Moreover, both mean CBT and DPG were significantly higher in the exercise condition (CBT:$p=0.021$; DPG:$p=0.038$). CBT showed a significant correlation with the fast-sigma/SWA ratio ($p=0.005$).

Conclusion: The results of our study indicate that performing a sufficient amount of exercise significantly increases slow-wave sleep as well as perceived sleep restorativeness in the following morning. Meanwhile, increased DPG and CBT as well as increase of fast-sigma power that might be related to supplementary motor area may play a role in specific physical status of the body after proper exercise.

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0067

COMPUTATIONAL PHENOTYPING IN POLYSOMNOGRAPHY: USING INTERPRETABLE PHYSIOLOGY-BASED MACHINE LEARNING MODELS TO PREDICT HEALTH OUTCOMES

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Introduction: Machine learning models have grown in popularity for the analysis of Polysomnographic (PSG) data, but many are disadvantaged by their significant lack of interpretability. From a clinical standpoint, it can be challenging to understand what determinant health factors are considered by predictive models to estimate the likelihood of health outcomes. In contrast, we utilize a Computational Phenotyping approach to predict adverse health outcomes based on common clinical variables and interpretable physiological features, providing a clear explanation as to why each estimation is made.
Methods: We used cross-sectional analyses of adults (N = 5,803), ages 39–90 (M ± SD = 63.2 ± 11.2 years), who completed an at-home PSG while participating in the Sleep Heart Health Study. In total, 1,541 interpretable physiological and clinical features were computationally derived from the dataset and used to predict 8 outcome variables including all-cause mortality, stroke, CHD, or CVD. Machine learning techniques including Random Forest, SVM, and Neural Networks were trained, optimized, and evaluated to model the relationship between the interpretable features and health outcomes.
Results: The Random Forest achieved the best predictive performance using a subset of 30 physiological and clinical features. The overall accuracy was 75.3%, with the best single variable performance on all-cause mortality (86% precision, 76% recall). These top 30 features included age, cigarette packs per year, blood pressure, cholesterol, and other variables that are well understood to contribute to the outcomes analyzed. Interestingly however, two thirds of these features represented PSG derived physiological measures. On a quantitative basis, measures of hypoxia, sleep fragmentation, sleep time, and HRV during arousal were observed to have comparable, and in some cases greater, importance than the better understood factors for predicting specific health outcomes.
Conclusion: Computational Phenotyping allows for the generation of accurate and interpretable predictive models for adverse health outcomes that rely on an intuitive subset of physiological and clinical variables. This work represents one of the largest studies analyzing the relationship between health outcomes and PSG based variables using novel machine learning algorithms, and highlights the critical role that sleep physiological measures play in contributing to health outcomes.
Support (If Any):

0068

ESTIMATION OF SLEEP STAGES USING CARDIAC AND ACCELEROMETER DATA FROM A WRIST-WORN DEVICE

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Introduction: We investigated the ability of a wrist-worn tracker to estimate sleep stages in normal adult sleepers. Such a device could be useful in simplifying sleep research and in increasing public knowledge of sleep.
Methods: Movement and cardiac data was collected from 60 adult subjects (36 M: 24 F, ages 34 ± 10 yrs) wearing two wrist worn devices (left and right hand) containing a 3D-accelerometer and an optical photoplethysmogram (PPG), while undergoing a sleep stage study using a Type III home sleep testing device. The accelerometer was used to generate various features of movement; the PPG records cardiac peaks generated by each heartbeat, and can be used to determine heart rate and heart rate variability metrics. The sleep study was scored independently by two registered PSG technicians, using consensus AASM scoring rules. Using these labels, an automated classifier and post-processing rule was developed to label 30-second epochs as one of Wake/Light/Deep/REM (note that Stages N1 and N2 were combined into a single "Light" classification). The estimated performance of this automated classifier system was calculated using a leave-one out validation method. The performance metrics were Cohen's kappa (measures the level of agreement greater than chance) and per-epoch accuracy (percent of epochs correctly labeled).
Results: The estimated Cohen's kappa was 0.52 ± 0.14 for left hand wear, and 0.53 ± 0.14 (right hand). The per-epoch accuracy was 69%. Across the population, there was no statistically significant bias in the estimated durations of the wake, light, deep and REM stages versus the gold standard measurements.
Conclusion: These results suggest that a wrist worn device with movement and cardiac sensors can be used to determine sleep stages with a reasonable degree of accuracy in normal adult sleepers, but without the cost and artificial sleep environment of a sleep laboratory. The reported performance figures are similar or better than previously reported results from non-EEG based sleep staging using combinations of cardiac, respiratory and movement information.
Support (If Any): This work was supported by Fitbit.

0069

DEVELOPMENT AND VALIDATION OF AN ALGORITHM FOR THE STUDY OF SLEEP USING A BIOMETRIC SHIRT IN YOUNG HEALTHY ADULTS

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Introduction: Portable polysomnography systems are often too complex and encumbering for home sleep recordings. We assessed the feasibility of measuring sleep with a biometric shirt.
Methods: Twenty healthy young adults (12 women, 8 men; 21.9 ± 2.0 years) were recorded in a sleep laboratory for two consecutive nights using standard polysomnography and a biometric shirt, simultaneously. Polysomnographic recordings were scored using standard methods. The biometric shirt had embedded electrocardiogram sensors, two respiratory inductance plethysmography bands, a 3-axis accelerometer and a detachable microcontroller performing signal acquisition, data processing and communication protocols. The shirt size was selected for each subject so that the signal was optimal. An algorithm was developed to classify the biometric shirt recordings into three vigilance states: wake, nonREM sleep and REM sleep. The algorithm was based on breathing rate and heart rate variability, body movement and included a correction for sleep onset and offset. The results from the two types of recordings were compared with percentages of agreement and kappa coefficients.
Results: Five nights from four subjects were rejected due to recurrent signal artefacts caused by an ill-fitting or misplaced shirt. The overall mean percentage of agreement for 35 recording pairs was 77.55%. When NREM and REM sleep epochs were grouped together, the

agreement was 90.7%. The overall kappa was 0.53. Removing breathing rate from the algorithm decreased kappa to 0.34±0.13, whereas removing heart rate did not significantly modify it (0.54±0.13). Five of the seven sleep variables were significantly correlated (sleep latency, total sleep time, %NREM and %REM sleep, the sleep period, wake time after sleep onset and sleep efficiency) while the minutes spent in NREM and of REM sleep did not.
Conclusion: The findings of this pilot study indicate that a simple portable system using a biometric shirt can estimate reasonably well the general sleep pattern of young healthy adults.
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0070

SLEEP DEPRIVATION EXACERBATES ALCOHOL-INDUCED TOXICITY IN DROSOPHILA

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Introduction: Excessive alcohol consumption and binge drinking are growing societal problems with alcohol toxicity and alcohol-induced mortality resulting in more than 20,000 deaths annually. Alcohol pathologies appear to be higher in populations in which sleep deprivation and sleep fragmentation are common including shift workers and aged individuals. Sleep disorders are frequently viewed as consequences of alcohol abuse with comparatively little research examining the effect of sleep loss on alcohol toxicity. Using Drosophila melanogaster, a powerful system for studies of both alcohol neurobiology and sleep, we investigated the effects of sleep deprivation on alcohol toxicity.
Methods: Wild type (Canton-S) Drosophila were mechanically sleep deprived using a rotating gyrator for 24h and then exposed to either 50% alcohol vapor in a single 1h session or 30% alcohol vapor for 1h on 3 consecutive days. Behavioral sensitivity to alcohol, gut hyperpermeability and mortality were assessed.
Results: We found that mechanical sleep deprivation increased behavioral sensitivity following single or repeated alcohol exposures. Total sleep deprivation for 24h prior to alcohol exposure eliminated the development of functional alcohol tolerance. Sleep deprivation increased alcohol-induced gut hyperpermeability and mortality. Pharmacological induction of sleep using the GABA(A) agonist Gaboxadol 48h prior to repeated alcohol exposure significantly decreased gut hyperpermeability and mortality. The effects of sleep deprivation on alcohol toxicity were distinct from circadian dysfunction as Gaboxadol also ameliorated the effects of alcohol-induced mortality in wild type flies grown in constant light, a condition that induces circadian arrhythmicity.
Conclusion: Our results suggest that sleep buffers the toxic effects of alcohol with sleep loss increasing alcohol-induced pathologies and mortality. These studies provide a foundation for future research investigating the mechanisms through which sleep and sleep deprivation modulate alcohol toxicity.
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0071

ROLE OF SLEEP RESTRICTION IN ADIPOCYTE INSULIN SENSITIVITY DURING AN INTRAVENOUS GLUCOSE TOLERANCE TEST IN HEALTHY ADULT MEN

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Introduction: Sleep restriction, or chronic partial sleep loss, increases obesity and diabetes risk by disrupting glucose metabolism and reducing whole-body insulin sensitivity without a compensatory increase in insulin secretion. Healthy adipocytes suppress hormone sensitive lipase (HSL) activity in response to insulin, which severely limits non-esterified fatty acid (NEFA) release. Elevated overnight NEFA levels are correlated with the reduction in insulin sensitivity that occurs in sleep restriction. Additionally, subcutaneous adipose biopsies from sleep-restricted subjects have reduced pAKT, evidence that sleep restriction decreases insulin sensitivity in adipocytes. The objective of this pilot study was to extend previous findings of the effects of sleep restriction on plasma glucose to mechanistic shifts within adipocyte metabolism.
Methods: Subjects (20–35 y/o) were enrolled in an 11-day in-lab protocol; light exposure, activity, temperature, and diet were carefully controlled. An intravenous glucose tolerance test (IVGTT) was performed at three time points: after three nights of baseline sleep (10 hrs/night), after five nights of sleep restriction (5 hrs/night), and after two nights of recovery sleep (10 hrs/night). NEFA were quantified (Wako Diagnostics) and parameters describing NEFA kinetics (i.e. rate of NEFA production, utilization, suppression threshold) in the Boston and Moate minimal model were calculated using WinSAAM Compartmental Modeling software.
Results: Five subjects completed the sleep restriction protocol; one did not complete IVGTT procedures for safety reasons. Preliminary results from four subjects show the fractional rate of NEFA utilization was increased by 0.024 [0.009, 0.039] min-1 in the restricted condition (p=0.008). Restriction also increased the modifier of the inhibitory effect of remote glucose on NEFA production by 4.3 fold [1.2, 15.9] from baseline (p=0.04).
Conclusion: Sleep restriction induces symmetrical changes in both glucose and lipid markers of insulin sensitivity in vivo. Preliminary evidence indicates that NEFA rate of utilization is increased in response to sleep restriction. In the context of whole-body metabolism, this indicates a shift in Randle cycle fuel selection by metabolic tissues. Additionally, a greater concentration of glucose was required to initiate NEFA suppression, evidence that sleep restriction functionally impairs HSL activity.
Support (If Any): UL1TR000127 (Chang PI)T32GM108563 (to KMN; Korzick PI).

0072

GLUCOSE TOLERANCE AFTER ACUTE SLEEP DEPRIVATION, SLEEP RESTRICTION, AND RECOVERY SLEEP

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Introduction: Shift-work is related to metabolic and cardiovascular disease. Sleep restriction and circadian misalignment have been shown to decrease glucose tolerance. Since shift-work is often associated with a combination of sleep restriction, total sleep deprivation and intermittent recovery sleep we tested (i) whether acute sleep deprivation and repeated sleep restriction exhibit similar effects on glucose tolerance, (ii) whether one night of recovery sleep after repeated sleep restriction is sufficient to restore glucose tolerance, and (iii) whether the effects of acute sleep deprivation and prior sleep restriction are cumulative.
Methods: Morning oral glucose tolerance (OGTT: 75g dextrose/300ml water; >10h fasting) was tested during a 12-day inpatient study in an intervention group (IG) (N=18; 9 females, mean age 26±3 years, BMI 23.2±2.0) and a control group (CG) (N=9; 3 females, mean age 25±5 years, BMI 23.5±3.4). In the IG OGTTs

were run after (i) two nights of baseline sleep (8h TIB), (ii) five nights of sleep restriction (5h TIB), (iii) one night of recovery (8h TIB), and (iv) 24h of sustained wakefulness following recovery. In the CG OGTTs were taken at the same time points except that TIB was 8h for all sleep episodes. Blood samples were taken immediately prior to the OGTT and every 30min thereafter for 120min. Mixed ANOVAs with Tukey adjustment compared glucose levels in each group between interventions.

Results: Glucose tolerance decreased after five nights of sleep restriction: compared to baseline, blood glucose stayed elevated 60min ($\Delta 19.1 \pm 6.2$ mg/dl (SE), $p<0.02$), 90min ($\Delta 25.6 \pm 6.0$ mg/dl, $p=0.0005$), and 120min ($\Delta 24.8 \pm 5.1$ mg/dl, $p<0.0001$) after intake. Glucose levels were still increased after recovery (90min: $\Delta 22.6 \pm 6.0$ mg/dl, $p=0.002$; 120min: $\Delta 16.2 \pm 5.1$ mg/dl, $p<0.02$), but were not different from baseline after 24h of wakefulness. Sleep deprivation in the CG did not alter glucose tolerance.

Conclusion: Restricting the sleep time to 5h for five nights decreased glucose tolerance. One 8h recovery sleep episode did not restore glucose tolerance. One night of sleep deprivation did not affect glucose tolerance and did not add to the effects of prior sleep restriction. A different metabolic regulation during the wake state might have prevented glucose tolerance from decreasing.

Support (If Any):

0073

DYNAMIC CHANGES IN HUMAN INNATE AND ADAPTIVE IMMUNE CELL NUMBERS IN RESPONSE TO SLEEP EXTENSION AND SLEEP DEPRIVATION

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Introduction: It has not been determined if innate and adaptive immune cell counts change following sleep extension (EXT). Here, we combine 2-days of baseline (8 h time-in-bed), 1-week of EXT (10 h time-in-bed) immediately followed by sleep deprivation (SD; 40 h) and recovery sleep (REC; 12 h time-in-bed). We characterized dynamic changes in human innate and adaptive immune cell numbers in response to bidirectional sleep homeostatic and circadian manipulations.

Methods: A total of 8 participants (4 males, mean age 24.7) stayed in the sleep research facility for 11 nights. Plasma was drawn ~0730 upon awakening for baseline, EXT, and 24 h into SD; and ~1030 after recovery. Innate (monocytes and natural killer [NK] cells plus surface markers) and adaptive (B-cells and T-cells plus surface markers) cells were quantified by flow cytometry. Gating ensured exclusion of apoptotic cells.

Results: Broadly, there was a change in the composition of the leukocyte populations across the study ($p<0.001$; repeated measures ANOVA). Innate cells significantly decreased by ~25% from baseline levels across EXT. Monocytes decreased more quickly than NK cells relative to baseline levels ($p<0.05$, paired t-tests). Monocytes rapidly increased by ~25% from baseline levels 24 h into SD ($p=0.027$), despite a week of EXT. NK counts remained ~25% reduced from baseline levels 24 h into SD ($p=0.043$). Monocytes and NK cells returned to baseline levels during REC. Adaptive cells also decreased by about ~25% from baseline levels across EXT; B-cell counts modestly decreased midway through EXT ($p=0.05$, paired t-tests), whereas T-cell counts immediately declined and remained reduced from baseline levels across EXT ($p<0.05$). Adaptive cells returned to baseline levels during SD and subsequent REC.

Conclusion: Sleep extension and deprivation had a significant effect on the number of innate and adaptive immune cells in the peripheral blood. Further analysis will look at changes in the functionality of these leukocyte populations.

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0074

INVESTIGATING THE EFFECT OF ACUTE SLEEP DEPRIVATION ON HYPOTHALAMIC-PITUITARY-ADRENAL-AXIS RESPONSE TO A PSYCHOSOCIAL STRESSOR

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Introduction: The hypothalamic-pituitary-adrenal (HPA) axis has been previously identified as one potential mechanism that may explain the link between sleep deprivation and negative health outcomes. However, few studies have examined the direct impact of sleep deprivation on HPA-axis functioning, particularly in the context of stress. Therefore, the aim of the current study was to investigate the relationship between acute sleep deprivation and HPA-axis reactivity to a psychosocial stressor.

Methods: Participants included 40 healthy, young adults between the ages of 18 - 29. The current protocol included spending two nights in the laboratory. After an adaptation night, participants were randomized into either a sleep deprivation condition (n = 20; 29 consecutive hours awake) or a control condition (n = 20; 8-hour sleep opportunity). Following the experimental night, all participants completed the Trier Social Stress Test (TSST). Salivary cortisol was collected before, during, and after the TSST. We used random effects growth curve models to examine the impact of experimental condition on cortisol stress trajectories - i.e., the effect of condition on pre-stress, baseline cortisol (intercept) and cortisol reactivity (non-linear slope) from baseline.

Results: Compared to participants in the control condition, participants in the sleep deprivation condition had greater baseline (i.e., pre-stress) cortisol [b = .727, p = .03], yet a blunted cortisol response to the TSST [b = -.026, p < .01]. These effects remained significant while controlling for known covariates (e.g., gender, mood, caffeine use).

Conclusion: Taken together, a combination of elevated baseline cortisol (and its subsequent impact on HPA-axis regulatory processes) and a relative 'ceiling' on the amount of cortisol a laboratory stressor can produce may explain why participants in the sleep deprivation condition demonstrated blunted cortisol responses. The current findings suggest that future research investigating the relationship between health outcomes and HPA-axis stress reactivity should account for variability in sleep during the night prior to exposing participants to stress.

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0075

ROLE OF GLUTAMATE RECEPTORS DURING SLEEP DEPRIVATION

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Introduction: Recently we discovered that the increase in extracellular glutamate (Glu) triggers a biochemical cascade critical in promoting recovery sleep (RS) after sleep deprivation (SD). This cascade includes production of inducible nitric oxide synthase (iNOS)-dependent NO followed by increase in adenosine (AD). The Glu-iNOS-NO-AD cascade is initially triggered in the basal forebrain (BF) and later in the prefrontal cortex (PFC). It is still not known which Glu receptors (GluRs) mediate this cascade. To answer this question, we: 1) blocked GluRs in the BF during SD by NMDAR or AMPAR selective antagonists and measured the changes in SD-induced AD in the BF/PFC and RS; 2) stimulated GluRs in the BF by NMDA or AMPA and measured the changes in AD and NREMs/NREM delta (delta); 3) evaluated the effects of SD and BF AMPA infusion on PFC AD after BF cholinergic (ChBF) lesions using 192 IgG-saporin.
Methods: 5 male rats were implanted with EEG/EMG recording electrodes and microdialysis guide cannulae targeting the BF and PFC. Microdialysis samples were collected during 8hSD and/or drug infusion. To block NMDAR/AMPAR we used dizoclipine (MK-801)/6,7-dinitroquinoxaline-2,3-dione (DNQX), respectively.
Results: SD induced an increase in AD by 154 ± 10% and 129 ± 17% in the BF and PFC, respectively, and in recovery NREMs/delta. DNQX prevented AD increase during SD in both BF (as compared to SD, 1 ± 3%, p=0.006, n=5) and PFC (-8 ± 9%, p=0.006, n=3) and attenuated NREM RS. MK-801 did not show any effect on these parameters. The infusion of AMPA in the BF mimicked the effects of SD by increasing AD in both BF (93 ± 16%, p=0.02, n=4) and PFC (95 ± 15%, p=0.03, n=4). NREMs/delta decreased during AMPA infusion, but increased post-infusion. NMDA was not effective. Lesion of ChBF prevented PFC AD increase during SD. BF AMPA infusion after ChBF lesion lead to the decrease in AD in PFC (-31 ± 11, p=0.03, n=4). ChBF lesion attenuated the decrease in NREMs/delta during the AMPA infusion and recovery NREMs/delta post-infusion/post-SD.
Conclusion: Our data suggest that the effect of Glu on SD-induced changes is primarily mediated via AMPAR, located on ChBF cells.
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0076

TWO NOVEL ADENOSINE ANALOGUES AS HYPNOTICS

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Introduction: Adenosine exhibits somnogenic effect, however, there is no adenosinergic hypnotic because of the cardiovascular adverse effects. This study investigates whether N^6-(4-hydroxybenzyl) adenine riboside (T1-11), an adenosine analogue extracted from Gastrodia elata, and its derivative, N^6-(2-sulfanyl-3-bromo) adenine riboside (JMF3464), produce somnogenic effects in normal and insomniac mice. We further determined the involvement of adenosine 2A receptors (A2AR) in the GABAergic neurons of the ventrolateral preoptic nucleus (VLPO), and the cardiovascular adverse effects.
Methods: C57BL/6 mice were surgically implanted with two EEG electrodes and a microinjection cannula directly into the VLPO. Mice were orally administered T1-11 and JMF3464 (1.0, 2.5, 5.0, 10, 20 mg/kg) at the dark onset. Cage exchange between mice, as an acute stressor, was performed prior to the light period to induce acute insomnia. A selective A2AR antagonist (SCH58261; 2.0 mg/0.5µl) was microinjected into the VLPO to clarify the mechanisms. Finally, determination of the c-fos expression in the transgenic mice of GAD2-Cre::Ai14 after oral administration of these two compounds was used to clarify the activation of GABAergic neurons in the VLPO. The heart rate variability (HRV) was measured after administrations.
Results: T1-11 and JMF3464 increased non-rapid eye movement (NREM) sleep during both the dark and the light periods in normal mice. Microinjection of SCH58261 into the VLPO blocked the sleep effects of T1-11 and JMF3464. Both compounds reversed the acute stress-induced insomnia and this reversal effect was blocked by SCH58261. The expression of c-fos in the GABAergic neurons of the VLPO was increased after administration of T1-11. There was no alteration in the heart rate and the LF/HF ratio of HRV.
Conclusion: In mice oral administration of T1-11 or JMF3464 increases NREM sleep and effectively ameliorates acute insomnia. The somnogenic effect is mediated by activation of GABAergic neurons in the VLPO. These two adenosine analogues could be potential hypnotics because of no cardiovascular adverse effects.
Support (If Any):

0077

PHASE ADVANCING TEENS WITH WEEKEND MORNING BRIGHT LIGHT: HOW LONG IS ENOUGH?

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Introduction: Approximately 85% of American teens experience chronic sleep restriction due in part to a dissonance between delayed circadian timing and early school start times. Morning bright light advances circadian timing and may be used to increase sleep duration on school-nights; however, the most effective light duration to advance rhythms remains unknown in this age group. The purpose of this study was to quantify phase advances in response to two durations of morning bright light in teenagers.
Methods: Thirty-seven adolescents (16.41 ± 1.04 years; 21 females) slept unrestricted at home for 3 weeks before living in the lab for a weekend. On Friday evening, participants completed a baseline dim light melatonin onset (DLMO) assessment. Salivary melatonin samples were collected in 30-min intervals in dim light (<5 lux). Participants received 1.5h bright light (n=11; ~6,000 lux; three 30-min exposures), 2.5h bright light (n=13; three 50-min exposures) or room light (~100 lux; control group; n=13) upon waking on Saturday and Sunday mornings. Bright light started 1h after weekend midsleep time (MST) on Saturday and at weekend MST on Sunday. The sleep/dark episode advanced on Saturday night. A final DLMO was measured on Sunday evening. Phase shifts were the difference between baseline and final DLMO.
Results: Room light, 1.5h, and 2.5h of bright light resulted in 0.56 ± 0.40h, 0.66 ± 0.53h, and 1.04 ± 0.44h phase advances, respectively (between group effect: $(F(2,34)=4.14$, $p=0.03)$. Post-hoc analyses revealed that 2.5h bright light produced greater phase shifts than both 1.5h bright light ($p=0.04$) and room light ($p=0.01$). 1.5h of bright light did not produce larger phase shifts than room light ($p=0.60$).
Conclusion: Findings demonstrate that 2.5h of bright light on two weekend mornings, is necessary to advance circadian rhythms of teens by 1h, and 1.5h of morning bright light was no more effective than room light when timed to begin just after weekend MST. Our adolescent phase response curve to light predicts maximum phase advances 2-6h after MST, which may explain why the longer stimulus produced the largest phase shift. These findings inform methods to phase

advance teenagers to facilitate earlier sleep onset and increase school-night sleep duration.
Support (If Any): R01HL223756(SJC).

0078

INTER- AND INTRA-INDIVIDUAL RELATIONSHIPS BETWEEN PLASMA AND SALIVARY MELATONIN AND URINARY AMT6S

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Introduction: Plasma melatonin is widely regarded as the gold-standard marker of circadian phase. Salivary melatonin and urinary 6-sulphatoxymelatonin (aMT6s) are also often used as circadian markers when a non-invasive approach is required, particularly in field settings. Few studies to date, however, have examined the inter- and intra-individual temporal relationships between plasma and salivary melatonin and urinary aMT6s. We aimed to quantify the temporal associations between the different melatonin phase markers under controlled laboratory conditions.
Methods: Eighteen participants (25.5±6.2 years, 13 males) underwent a 40 hour constant routine. Blood and saliva samples were collected hourly, and urine samples collected every 2 to 4 hours. Melatonin and aMT6s was determined by radioimmunoassay. Plasma and salivary dim light melatonin onset (DLMO; cut off: 5 pg/ml) timing was calculated, and urinary aMT6s profiles were subjected to cosinor analyses to determine aMT6s acrophase (peak) timing.
Results: Overall, plasma and salivary DLMO occurred at 21:09±01:17 h and 21:42±01:26 h, respectively. Urinary aMT6s acrophase occurred on average at 03:48±01:00 h. Within individuals, plasma and salivary DLMO were highly correlated ($r=0.95$, $p<0.001$), with salivary DLMO occurring on average 38 minutes after plasma onset. Relative to individual plasma DLMO timing, aMT6s acrophase peak occurred 6.46±0.66 hours later. While plasma DLMO and aMT6s and were significantly correlated ($r=0.74$, $p<0.01$), it was a weaker association than with salivary DLMO.
Conclusion: Salivary melatonin and urinary aMT6s display reliable associations with plasma melatonin under highly controlled laboratory conditions. These data will also aid in the development of algorithms to predict circadian melatonin rhythms.
Support (If Any): The study was supported by the Cooperative Research Centre for Alertness, Safety and Productivity.

0079

PREDICTING THE TIMING OF DIM LIGHT MELATONIN ONSET IN REAL-WORLD CONDITIONS USING A MATHEMATICAL MODEL

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Introduction: Circadian rhythms modulate the timing and quality of sleep. Methods for measuring and predicting the timing of an individual's circadian rhythms are therefore valuable to clinical assessment of sleep pathology or operational assessment of sleep scheduling. Mathematical models have been developed to predict the effects of light/dark patterns on the timing of human circadian rhythms. To date, however, these models have only been validated in clinical or inpatient laboratory settings, and typically at the group-average level rather than the individual level. Here, we compare individual-level predictions of the leading model to real-world assessments of circadian timing in a college student population.
Methods: Light data were recorded around-the-clock from 256 college students for 1–4 weeks using wrist-worn actigraphy, which were first tested for accuracy against a calibrated light meter. Each individual also completed a single overnight inpatient laboratory visit to measure the timing of salivary dim light melatonin onset (DLMO). For each individual, light data, binned to maximum values in 1-h bins, were input to the St. Hilaire 2007 model of the human circadian pacemaker and its sensitivity to light. Model predictions of the average timing of DLMO were compared to the experimental data.
Results: Preliminary results are presented for a subset of ~80 participants, with average DLMO of 22:40±1:50. In approximately 20% of participants, the model was unable to predict circadian phase due to inability to entrain to the measured light pattern (despite a sleep/wake pattern that appeared entrained and normal DLMO time). Among the entrained cases, the model predicted DLMO to within ±1 hour of the true value in 40% of individuals and to within ±2 hours in 80% of individuals.
Conclusion: Our findings suggest that if the goal is predicting DLMO from light data, actiwatches can be used with models to predict DLMO within ~1–2 hours in most individuals. Additional data or model refinement may be needed to improve accuracy.
Support (If Any): NIH R01-GM-105018, NIH R01-HL-114088, NIH R01-HL094654, NIH P01-AG09975, NIH K24-HL105664, NIH R00-HL119618, R01HL128538, NIH F32DK107146, T32HL007901, NSBRI HFP0280, NSBRI HFP02802, and NSBRI HFP02801.

0080

DIURNAL VARIATION OF PLASMA LYSOPHOSPHATIDYL LIPIDS IN HEALTHY NON-OBESE OLDER ADULTS

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Introduction: Disruption of daily rhythms in energy expenditure has been implicated in metabolic dysfunction. The rhythmic control of lipid metabolism and its temporal coordination with rest-activity and food intake have been studied in young adults, but remain poorly understood in older adults who are at greater risk for metabolic disorders. Lysophosphatidyl lipids (LPLs) are a class of membrane phosphatidyl lipids reported to exhibit diurnal variation. We characterized the effects of rest-activity and timing of food intake on LPLs in healthy older adults studied in controlled laboratory conditions.
Methods: As part of a larger study, blood samples from eight healthy non-obese older adults (56–69, 4 women) were collected every 4h for 24h. Participants had a 10h scheduled sleep episode followed by 14 h of wakefulness with controlled posture and activity, during which time three calorie/nutrient controlled meals (breakfast, lunch, dinner) were served. Plasma lipid profiling was done by liquid chromatography-high resolution mass spectrometry. Eighteen LPLs were identified based on their *m/z* in both positive and negative ionization modes. Rhythmicity was tested by fitting a cosinor model; two-way ANOVA

was used to test the effects of rest-activity and fasting (>8h since last meal) on LPL levels.
Results: All 18 LPLs showed rhythmicity ($p<0.001$). 16 were significantly different between scheduled sleep and wake ($p<0.05$), with higher levels during sleep. 10 of those (and 2 others) were also significantly different between fasted and non-fasted conditions ($p<0.05$), with higher levels during the non-fasting condition. LPL levels were highest around bedtime (~2.5h after dinner) and lowest before breakfast after the overnight fast.
Conclusion: Plasma LPL levels vary with both the rest-activity cycle and fasting-feeding in healthy non-obese older adults. Future studies that assess whether these and other LPLs are also under circadian control will allow us to understand how circadian dysregulation can lead to metabolic syndrome.
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0081

FOOD INTAKE DURING EARLY MORNING SHIFTWORK AS A NOVEL RISK FACTOR FOR METABOLIC DYSREGULATION

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Introduction: Increased risk of obesity and metabolic diseases in night and shift workers is thought to be related to caloric intake at adverse circadian times. Over 20% of adults in the US work non-traditional hours and thus eat some of their meals during the biological night. Little is known, however, about metabolic disease risk in the largest population of shift workers in the US, i.e., early morning shift workers who start work between 0400-0700h. We therefore tested the impact of simulated early morning shiftwork on glucose metabolism.
Methods: 18 subjects (9 female) aged 23.2 ± 3.8y (±SD) completed the 16-day randomized, counterbalanced, within-subject protocol. Subjects were healthy based on Clinical and Translational Research Center and PSG sleep disorders screens. Subjects maintained habitual, self-selected 8h sleep schedules for one-week prior to each of two study visits: the control condition where subjects slept 8h at their habitual time and the simulated early morning shiftwork condition where subjects went to bed ~1h prior to habitual bedtime and woke up ~2.5h prior to habitual waketime (based on unpublished data from early morning shiftworkers collected by our laboratory). After waking, baseline blood glucose, insulin and melatonin levels were sampled then subjects were served the same breakfast 45min after awakening consisting of 25% of daily caloric needs (30% fat, 55% carbohydrate, 15% protein). Blood was then sampled every ~40min for the next 2h.
Results: The early morning shiftwork condition induced morning circadian misalignment and thus melatonin levels were significantly higher on the day of the early shift compared to the habitual wake time condition ($p<0.05$). Morning circadian misalignment increased glucose levels by ~5% in response to breakfast ($p<0.05$) in the early shiftwork compared to habitual wake time condition. This percent change is similar in magnitude to that found in prior forced desynchrony protocols. No significant differences in insulin were observed for condition.
Conclusion: Early morning shiftwork may contribute to risk of diabetes by inducing circadian misalignment and higher morning glucose levels associated food intake during the biological night.
Support (If Any): University of Colorado Boulder Dean's Graduate Student Research Grant; NIH DK092624 and TR001082.

0082

SIMULATED NIGHT-SHIFT WORK ALTERS THE BALANCE AND 24H PATTERN OF THE COAGULATION-FIBRINOLYSIS AXIS

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Introduction: Circadian misalignment resulting from shift-work is, in part, thought to contribute to elevated cardiovascular disease risk among shift-workers. The circadian system reportedly regulates multiple proteins implicated in controlling the coagulation-fibrinolysis axis. Thus, circadian misalignment may cause an imbalance between fibrinolysis and coagulation, thereby increasing cardiovascular disease risk. Here, we investigated the impact of circadian misalignment on the coagulation-fibrinolysis axis using plasma proteomics during a simulated night-shift work protocol.
Methods: Six healthy men aged 26.2 ± 5.6y (mean±SD) completed a 6 day in-laboratory simulated night-shift work study with 2 baseline days (circadian alignment) followed by a transition day and then 2 simulated night-shift work days (circadian misalignment). Subjects received 8h sleep opportunities at their habitual sleep time during circadian alignment, and 8h daytime sleep opportunities with nighttime wakefulness during circadian misalignment. Plasma was collected every 4h across 24h during circadian alignment and misalignment for proteomics analyses.
Results: In total, we analyzed 181 proteins involved in the coagulation-fibrinolysis axis. Circadian misalignment altered (false discovery rate<0.1) 24h average expression in 24 of these 181 proteins analyzed. During circadian alignment, 43 of these 181 proteins showed an ~24h expression pattern ($p<0.05$), and 35 of these proteins lost their ~24h expression pattern during circadian misalignment. For example, circadian misalignment altered the temporal expression profile of plasminogen activator inhibitor-1, a key regulator of fibrinolysis, and elevated expression of tissue factor and reduced expression of tissue factor pathway inhibitor, key positive and negative regulators of coagulation, respectively.
Conclusion: During circadian alignment, there was ~24h temporal regulation in the coagulation-fibrinolysis axis with higher fibrinolysis during wakefulness and lower fibrinolysis during scheduled sleep. During circadian misalignment, the ~24h temporal regulation of fibrinolysis was lost and proteins regulating coagulation were altered, promoting thrombus formation. Thus, circadian misalignment may disrupt the coagulation-fibrinolysis axis by promoting thrombus formation without concomitant increases in fibrinolysis. If chronic, such changes in the coagulation-fibrinolysis axis may contribute to elevated cardiovascular disease risk among shift-workers.
Support (If Any): NIH DK092624, TR001082, DK048520, R01HL132150, and Sleep Research Society Foundation 011-JP-16.

0083

IMPACT OF A SINGLE WEEK OF SLEEP EXTENSION ON PERFORMANCE, MOOD, AND NUTRITION AMONG FEMALE COLLEGE TRACK ATHLETES

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Introduction: Detrimental effects of inadequate sleep on athletic performance have been well documented. Increasing sleep (sleep extension) has not been thoroughly investigated, especially among college athletes whose student status makes them particularly vulnerable to sleep restriction. Furthermore, the effects of sleep on an athlete's nutrition behaviors have yet to be determined. This study aimed to determine the effects of experimentally adding one additional hour of sleep on physical performance, mood, and nutrition behaviors among female collegiate track and field athletes for seven consecutive days.
Methods: Twenty-one females (20±2 yrs) maintained their usual sleep habits for one week. Sleep (actigraphy plus diary), mood (Profile of Mood States; POMS), Psychomotor Vigilance Test (PVT; 5-minute version), athletic performance (standard Wingate Anaerobic Test), and 24-hour food-recall questionnaire) were collected during one week of usual schedule (baseline) followed by one week of daily sleep extension (up to 60 minutes).
Results: Subjects significantly increased total sleep time by 7% from baseline to sleep extension (429±38 minutes, 451±45 minutes, respectively; $p<0.05$). POMS total mood disturbance scores decreased significantly ($p<0.05$) with sleep extension. However, of the other performance and food measures, only peak power showed a trend toward improvement (693±213 versus 714±215 watts; $p=0.07$).
Conclusion: Extending sleep time for one week improved mood among female collegiate track and field athletes but did not significantly impact their nutrient intake, or psychomotor vigilance. Marginal improvements in anaerobic exercise performance, though not statistically significant, may be meaningful in highly competitive fields. We submit that a single week of increased sleep time may not suffice to see improvements in all areas and that athletic programs should be prepared to coach their athletes that performance results may not be immediate. Rather, long-term commitments to healthy sleep may be necessary.
Support (If Any): United States Department of Agriculture, West Virginia University Agricultural Experimental Station Hatch (#WVA00627/#WVA00641) and a sub-contract award from Agriculture and Food Research Initiative (#2012-68001-196006/#2014-67001-21851).

0084

THE PSYCHOLOGICAL AND PHYSIOLOGICAL IMPLICATIONS OF SLEEP RESTRICTION: A COMPARISON OF VOLUNTARY AND EXPERIMENTAL SLEEP RESTRICTION GROUPS

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Introduction: Sleep restriction (SR) has profound adverse effects on health and wellbeing; however, it isn't clear if there are differential effects of chronic and voluntary SR vs. short-term and involuntary SR. In order to examine this possibility, we tested the extent to which psychological and physical health measures were influenced by a group of participants who voluntarily restricted their sleep (VSR) relative to participants who underwent 7 days of experimental SR (ESR). We tested a female-specific population since sleep complaints in women are particularly associated with impaired psychological functioning.
Methods: Participants underwent a psychiatric interview in order to screen for psychopathology and existing sleep disorders. Upon study enrollment, sleep group categorization (ESR vs. VSR) was confirmed through sleep diary and actigraphy monitoring for 1 week. The VSR group slept less than 7 hours per night (actigraphy-verified) and ESR group was asked to sleep 90 minutes less than their average sleep time (actigraphy-verified). Participants in both groups completed clinical health measures and provided saliva samples for the quantification of IL-1β, IL-6, and cortisol.
Results: Preliminary results suggest that ESR results in decreased psychological health including perceived stress (PSS: BL mean = 16.8, day 7 = 18.2), moodiness (POMS: BL mean = 0, day 7 = 26.6), and state anxiety (STAI: BL mean = 34.2, day 7 = 44.8). In addition, relative to baseline, measures of inflammation were increased with ESR (IL-6: BL mean = 18.98 pg/mL, day 7 = 41.83 pg/mL and IL-1β BL mean 38.06 pg/mL, day 7 = 87.76 pg/mL). Comparing VSR to ESR, we found that the ESR group reported worse psychological health and higher inflammation markers (IL-6 VSR mean = 15.70 pg/mL and ESR day 7 mean = 41.6 and IL-1β VSR mean = 32.10 pg/mL ESR day 7 mean = 87.76 pg/mL).
Conclusion: We find that, consistent with previous reports, involuntary experimental SR (ESR) results in decreases in self-reported psychological health and increases in measures of inflammation. New to our study, we show that relative to people who voluntarily restrict their sleep (VSR), the psychological and physiological effects of ESR are more pronounced.
Support (If Any):

0085

EFFECT OF SLEEP FRAGMENTATION ON THE MICROBIOME-GUT-BRAIN AXIS

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Introduction: Bi-directional interactions between the gut microbiota, immune system, and brain (microbiota-gut-brain (M-G-B) axis) are thought to be critical mediators of health and disease. Here, we assessed the effects of sleep fragmentation (SF) on the M-G-B axis.
Methods: Mice (4 to 5 per cage) were housed in devices (Lafayette Instruments, Sleep Fragmentation Chamber (SFC), model 80391) that induce SF via mechanical stimulation. The SFCs were set for 2-min intervals for the entire light period (SF) or for the entire dark period (DD, dark disturbances). Home cage (HC) controls were undisturbed. After 10 days, fecal samples were collected at light onset, midday, light-offset, and midnight. Subsequently, the mice were randomized across groups and allowed 20 days of recovery followed by 10 additional days of SF or DD. Fecal samples were subjected to Next-Gen sequencing to assess effects on the microbiota, and the mesenteric lymph nodes (MLNs) and cortex were analyzed using inflammatory cytokine arrays (SABiosciences, PAMM-0011).
Results: SF and DD produced significant alterations in the microbiota compared to HC. DD could have a greater impact than SF on some organisms. However, SF had a marked impact on both the peripheral (mucosal) and central immune systems whereas DD was similar to HC. SF produced marked suppression in MLNS of chemokines that regulate inflammation (CCL3, CCL4 and their receptor CCR5) and maintain the immune mucosal barrier (Cxcl13) that prevents bacterial translocation at the same time that cortical cytokines (IL-33) indicated neuroinflammation.
Conclusion: These data demonstrate that SF can alter the microbiome and suggest that it may lead to persistent, low-grade brain inflammation at the same time that mucosal immunity is suppressed. The

combination of effects of SF on the microbiome and mucosal and central immune systems may have relevance for the role the M-G-B axis plays in mediating health.
Support (If Any):

0086

SYSTOLIC BLOOD PRESSURE IS INCREASED DURING NON-REM SLEEP AFTER LIGHT-PHASE SLEEP FRAGMENTATION IN RATS

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Introduction: Occupational responsibilities (working night-shift, being on-call) can restrict and fragment sleep. We tested the hypothesis that sleep fragmentation (SF) has cardiovascular (CV) consequences by studying the impact of light-phase SF (LP-SF) on blood pressure (BP) and heart rate (HR) in Wistar-Kyoto (WKY) rats.
Methods: WKY rats (N=5) were implanted with telemetry transmitters to measure electroencephalogram/electromyogram, electrocardiogram, and BP. Rats were acclimatized to light (LP; 0800-2000) and dark phases (DP; 2000-0800) and housed in SF chambers (Lafayette Neuroscience Co.). After obtaining baseline data (3 days), rats were recorded while mechanical arms continuously swept through the chambers (0800-1600) for 6±2 consecutive days (each full sweep lasting 7.5 sec). Sleep was scored in 10 sec epochs. CV data were aggregated for wakefulness, rapid eye movement (REM) sleep, and non-REM sleep, which were compared across the LP-SF, LP-rest, and DP-rest periods (t-tests, repeated-measures ANOVA).
Results: Compared with baseline sleep behaviors, the 8 hr LP-SF caused a 30% increase in non-REM sleep during the subsequent LP rest periods (1600–2000), but DP sleep-wake patterns were not significantly altered. Compared with LP baseline parameters between 1600–2000, the LP rest periods during this timeframe following SF were characterized by increased systolic BP during non-REM sleep (139±4 mmHg [baseline], 147±3 mmHg [last day], p=0.01) while associated HR responses did not differ significantly (363.3±19 beats per min [bpm, baseline], 373±26 bpm, p=0.5). None of the CV variables differed from baseline during REM sleep or during the DP. Collectively, these observations suggest that in nocturnal animals, LP-SF alters BP regulation in the subsequent rest period and that the impact on sleep and CV activities is reduced during the DP when rats are naturally more active.
Conclusion: This experimental model allows for timed-periods of SF, an approach important for understanding the links among sleep, circadian rhythms, and CV disease risk. Future directions include measuring genetically-hypertensive WKY rats' responses to both LP-SF and DP-SF to understand whether rats with existing hypertension also respond detrimentally to SF. Ultimately the work will guide the identification of CV disease risk reduction strategies for people with irregular work schedules.
Support (If Any): Midwest Nursing Research Society.

0087

POWER SPECTRAL ANALYSES IN BROAD BAND EEG FREQUENCIES AFTER SLEEP RESTRICTION AND WEEKEND RECOVERY SLEEP

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Introduction: Millions of people worldwide suffer from insufficient sleep during the week to accommodate work and social demands and attempt to make up for it by sleeping in on the weekends. Prior studies investigating sleep restriction have focused on changes in delta power and have limited the recovery sleep opportunity. Therefore, the aims of the current analysis were to investigate changes in broad band EEG frequencies beyond delta, during a work-week of sleep restriction, and to examine changes during ad libitum weekend recovery sleep.
Methods: 36 healthy participants (18 females, aged 25.5±4.7y mean±SD) were randomized into three study conditions: control (9h sleep/night), sleep restriction (5h sleep/night), or weekend recovery (5h sleep for 5 nights then 2 days of ad libitum weekend recovery sleep). Each condition began with 3 in-laboratory baseline nights of 9h sleep/night. PSG was recorded and analyzed by standard methods and power spectral analyses were performed for C3, F3, and O1 brain sites.
Results: Beyond increases in delta during sleep restriction and recovery sleep ($p<0.05$), we observed: significantly higher theta at the beginning of the night during sleep restriction and later in the night during recovery sleep in all brain sites ($p<0.05$); lower alpha later in the night in F3 and C3 during sleep restriction, whereas there was lower alpha at the beginning of the night during weekend recovery and higher alpha later in the night in F3. We also observed lower sigma power during sleep restriction for all brain sites, especially F3, and higher sigma power later in the night during weekend recovery in F3 and O1. Lastly, lower beta power was observed especially at the end of the night during sleep restriction in all bran sites ($p<0.05$), with no significant changes in beta during weekend recovery.
Conclusion: Sleep restriction and weekend recovery sleep alter EEG activities across the entire delta to beta range, with evidence of similarities and differences across brain regions. Our findings that EEG changes during sleep restriction and recovery sleep extend beyond the delta band has implications for understanding sleep homeostatic and recovery processes.
Support (If Any): R01 HL109706 and TR001082.

0088

RELATIONSHIPS BETWEEN SLEEP DISORDERED BREATHING AND CENTRAL AORTIC PRESSURE IN A COMMUNITY BASED POPULATION: THE TOON HELATH STUDY

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Introduction: Sleep-disordered breathing (SDB) has been developed as one of the risk factors for cardiovascular diseases. Recent studies suggest that central aortic pressure (CAP) could be a better predictor of coronary heart disease than brachial cuff blood pressure. However few population-based observational studies have shown the association between SDB and CAP. Thus, the objective of this study was to examine the association between SDB and CAP, using respiratory disturbance index (RDI) and snoring severity as an index of SDB.
Methods: This cross-sectional study was conducted in the Toon Health Study between 2009 and 2012. The total number of 932 Japanese women and men aged 30 to 79 years were included in the analysis, excluding persons with missing values for RDI, CAP, snoring, and persons with history of hypertension, coronary heart disease, and stroke. RDI was estimated with one night sleep test using an airflow monitor. Subjects were grouped into 3 categories according to the levels of RDI: low (<10), moderate (10–20), high (>20). Snoring severity was estimated using a Berlin questionnaire, and subjects were grouped into 3 categories according to the levels of snoring: habitual snorers (snores nearly everyday, or 3–4 times a week), occasional snorers (snores 1–2 times a week, 1–2 times a month or nearly never), non-snorers (doesn't snore). The CAP was measured using the HEM-9000 AI device, an automated

tonometer. The association between RDI levels/snoring severity and CAP were analyzed using analysis of covariance and regression model.
Results: The persons with higher levels of RDI/habitual snoring tended to be male and to have higher BMI. Multivariable adjusted mean of CAP was significantly increased as the levels of RDI increased. (low:127.93mmHg, moderate:130.34 mmHg, high:132.43 mmHg, p for trend:0.01). However, the association was no longer significant after adjusted for BMI. Multivariable adjusted mean of CAP was significantly increased among snorers and it remained significant after adjusted for BMI. (habitual snorer:130.76 mmHg, occasional snorer:130.87 mmHg, non snorer: 127.58mmHg, p for difference:0.04).
Conclusion: RDI was associated with CAP through BMI, whereas snoring severity was independently associated with CAP.
Support (If Any):

0089

NOCTURNAL INTERMITTENT HYPOXIA AND CAROTID-ARTERY ATHEROSCLEROSIS IN A GENERAL JAPANESE POPULATION: THE TOON HEALTH STUDY

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Introduction: Sleep-disordered breathing (SDB) is one of the potential risk factors for cardiovascular diseases. However, few studies have indicated the association of SDB and carotid-artery atherosclerosis. In this study, we examined the relationship between nocturnal intermittent hypoxia, a surrogate marker of sleep disordered breathing, and Carotid-artery intima-media thickness (IMT), an early finding of atherosclerosis, in middle-aged and elderly Japanese population.
Methods: The participants were 690 men and 1249 women aged 30–79 years in the Toon Health Study between 2009 and 2012. Nocturnal intermittent hypoxia was assessed by 3% oxygen desaturation index (ODI) during one-night using pulse-oxymetry. Subjects were divided into 3 categories according to the levels of 3% ODI: low (<5 times/hour), moderate (5–15 times/hour), and high (>=15 times/hour). Carotid-artery intima-media thickness (IMT) was measured by using ultrasonography. Carotid-artery atherosclerosis was diagnosed according to the IMT of >=1.1. Multivariable logistic regression analysis was performed to assess the association between 3%ODI and atherosclerosis after adjusting for potential confounding factors.
Results: Higher 3% ODI was significantly associated with having atherosclerosis in men, but not significant in women. Compared to low 3% ODI, the multivariable adjusted odds ratios (95% CIs) were 1.41 (0.86–2.30) in moderate, and 1.85 (1.01–3.39) in high among men. The multivariable adjusted odds ratios of having atherosclerosis associated with the level of 3%ODI were more evident among BMI of >=25.
Conclusion: Our results indicated that the severity of nocturnal intermittent hypoxia is independently associated with atherosclerosis in middle-aged and elderly Japanese men.
Support (If Any):

0090

A MOUSE MODEL OF SLEEP APNEA REVEALS A KEY ROLE FOR LEPTIN IN THE PATHOGENESIS OF DISORDERED BREATHING

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Introduction: Sleep apnea is highly correlated with obesity and neck circumference. This observation has led many to conclude that the physical weight of fat around the airway leads to restriction and apnea. However, recent evidence implicates obesity-related physiology, including the role of leptin, in the pathogenesis of sleep apnea. Here we determine how leptin signaling within the periaqueductal gray (PAG) affects baseline ventilation and the ventilatory response to hypercapnia (HCVR) using a mouse model.
Methods: To ablate leptin receptors specifically within the PAG, we used a local injection of an adeno-associated virus that drives cre-expression in LepR floxed mice. To drive leptin receptor (LepR) neurons within the PAG, we used LepRcre/L10 mice locally injected with a cre-inducible DREADD hM3dq virus.
Results: Ablating leptin receptors within the PAG leads to tachypnea, as demonstrated by an increased breathing frequency and shorted expiration times. Similarly, driving LepR neurons within the PAG leads to tachypnea but also results in a significant decrease in HCVR.
Conclusion: Using this model, we find that leptin signaling within the PAG can alter respiration and respiratory drive. Taken together with our previous findings, these data suggest a neuronal component to disordered breathing independent of physical body weight.
Support (If Any): NIH-NIDDK: DK082480-01 (D.Sandoval) and DK093848-01 (R.Seeley).

0091

WHAT CHARACTERIZES THE COMBINATION OF SEEKING MEDICAL HELP FOR INSOMNIA AND SNORING IN TERMS OF PSG AND METABOLIC PARAMETERS?

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Introduction: Insomnia and snoring are sometimes occurring in combination, but rather little is known about their interaction with respect to polysomnography (PSG), subjective sleep quality and metabolic parameters.
Methods: We used a representative set of data of 328 women with one night of in-home PSG. In this set we identified those individuals who had sought medical help for sleep problems (insomnia), and those that had sought help for snoring. Crossing these dimension yielded 4 groups: Good sleepers (Controls, N=250), Insomniacs without snoring (N=40), Snorers with good sleep (N=16) and Snorers with insomnia (N=22). A two-factor analysis of variance was applied to the data (Snore status vs Insomnia status).
Results: The results showed significant main effects and interaction for N1%. The highest level was seen for Snorers with insomnia. The same result was seen for AHI/h, and the highest level was seen in Snorers with insomnia (mean AHI=25 vs 8–10 for the others). Again, a similar result was seen for prediabetes (Impaired f-glucose), triglycerides, and the LDL/HDL ratio. N2% and N3% decreased with Insomnia, and awakenings/h increased (no effect of snoring). Reported sleep quality and alertness decreased in insomnia with or without snoring.
Conclusion: It was concluded that individuals who had sought help for *both* insomnia and snoring showed worse PSG sleep, AHI-levels and metabolic profile.
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0092

INFORMATION PROCESSING DURING SLEEP AND SLEEP MISPERCEPTION IN INSOMNIA: AN ERP STUDY.

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Introduction: Hyperarousal is linked to sleep misperception, which is especially present in paradoxical insomnia (PARA-I). ERP studies showed that hyperarousal can be expressed through enhanced

information processing, which is different between PARA-I and psychophysiological insomnia (PSY-I). Our objective is to use ERPs to investigate the link between misperception and information processing. Specifically, N1 (vigilance) and P2 (inhibition) were chosen for information processing and sleep onset latency (SOL) and wake after sleep onset (WASO) were used for misperception. Our hypothesis is that the link between misperception and information processing will be stronger for PARA-I than for PSY-I and good sleepers (GS).

Methods: 50 GS (age 34.7±9.0), 40 PSY-I (40.9±9.1) and 29 PARA-I (39.41±9.2) underwent four PSG nights. Subjective and objective sleep measures were obtained for SOL and WASO. ERPs were recorded all night on Night 4 (oddball paradigm). A linear mixed model including 3 within-subject factors (peak, N1 and P2; auditory stimuli, standard and deviant; recording time, S2E, S2L, SWS, REM), 3 between-subject independent factors (group, GS, PARA-I, PSY-I; SOL and WASO misperception, over, good, under) was computed on amplitude data at Cz. Misperception was calculated as the difference between subjective and objective measures.

Results: Results revealed no differences between groups for information processing ($p = 0.451$). However, the interaction effect group x peak, ($p=0.004$), showed that P2 was higher in PARA-I. There was no moderator effect of group on the link between misperception and hyperarousal ($p=0.769$, $p=0.440$).

Conclusion: A higher P2 in PARA-I would indicate that they need to deploy more energy to inhibit information processing, which would explain their greater misperception. Knowing that hyperarousal is a 24-hour problem, daytime ERPs should be investigated in connexion with sleep misperception. No group moderation effect means that the link between misperception and hyperarousal stays stable across sleep types. Consequently, mechanisms linking sleep misperception and hyperarousal appear similar for each group.

Support (If Any): -

0093

CHANGES IN DISTAL TO PROXIMAL SKIN TEMPERATURE GRADIENT DURING 4 DAYS OF SIMULATED MICRO-GRAVITY

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Introduction: Previous findings show space flight negatively impacts sleep quality. Head-down tilt bed rest (HBTBR) is a physiological analog for simulating micro-gravity experienced during space-flight. Prolonged micro-gravity presents a physiological challenge as blood pools in the thoracic region. Potentially, this may alter thermoregulatory changes that are intimately linked with sleep (e.g., increases in distal skin temperature and associated narrowing of the distal-proximal gradient [DPG] in response to increased blood flow to the periphery). To our knowledge, the relationship between this redistribution of blood stemming from simulated micro-gravity and the DPG remains unknown. Here, we examined the effect of 4 consecutive days of HDTBR on the DPG across the sleep episode.

Methods: Eight healthy recreationally active males, [21±3 years (mean±SD)] completed an ambulatory week with 8h per night sleep opportunities, followed by a five day in-laboratory protocol -consisting of a baseline night and 4 consecutive days of HDTBR. Throughout the study, we collected DPG during the sleep episodes using skin temperature sensors placed on the non-dominant side of the body -palmar side of the foot and beneath the clavicle. DPG was calculated using the formula: $\text{temperature}_{\text{foot palmar}} - \text{temperature}_{\text{infra-clavicular}}$.

Results: Mixed-model ANOVA showed a significant effect of study day ($p<0.05$). Planned comparisons showed that the DPG was significantly higher on the first night of HDTBR in the first quarter of the sleep episode ($p<0.05$), leading to a more positive DPG score. No significant differences were observed comparing other days of HDTBR, which was impacted in part by data loss for some subjects.

Conclusion: Findings indicate that simulated microgravity, using HDTBR, acutely alters the DPG during the first night. Additional research is needed to determine the physiological mechanisms underlying the altered DPG observed during HDBTR, any physiological adaptations across days, and potential impacts on sleep and waking function.

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0094

SLEEP MODULATION IN CONTROL AND EPILEPTIC MICE THROUGH AMBIENT TEMPERATURE REGULATION

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Introduction: Sleep is altered in most neural disorders including Alzheimer's, Parkinson's, and epilepsy. This may present as reduced sleep depth, alterations in rapid eye movement sleep (REM) and non-REM sleep (NREM), and other phenomena. In epilepsy, poor sleep can trigger seizures, which further disrupt sleep. We speculate that improving sleep quality could alleviate seizures. To this end, we characterized the effects of acute changes in cage temperature *Ta* on sleep in a mouse model of chronic epilepsy.

Methods: With IACUC approval, adult male C57BL/6 mice (n=4) were injected with pilocarpine to induce chronic epilepsy; unimplanted mice (n=10) served as controls. After spontaneous seizures were documented, each animal was instrumented for EEG/EMG monitoring. A thermostatic system elevated *Ta* to 30°C in the light period (0700-2100) on alternate days for 3–4 weeks with reversal to baseline (23°C) at other times. Control mice were exposed to 23°C and 30°C on different days. Vigilance state was scored in 4s epochs as Wake, REM, or NREM; NREM was further divided into light and deep sleep. Seizures were detected from the EEG. Sleep metrics were estimated and compared for elevated *Ta* versus baseline.

Results: Control mice spent more time in NREM and REM and less in Wake at higher *Ta* ($p<0.05$); NREM bouts were less frequent but longer in the mean. Likewise, epileptic mice spent more time in NREM and less time in Wake ($p<0.05$) at higher *Ta*; however NREM bouts were more frequent ($p<0.001$). Deep sleep increased significantly in epileptic mice but not in controls. Thus, total sleep increases with *Ta* in control and epileptic mice, except NREM becomes more fragmented in epileptic mice but with more deep sleep. Seizures decreased with *Ta* in two animals but increased for the other two; neither change was significant.

Conclusion: Ambient temperature may have distinctive effects on sleep architecture and seizures in epileptic mice. Ongoing work investigates strategies for dynamic sleep modulation, which could serve as adjunctive therapy for epilepsy.

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0095

THE EFFECTS OF EVENING ELECTRONIC DEVICE USE ON SLEEP IN HIGHLY TRAINED ATHLETES

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Introduction: Sleep is considered one of the most important components of recovery for athletes, and sleep optimisation may assist athletes in achieving peak performance. Currently, it is thought that sleep quality and quantity are negatively affected by electronic device use (e.g. laptops, smartphones, televisions), but the mechanism underlying this relationship is unclear. This study aimed to investigate the influence of different types of tasks (i.e. puzzles vs. reading) performed with or without an electronic device (tablet) on pre-sleep alertness and sleep quality.
Methods: Eight highly-trained netball players attended a sleep laboratory for pre-sleep testing and polysomnographic sleep monitoring on five separate occasions (1 familiarisation and 4 experimental sessions), each conducted at least one week apart. During the 2 h prior to bedtime in each experimental session, athletes completed cognitively stimulating tasks (puzzles) or passive tasks (reading) administered with or without an electronic device (tablet). The order of task administration was randomised. Sleep measures were obtained from polysomnography and questionnaires; melatonin concentration was measured via saliva samples. Sleep measures were compared using repeated measures ANOVA. Effect sizes were calculated using Cohen's d statistic.
Results: The increase in melatonin concentration was significantly greater after reading compared to completing puzzles on a tablet ($p=0.02$), but was not different between any other conditions. A moderate-large effect size indicated that perceived sleepiness tended to be greater after reading compared to completing puzzles without a tablet ($d=0.80$), but not with a tablet. There were no significant differences in sleep duration, sleep onset latency, wake after sleep onset, sleep efficiency or percentage of time spent in each stage of sleep between any of the conditions.
Conclusion: These data suggest that using a tablet for 2 h prior to sleep does not negatively affect subsequent sleep in athletes. Further research is required to better understand the relationship between evening electronic device use and sleep.
Support (If Any):

0096

TEMPORAL VARIATION OF TRANSPORTATION NOISE DURING SLEEP IMPACTS ON GLUCOSE METABOLISM

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Introduction: Intermittency ratio (IR) has been proposed as a new metric to reflect the effects of transportation noise exposure on health. IR takes the frequency distribution of events into account. Since nocturnal transportation noise has been linked to higher risk of incident type 2 diabetes, we investigated the short-term effect of IR during sleep on glucose metabolism.
Methods: Twenty-three young volunteers (age: 19-33y; BMI: 18.5–25; 11 females) participated in a six-day laboratory study starting with a noise-free baseline night (BL) followed by four nights with night-time noise scenarios (NN2-NN5) differing in IR (LowIR: distant highway, dense traffic vs. HighIR: short distance, residential street or railway line) with a constant hourly Leq of 45 dB(A) at the ear of the sleeper. The study ended with a noise-free recovery night (RC). Carbohydrate metabolism was assessed during an oral glucose tolerance test conducted upon awakening in the mornings of BL, NN5 and RC.
Results: Post-charge glucose levels (AUCglc) increased after four nights of nocturnal transportation noise compared to BL ($+12 \pm 3\%$; $p=0.004$ for LowIR on NN5 (LowIR_NN5) and $+16 \pm 3\%$; $p=0.0003$ for HighIR on NN5 (HighIR_NN5)). After one recovery night AUCglc returned to baseline levels in the case of LowIR_NN5, while it stayed higher for HighIR_NN5 (BL-RC: $p=0.0004$). Sleep macrostructure did not significantly change across the noise nights compared to BL. However, the percentage increase in arousals was $31 \pm 12\%$ ($p<0.036$) for the HighIR_NN5 and only $7 \pm 8\%$ (NS) for the LowIR_NN5 compared to BL.
Conclusion: Four nights of nocturnal traffic noise impaired glucose tolerance in lean young volunteers - an effect that disappeared after one recovery night in the LowIR but not in the HighIR condition. In addition, sleep was more fragmented in the HighIR compared to the LowIR condition. Thus, short-term effect of nocturnal HighIR noise is more deleterious for sleep and glucose metabolism than LowIR.
Support (If Any):

0097

SPINDLE DENSITY PREDICTS AROUSABILITY FROM ACOUSTIC STIMULATION DURING SLEEP

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Introduction: Nocturnal transportation noise can disturb sleep by causing awakenings, sleep-stage changes or EEG arousals. However, not all external acoustic stimuli disrupt sleep. Processing of stimuli is modulated by transient EEG rhythms during sleep such as sleep spindles where sensory relay is hindered at a sub-cortical level. Thus, we investigated whether sleep spindle density rhythms predict arousability from acoustic stimulation (noise) during sleep.
Methods: Twenty-six healthy participants (age: 19-33y, 12 female) were exposed to 80 railway noise events (RNE) that were played back in regular intervals during an 8-h night. For this, ten pre-recorded noise events were used, that differed with respect to maximum sound pressure level (SPL), event duration (SPL above 35 dB(A)), and slope of the SPL. Polysomnography and SPL of the noise events were recorded simultaneously during the night. Sleep and EEG arousals were scored according to standard criteria. Spindles on central channels were detected in EEG arousal and artefact free parts of sleep (NREM stages 1, 2 and 3) using an automatic scoring algorithm (http://spisop.org). Single RNE's that occurred during stage 2 sleep were post-hoc classified as Non-arousal or Arousal trials depending on whether an EEG arousal occurred during the particular event duration.

Results: Depending on the noise event type, 12–48% of all RNE's were associated with an EEG arousal that occurred particularly during the part of rising SPL (between the event onset and the maximum SPL). The mean spindle density during this period was a significant predictor in a logistic regression model (chi-square = 87.9, $p < .001$ with df = 2). The lower the mean spindle density, the higher was the arousal probability.
Conclusion: We gained evidence that arousability from noise during sleep is modified by the spindle density during the part of rising SPL of a railway noise event. Whether acoustic stimuli themselves can trigger sleep spindle occurrence in humans remains to be investigated.
Support (If Any):

0098

BASAL FOREBRAIN PARVALBUMIN NEURONS CONTROL THALAMIC RETICULAR NEURONS: AN OPTOGENETIC STUDY INVESTIGATING SPINDLES AND NREM SLEEP REGULATION

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Introduction: Spindles are EEG oscillations (12-15Hz humans, 8-15Hz rodents) that occur during non-REM (NREM) sleep. Recent studies in schizophrenia (Sz) patients showed consistent evidence for sleep spindles abnormalities (number/intrinsic frequency) and an association with cognitive deficits. Spindles originate in the thalamic reticular nucleus (TRN). A major, likely inhibitory input comes from wake-promoting basal forebrain (BF) PV neurons, as these neurons project extensively into TRN. Thus, here we used optogenetic techniques to investigate whether BF PV neurons control TRN neurons and in doing so modulate spindles and/or NREM sleep.
Methods: AAV-ChR2-EYFP (excitation) were bilaterally injected into BF of PV-Cre mice. Optical stimulation of BF PV fibers in TRN was performed to study the effects on spindles and NREM sleep. Sleep-wake activity (EEG/EMG electrodes) and TRN single-units (microwire assembly) were recorded in freely moving mice. Excitation was induced by 473nM bilateral laser illumination and was compared with no illumination in the same animal. A custom-designed script (Spike2/Matlab) was used to detect/verify individual spindles (10-15Hz), allowing analysis of spindle density (spindles/min) during NREM.
Results: Single-unit recordings showed TRN neuron discharge during spindle was inhibited by optogenetic activation BF PV cells. Bilateral ChR2 excitation (5s/min 40Hz; 6hrs) of BF PV neuron terminals in TRN (N=11) produced increased wakefulness (+16%; $p<0.05$), decreased NREM (-7%; $p<0.05$) and REM sleep (-11%; $p<0.05$). Excitation of BF PV fibers also produced an immediate cessation of spindles followed by a strong rebound resulting in an overall increase (+6%; <0.05, vs. sham stimulation) in the spindle density. This effect was similar to direct ArchT inhibition of TRN PV neurons (N=7).
Conclusion: These data suggest BF PV neurons promote wakefulness and suppress spindles through projections to TRN neurons. Hence, BF PV neurons may provide a potential target for pharmacologic manipulation to increase spindles in disorders such as Sz.
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0099

INFUSION OF A PURINERGIC P2 RECEPTOR AGONIST INTO THE BASAL FOREBRAIN BY REVERSE MICRODIALYSIS ATTENUATES HOMEOSTATIC SLEEP REBOUND

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Introduction: Adenosine triphosphate (ATP) is an important glio and neuro-transmitter in the brain. ATP acts directly on P2 purinergic receptors (P2Rs) and indirectly on P1 receptors following breakdown to adenosine. While adenosine's role in sleep-wake control has been extensively investigated, the effects of ATP, acting on P2Rs, have been largely neglected. The basal forebrain (BF) is a key node of the ventral ascending activating system, and strongly implicated in sleep homeostasis. Our previous *in vitro* data suggested strong excitatory effects of P2-receptor activation on BF wake-promoting neurons. Therefore, here we investigated *in vivo* whether selective P2-receptor activation in BF could attenuate homeostatic sleep rebound.
Methods: Reverse microdialysis was used to infuse drugs into BF in freely-moving mice. Sleep-wake states were recorded with electroencephalography (EEG) and electromyography (EMG). Adult Swiss-Webster male mice with microdialysis cannulae targeting BF bilaterally and implanted with EEG/EMG electrodes were sleep-deprived for 4 hours (ZT1-5) using a gentle handling protocol which included presentation of new objects into the cage and gentle touching of the animals by a brush when animals attempted to sleep. A P2 receptor agonist (ATP-γ-S) which cannot be hydrolyzed to adenosine was used to selectively activate P2Rs.
Results: Three-hour bilateral infusion of 1mM ATP-γ-S into BF following acute sleep deprivation produced an increase in % time in wakefulness compared to ACSF infusion (ATP-γ-S vs. ACSF: 44.8 ± 7.35% v.s. 32.3 ± 4.6%, p=0.027, n = 4).
Conclusion: Our data suggest that application of a selective P2R agonist into the BF attenuates recovery sleep after an acute sleep deprivation and can override the sleep-inducing effects of adenosine, presumably by direct excitation of wake-promoting neurons. P2Rs on BF neurons may be interesting targets for the development of novel pharmacological agents to prevent sleepiness in sleep-deprived individuals.
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0100

LATERAL HYPOTHALAMIC HYPOCRETIN AND NON-HYPOCRETIN NEURONS ACTIVATE PARALLEL AROUSAL PATHWAYS

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Introduction: Until recently, hypocretin (HCRT) neurons were the only verified wake-promoting neurons in the lateral hypothalamus (LH). Lately, optogenetic and chemogenetic excitation of GABAergic

hypothalamic neurons has been shown to induce arousal. Whether HCRT and non-HCRT cells interact in wake promotion is unknown.
Methods: To determine the relative roles of HCRT and non-HCRT LH cells in wakefulness, we bilaterally injected orexin-tTA mice with a leaky Tet-O-hM3Dq AAV that, in presence of doxycycline (DOX), transfected only 10% of HCRT neurons as well as non-HCRT neurons. Three weeks after removal of DOX, 40% of HCRT neurons were transfected and the non-HCRT transfection remained. This preparation allowed us to activate non-HCRT LH neurons with or without HCRT neuron coactivation. To determine the role of HCRT vs. non-HCRT neurotransmission in chemogenetically-evoked arousal, clozapine-N-oxide (CNO, 3mg/Kg ip) or saline was injected 1h after the dual orexin receptor blocker Almorexant (ALM, 200 mg/Kg, ip) or vehicle at ZT5.
Results: In all conditions, hM3Dq activation of LH cells induced nearly 100% wakefulness during the first hour post-injection. When both HCRT and non-HCRT neurons were activated, mice remained awake close to 100% of the time for >3 h. In contrast, when fewer HCRT neurons were transfected or when HCRT neurotransmission was blocked, the arousal effect gradually decreased after the 2nd h after dosing over a similar time course.
Conclusion: Excitation of non-HCRT hypothalamic neurons has a strong wake-promoting effect even after HCRT blockade but concomitant excitation of HCRT neurons provides further consolidation of Wakefulness. Consequently, HCRT and non-HCRT LH cells appear to activate parallel arousal pathways.
Support (If Any): 1R01NS077408, NIH/NINDS.

0101

MUSHROOM BODY GAMMA LOBE ACTIVITY REDUCES AROUSALS THRESHOLDS AND SLEEP THROUGH PROTEIN KINASE A

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Introduction: One of the canonical aspects of sleep is decreased responsiveness to sensory stimuli from the outside world, due to an elevated arousal threshold. Even though sensory responsiveness is reduced during sleep, the brain is not fully disconnected from sensory input. Instead, sensory input is filtered and only the most salient stimuli are allowed to pass this filter and penetrate into the sleeper's awareness, rousing them from sleep. How does the brain modulate this filter?
Methods: Here we use the fruit fly *Drosophila melanogaster* to address this question. The mushroom body consists of three major subdivisions: the α/β-lobe, α'/β'-lobe and the γ-lobe and are thought to have evolved from a common structure as the mammalian cerebral cortex. We used genetic tools to depolarize or hyperpolarize gamma lobe neurons and used video tracking and activity monitoring to measure how this affected sleep and arousal thresholds.
Results: Excitation of mushroom body gamma lobe neurons decreases both arousal thresholds and sleep while inhibition of this region has the opposite effect. Importantly, gamma lobe activity alters the response to both photic and mechanical stimuli, suggesting a central role in setting arousal thresholds. Neither sleep homeostasis nor learning and memory were affected by these manipulations, suggesting that these neurons play a discrete role in regulating sensory responsiveness. Additionally, we show that the gamma lobe regulates both sleep and central arousal thresholds through Protein Kinase A signaling.
Conclusion: Here we demonstrate how a specific region in the *Drosophila* mushroom body - the gamma lobe -modulates arousal thresholds and sleep. The mushroom body gamma lobe has previously been shown to be involved in sensory gating during learning as well as salience-based decision making. These studies reveal the neural basis for the central control of arousal in *Drosophila*.
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0102

BASAL FOREBRAIN PARVALBUMIN NEURONS PROMOTE SHORT-LATENCY AROUSALS AND WAKEFULNESS IN MICE

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Introduction: Cortically-projecting basal forebrain (BF) GABAergic parvalbumin (PV) neurons discharge at a high rate during wakefulness and regulate cortical gamma band (~40 Hz) oscillations associated with feature binding, attention and consciousness (Kim et al., 2015). These neurons are excited by acetylcholine and may mediate the arousal effects of BF cholinergic neurons (Yang et al., 2014; Zant et al., 2016). We hypothesized that input from BF-PV neurons to cortical-PV neurons would mediate a short-latency arousal when optogenetically stimulated since BF-PV neurons project directly onto cortical-PV neurons (Kim et al., 2015).
Methods: We injected PV-Cre mice (N=14) with double-floxed adeno-associated viral vectors expressing Channelrhodopsin2 (AAV-ChR2-EYFP) bilaterally into BF. 40Hz optogenetic stimulations (5s/min) of BF-PV neurons (blue laser 473nm, 20mW) were performed from ZT2-8 to evaluate during stimulation: (1) the latency to arousal from NREM-sleep; (2) frequency of NREM-Wake transitions; and (3) time spent in wake, NREM, and REM state. Time-matched mock-stimulation (laser-off) served as baseline (BL) control. The 'median' statistic (Mann-Whitney test) comparison was used because of the skewed, non-normal distribution of responses. Post-hoc immunohistochemistry confirmed transduction efficiency/selectivity and optical-fiber targeting within BF.
Results: The median latency for NREM-wakefulness transitions was significantly decreased for bilateral stimulation (BL 19.53 ± 1.0s (SEM); Stimulation 3.96 ± 0.7s, $p<0.001$; N=14). Of all NREM-Wake transitions, the majority of events occurred within 5s from the start of optical stimulation (BL 19.31 ± 1.9%; Stimulation 67.76 ± 4.8%; $p<0.05$). We observed that bilateral stimulations (N=14) significantly increased the time spent in wakefulness by 14.2 ± 3.4% ($p<0.05$), whereas NREM sleep decreased (-8.5%±2.5%; $p<0.05$), with no change in REM sleep.
Conclusion: Optogenetic stimulation of BF-PV neurons increased overall wakefulness and decreased the median latency for NREM-Wake arousals. Latencies were shorter than those associated with optogenetic stimulation of BF-cholinergic neurons (median:10.6s, Zant et al., 2016). Thus, our data suggests that BF-PV neuronal excitation causes rapid EEG arousal, likely due to fast cortical disinhibition elicited via direct innervation of the inhibitory interneurons.
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0103

REM SLEEP IS INDUCED BY DUAL AND OREXIN 2 RECEPTOR ANTAGONISTS VIA MECHANISMS BEYOND ALPHA1-NORADRENERGIC SIGNALING

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Introduction: Orexin receptor (OX1R, OX2R) antagonism induces sleep architecture characterized by increases in both NREM and REM reminiscent of unmedicated sleep. REM sleep is thought to be controlled in part by noradrenergic neurons of the locus coeruleus (LC), a site of selective OX1R expression. This work utilizes selective DORA and 2-SORA antagonists in combination with prazosin (alpha1-noradrenergic blocker) in genetic models to determine specific roles of OX1R and OX2R in sleep architecture changes induced by DORAs and 2-SORAs.

Methods: Sleep architecture was evaluated by polysomnography in preclinical animals (mice, rats, dogs, and rhesus monkeys) via radio-telemetry implants in across 3–5 days of drug administration. Stages of sleep were quantified with automated software modules evaluating ECoG, EMG, EOG (dog, monkey) data. Drug-induced sleep stage changes were correlated with receptor occupancy in transgenic rats expressing hOX2R at Cmax. A double-blind, randomized, 4-period crossover Phase I polysomnography study evaluated responses to single doses of 2-SORA, MK-1064, in twenty healthy male subjects.

Results: In rats, NREM and REM sleep induced by DORAs is statistically no different from un-medicated inactive phase sleep. Mouse genetic models indicate that OX2R primarily modulates orexin-induced arousal, while OX1R appears involved in vigilance state gating. Prazosin similarly augmented REM sleep induced by DORAs and 2-SORAs, however, indicating that noradrenergic signaling from the LC is not maximally inhibited by either treatment. In rats, sleep was induced by lower receptor occupancies of DORAs relative to 2-SORAs. Across mammals including humans, REM sleep was induced by MK-1064, a 2-SORA exhibiting 3000x binding selectivity for OX2R over OX1R.

Conclusion: DORAs promote sleep by attenuating arousal and reducing sleep stage threshold through mechanisms beyond alpha1-noradrenergic signaling of the LC. 2-SORAs promote REM sleep across mammals in a manner similar to DORAs and do not appear to measurably differentiate from DORAs in sleep architecture.

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0104

TEMPORALLY CONTROLLED CELL-SPECIFIC ABLATION OF MELANIN-CONCENTRATING HORMONE (MCH) NEURONS ATTENUATE NON-REM SLEEP IN MICE

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Introduction: Melanin-concentrating hormone (MCH) is a neuropeptide produced in neurons sparsely distributed in the lateral hypothalamic area. Recent studies have reported that MCH neurons are active during rapid eye movement (REM) sleep, but their physiological role in the regulation of sleep/wakefulness is not fully understood. To determine the physiological role of MCH neurons, we assessed sleep in MCH-tetracycline-controlled transactivator (tTA); tetracycline operator (TetO)-diphtheria toxin A (DTA) transgenic (TG) mice that enables temporal control of MCH neuronal ablation by cell-specific expression of DTA.

Methods: TG mice were fed with chow containing Dox (100 mg/kg) until 10 weeks of age. Then, Dox(+) chow was replaced with Dox(-) chow for another 4 weeks. Control mice received Dox(+) chow throughout the experimental period. These mice were chronically implanted with EEG and EMG electrodes for polysomnographic recording of sleep/wake states. The vigilance states were automatically classified by SleepSign ver.3 software. The number of MCH(+) neurons were assessed immunohistochemically.

Results: When 90% of the MCH neurons were ablated, NREM sleep amount was significantly reduced. On the other hand, no significant difference in REM sleep amount was observed. The EEG power spectra from both NREM and REM sleep of MCH neuronal ablated mice were indistinguishable from those of before ablation, suggesting that ablation of the MCH neurons does not affect the nature of basal cortical activity. Next, we assessed sleep profile in response to fasting in MCH neuron ablated mice. Their sleep response as well as the amount food intake during and after fasting (re-feeding) was mostly identical as control mice.

Conclusion: From our result, the main role of MCH neurons in the regulation of sleep is thought be the maintenance of NREM sleep. In spite of many reports suggested the role of MCH in the fasting condition, there were no significant differences in sleep response in MCH neurons ablation mice. Thus, MCH neurons have a minor role to regulate sleep in response to fasting.

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0105

EXTRACELLULAR DISCHARGE ACTIVITY PROFILES OF PARAFACIAL ZONE NEURONS ACROSS SLEEP-WAKE CYCLE IN RATS

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Introduction: Recent studies suggest that medullary parafacial zone (PZ) plays a role in sleep regulation. GABAergic/glycinergic neurons in the PZ express sleep-associated fos-immunoreactivity. Cell-body-specific lesions as well as genetic disruption of GABAergic/glycinergic transmission from PZ cause sustained waking and suppression of both nonREM and REM sleep, whereas, activation of these neurons increases nonREM sleep and suppresses both waking and REM sleep. The discharge activity profiles of PZ neurons across spontaneous sleep wake cycles, especially during transitions from waking to nonREM sleep and from nonREM to REM sleep are unknown. The present study determined the extracellular discharge activity profiles of PZ neurons across spontaneous sleep-wake cycle in freely behaving rats.

Methods: Adult Sprague-Dawley rats were surgically implanted with EEG and EMG electrodes for chronic recording of sleep-wake states. Five pairs of 20μm microwires were implanted through the barrel of a mechanical microdrive into the PZ for recording extracellular activity of PZ neurons across its dorsal-ventral extent. All recordings were conducted early in the light phase of a 12:12 light-dark cycle. Following

isolation of single units, the discharge activity was recorded through 3–5 sleep-wake cycles.
Results: Extracellular discharge activity profiles of 45 neurons in the PZ were recorded across sleep-wake cycle. Based on their nonREM/wake, nonREM/REM, and REM/wake discharge ratios and a minimum 25% change criterion, a majority of neurons (n=24) were sleep-active including neurons that exhibited increased discharge during both nonREM and REM, nonREM only, or REM sleep only. The nonREM/REM and nonREM-sleep active neurons exhibited sustained discharge during the entire nonREM sleep episode with only small changes during wake to nonREM sleep transitions. Wake-active neurons (n=13) constituted second largest neuronal group and included both wake-REM and wake-active neurons. State-indifferent neurons (n=8) constituted 18% of the recorded neurons.
Conclusion: Our preliminary findings show that a majority of neurons in the rat PZ are sleep-active. These sleep-active neurons, however, do not seem to anticipate transitioning of sleep-wake state. These findings are consistent with a role of the PZ in sleep regulation, especially its maintenance.
Support (If Any): VA Merit Awards, BX000936 (Alam), BX003520 (McGinty) and BX00155605 (Szymusiak), and R01 DA034748, BX001753 (Siegel).

0106

EFFECTS OF ACUTE KYNURENINE CHALLENGE ON SLEEP-WAKE ARCHITECTURE IN MALE RATS

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Introduction: Cognitive dysfunction is a negative consequence of sleep loss. The present study was designed to test the hypothesis that tryptophan metabolism via the kynurenine pathway may represent a key molecular link between sleep and cognition. Modest increases in the kynurenine pathway metabolite kynurenic acid (KYNA) result in cognitive impairments. By antagonizing N-methyl-d-aspartate (NMDA) and α7 nicotinic acetylcholine (α7nACh) receptors in the brain, KYNA impacts learning and memory. The association between KYNA and cognition is bolstered by animal studies wherein modest increases in brain KYNA cause a reduction in extracellular glutamate levels. As glutamate signaling is critically involved in cognitive function, sleep-dependent plasticity, and modulation of sleep, our current experiments were designed to test the hypothesis that increased KYNA impairs cognition by negatively impacting sleep quality.
Methods: Adult male Wistar rats were implanted with a telemeter that records electroencephalograms (EEG) and electromyograms (EMG). At the beginning of the light-cycle, zeitgeber time (ZT) 0, animals were treated with vehicle (day 1) and kynurenine (day 2; 100 mg/kg; i.p.), the direct bioprecursor of KYNA. Data recorded post-treatment were scored in 10-s epochs as wake, rapid eye movement (REM) sleep, or non-REM (NREM) sleep.
Results: During the 6-h long block when KYNA levels are significantly elevated (ZT0 to ZT6), total REM duration was significantly reduced and total wake duration was significantly increased after kynurenine treatment compared to vehicle treatment. There was no difference in total duration spent in NREM. Importantly, in the subsequent 6-h long block (ZT7 to ZT12), when KYNA levels are no longer elevated after acute kynurenine challenge, there were no significant differences in duration spent in any of the vigilance states. Taken together, kynurenine challenge reduced REM duration -27% from baseline and increased wake duration +23% from baseline. Additionally, kynurenine challenge significantly suppressed theta power during REM and significantly reduced delta power during NREM when compared with vehicle treatment.
Conclusion: Taken together, our results demonstrate that acute kynurenine challenge impacts sleep patterns and introduce KYNA as a novel molecular link between sleep impairments and cognitive dysfunction.
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0107

INCREASED GLOBAL FMRI SIGNAL VARIABILITY AFTER PARTIAL SLEEP DEPRIVATION: FINDINGS FROM THE STOCKHOLM SLEEPY BRAIN STUDY

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Introduction: Neural correlates of sleep deprivation are not fully understood and the difference between young and older adults in this regard has received little attention. We aimed to investigate the effect of partial sleep deprivation on resting state connectivity.
Methods: 30 younger (20–30 years) and 23 older (65–75 years) healthy participants underwent MR imaging after normal sleep and partial sleep deprivation (3 h sleep). We acquired two runs of eyes-open resting state functional magnetic resonance images. Participants were monitored with eye-tracking to ensure their eyes remained open during scanning.
Results: Global signal variability, defined as log-transformed standard deviation of average gray matter signal, was increased following partial sleep deprivation (0.16 [0.07, 0.24], p = 0.0004). In contrast to previous studies, we did not find that partial sleep deprivation inhibited connectivity in the default mode network, nor in other major networks investigated.
Conclusion: Sleep deprivation caused increased global signal variability. This novel finding should be confirmed using independent data. Our finding of no difference in default mode connectivity in the sleep deprived state, could possibly be due to stricter monitoring of participants' wakefulness compared to some earlier studies.
Support (If Any): This work was supported by Riksbankens Jubileumsfond, Fredrik and Ingrid Thuring's Foundation, and the Karolinska Institutet Strategic Neuroscience Program.

0108

INFLUENCE OF SLEEP DEPRIVATION ON EMOTION REGULATION STRATEGIES: AN EVENT-RELATED POTENTIAL STUDY

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Introduction: Sleep loss is suggested to affect emotion regulation but few studies directly examined it. The objective of this study was to examine the impact of sleep deprivation on the use of adaptive as well as maladaptive emotion regulation strategies. Reappraisal and distraction are commonly found to be effective emotion regulation strategies, while suppression is less effective or even maladaptive. The late positive potential (LPP) component of the event-related potential (ERP) is an established tool to index emotion regulation.
Methods: 53 young healthy adults participated in a 3-Day experiment. On Day 1, all participants were taught to apply the three emotion regulation strategies (reappraisal, distraction and suppression) and had a normal sleep night. On Day 2, they were randomly assigned to the Sleep Control group (SC group: $n = 26$, 20.30 ± 1.71 years) or

the Sleep Deprivation group (SD group: $n = 27$, 20.00 ± 1.71 years). After a well-rested sleep night (SC group) or 24-h sleep deprivation (SD group), the participants completed a computerized emotion regulation task on Day 3 morning, in which they were asked to regulate (reappraise, distract or suppress) or simply maintain the feeling towards unpleasant pictures, with electroencephalographic (EEG) recordings. The amplitudes of LPP at the central-parietal area (CPz) were calculated.

Results: A group (SC vs. SD) by condition (maintain vs. reappraise) interaction indicated that sleep deprivation significantly diminished the regulating effects of reappraisal on LPP amplitudes, $F(1, 36) = 4.76$, $p = .036$, $\hat{\eta} = .117$. Another group by condition (maintain vs. distract) interaction suggested that the regulating effects of distraction on LPP was only marginally affected by sleep deprivation with a smaller effect size, $F(1, 37) = 3.20$, $p = .082$, $\hat{\eta} = .080$. Suppression was ineffective in attenuating LPP in both groups, $p > .05$.

Conclusion: The results suggest that sleep deprivation may compromise the effectiveness of two adaptive emotion regulation strategies (i.e. reappraisal and distraction), particularly the strategy of reappraisal. This study was the first to provide electrophysiological correlates of the influence of sleep loss on emotion regulation.

Support (If Any): N/A.

0109

A NONINVASIVE ECG RECORDING IN INTACT MICE DURING SLEEP AND WAKE-SLEEP TRANSITION

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Introduction: Recently we attempted an ECG recording in intact freely-behaving mice by using a plate sensor that has multiple (15) gold-plated electrodes, on which mice can walk around freely, without the use of tether or telemetry system. Although the electrodes are a kind of dry electrode, we found that the ECG plate sensor detects ECG from mouse's footpads during sleep or even during wake-sleep transition probably because of the sweating from their footpads.

Methods: A mouse cage, in which the ECG plate sensor was mounted, was placed in a Faraday cage. Fifteen ECG signals of the ECG plate sensor were fed to a PC via a 15-channel amplifier and a 16-channel A/D converter with using Clampex7 (Axon Instruments) signal acquisition software. Mouse behavior was also recorded by a DVD recorder. Intact, wild-type C57BL/6J mice were simply put on the ECG plate sensor for the recording for about 2 hours.

Results: Although the ECG plate sensor could not detect ECG most of the period during active state, ECG signal appeared relatively stably during sleep state from 10 out of 12 mice examined; two mice did not fall asleep within 2 hours. The ECG appearance during sleep continued for a maximum of ~15 minutes and disappeared when they awoke. One mouse allowed us to record ECG from the period before sleep onset that appeared to be quiet waking state based on the images stored in the DVD recorder.

Conclusion: The physiological role of the sweating during sleep in mice is inexplicable because most of mammals including mice have eccrine sweat glands that are considered to be activated by sympathetic nerve activity in response to emotional stressors, to which mice would not exposed during sleep. Nonetheless, the finding of the sweating during sleep in mice that enables noninvasive ECG recording may provide us a new tool to investigate cardiac and autonomic nervous system activities during sleep and wake-sleep transition states.

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0110

AUTOMATED SLEEP STAGING USING BIG DATA FROM A CLINICAL SLEEP LABORATORY

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Introduction: Automated sleep staging has been previously limited by a combination of clinical heterogeneity and relatively limited sample sizes. We investigate the extent to which machine learning methods can utilize electroencephalogram features to approximate the performance of human experts when supplied with sufficient numbers of training cases, and to investigate how staging performance depends on the number of training nights, contextual information, model complexity, and imbalance between sleep stage proportions.

Methods: We analyzed full-night recordings from 2000 diagnostic studies separated into training (n=1000) and testing (n=1000) sets. Extreme learning machine (ELM) algorithm was based on features extracted from six EEG leads. A hidden Markov model was then applied to take into account contextual information. Cohen's Kappa statistic was used to evaluate agreement between algorithm output and human scoring.

Results: Staging performance improved with increasing numbers of training nights until saturation occurs (exceeding ~n=300) cases, beyond which point testing performance largely saturated. Performance was improved by accounting for contextual information, increasing model complexity, and adjusting the model training procedure to account for stage imbalance of stage percentage. The final testing performance was 0.68 as measured by Cohen's kappa. Automated staging was less accurate for epochs at stage transition points.

Conclusion: Training with a large dataset enables automated sleep staging that compares favorably with manual scoring by human-experts. Staging near transitions was less accurate, suggesting that automated algorithm performance may vary depending on the degree of pathophysiology present. Because testing was performed on a large and heterogeneous dataset, it is likely that these results will generalize broadly.

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0111

A POLYSOMNOGRAPHIC VALIDATION STUDY OF A NOVEL COMMERCIALLY-AVALIABLE MULTISENSORY SLEEP TRACKER

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Introduction: The wearables industry is producing novel devices claiming to measure sleep/wake state and, most recently, sleep stage composition, by using information from several bio-signals in addition to motion. We evaluated the validity of a multi-sensor sleep-tracker (the ŌURA ring) against polysomnography (PSG) in measuring sleep/wake states, "light sleep" (PSG-N1+N2), "deep sleep" (PSG-N3) and rapid-eye-movement (REM) sleep.

Methods: We compared standard PSG and ŌURA ring sleep data obtained from a single laboratory overnight in forty-one healthy adolescents and young adults (13 females; Age: 17.2 ± 2.4 years).

Results: ŌURA ring significantly underestimated PSG-N3 by about 20min, and overestimated PSG-REM sleep by about 17min ($p<.05$). It

showed no significant bias for sleep onset latency (SOL), total sleep time (TST), and all-night wake after sleep onset (WASO). The PSG-ŌURA differences for TST and WASO lay within the ≤30min a priori set clinically satisfactory ranges for 87.8% and 85.4% of the sample, respectively. PSG-ŌURA discrepancies for WASO were greater in participants with more PSG-defined WASO ($p<.001$). The ring position affected the magnitude of the PSG-ŌURA discrepancies for "light sleep" and REM sleep ($p<.05$), with greatest discrepancy when placed on the ring finger. Epoch by epoch analysis indicated that the ŌURA ring had a sensitivity (ability to detect sleep) of 96%, specificity of 48% (ability to detect wake), agreement of 65% in detecting "light sleep", agreement of 51% in detecting "deep sleep" and agreement of 61% in detecting REM sleep, relative to PSG. Importantly, similarly to PSG-N3 ($p<.001$), "deep sleep" detected with the ŌURA ring was negatively correlated with advancing age ($p=.001$), showing the ability of the device to capture a well-established effect in the literature. Finally, the percentage of participants the ŌURA ring correctly categorized into PSG-defined TST ranges of <6h, 6-7h, >7h were 90.9%, 81.3%, and 92.9%, respectively.

Conclusion: The ŌURA ring showed the potential for detecting sleep outcomes beyond "sleep" and "wake" by using multiple sources of information in addition to motion, including heart rate variability and pulse wave amplitude. The potential and reliability of a multisensory approach in assessing sleep stages needs to be further explored.

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0112

AUTOMATIC DETECTION OF SLEEP SPINDLES IN SIMULTANEOUSLY ACQUIRED EEG-FMRI DATA

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Introduction: Sleep spindles play an important role in memory and cognition, and have complex spatial properties that are not well understood. Simultaneous EEG-fMRI has the potential to identify local neural activity underlying sleep spindles. Past work has developed automated spindle detectors that can compare to a "gold standard," i.e. human experts, to enable quantitative study of sleep spindles. However, these methods have been used primarily on EEG datasets, as it is difficult to detect spindles in combined EEG-fMRI experiments due to artifacts induced by the MR environment. In this study, we compare an automated method for detecting sleep spindles in EEG and combined EEG-fMRI data.

Methods: Raw and sleep-scored EEG data were obtained from 6 subjects in the preexisting DREAMS Sleep Spindles Database. 256-channel EEG-fMRI data was collected from 2 subjects in a 3T scanner and then sleep scored. Stage 2 EEG data was filtered using a 10–15 Hz bandpass filter and subjected to a Hilbert transform to estimate instantaneous amplitude. Spindles were detected by locating peaks that were above a set threshold (mean plus 1 standard deviation), and then compared to spindles detected manually.

Results: We found that sleep spindles in the DREAMS database were detected with 55% sensitivity and 43% precision. Using EEG-fMRI data, we detected sleep spindles with 54% sensitivity, but only 26% precision. When the threshold was increased to mean + 2 s.d., sensitivity decreased to 30% while precision increased to 31%, demonstrating that precision was lower even when using a more stringent threshold.

Conclusion: While the sensitivity of the spindle detector was not affected in EEG-fMRI data, its precision decreased, suggesting that MR-induced artifacts may increase 10–15 Hz power and cause spurious EEG events. Future work will address artifact cleaning approaches to improve these results. Since the detector was able to find spindles in EEG-fMRI data, it can next be used to find neural activity correlated with spindles.

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0113

STRUCTURE OF ELECTRODERMAL RESPONSES DURING SLEEP

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Introduction: Spontaneous electrodermal responses (EDRs) during sleep, or sleep storms, have been observed since the 1960s. With results counter-intuitive to an emotional arousal interpretation, these studies have found that sleep storms occurred most frequently during slow wave sleep and least frequently during REM sleep. However, little is known about the sleep EDR structure. We used the state-space generalized linear model (SSGLM) to investigate the structure of EDRs during sleep.

Methods: Eleven individuals (10 male) wore two sensors to capture actigraphy and electrodermal activity and reported their sleep timing via online surveys for 30 days. The EDRs during sleep (sleep was determined by actigraphy and surveys) for each participant were modeled using the SSGLM using the Kolmogorov-Smirnov test. This approach allowed us to model the rate of EDRs during different time periods during sleep. Using Monte-Carlo techniques, we computed a comparison between EDR event rates between pairs of time periods during sleep, without needing to correct for multiple comparisons. Previous work found that periods of high frequency EDRs were most probable in the first half of the night; thus, we chose to compare the first two 90min of sleep. In particular, we computed the probability that the rate during one period was greater than during another period within a night.

Results: When comparing the first two 90min of sleep, we found that for 8 of the 11 participants there were a high percentage of nights (>80%) where one of the two 90min periods had a significantly higher probability of being greater than the other. Furthermore, we found that 8 of the 11 participants had more days with the higher rates during the second 90min than the first.

Conclusion: Using the SSGLM provides a framework to compare the rates of EDRs during different time periods of the night. This work provides a baseline for what pattern of EDRs are typical in a healthy college-age population. The methodology can be extended to model EDRs during sleep in other populations and used to compare differences.

Support (If Any): This work was supported by the MIT Media Lab Consortium, NIH (R01GM105018), and Samsung Electronics.

0114

A PRINCIPLED QUANTITATIVE CHARACTERIZATION OF CONTINUOUS EEG DYNAMICS IN SLEEP CONTINUOUS EEG DYNAMICS IN SLEEP

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Introduction: Sleep has been shown to be a continuous and dynamic process in every physiological and behavioral system studied thus far. The ability to accurately describe these dynamics is therefore essential to understanding the way in which healthy and pathological

brain activity evolves during sleep. Although current clinical staging has been instrumental in important advances in sleep medicine, it artificially discretizes the continuum of sleep into 30-second epochs of fixed sleep stages. As such, this discretization disagrees with our understanding of sleep circuitry dynamics, and also fails to account for activity that does not into a single stage definition. Additionally, quantitative sleep electroencephalogram (EEG) analysis relying on spectral estimation is highly prone to "spectral bleeding", as an oscillation may not fall fully within a fixed canonical band or unrelated oscillations may enter. It is therefore vital to progress in our understanding of sleep and related pathologies that we develop accurate, objective methods to capture the full dynamic nature of sleep neurophysiology.

Methods: We describe a novel framework for more accurately characterizing the dynamics of multiple simultaneously-occurring oscillations within the sleep EEG. Given the time-frequency spectral representation of the sleep EEG, we estimate the peak frequency, power, and bandwidth of multiple oscillations (e.g. alpha, delta, sigma, theta) at each point in time. This is achieved by decomposing the EEG spectrogram into a series of time-varying parametric spectral basis functions.

Results: We present applications to simulated and experimental sleep EEG data, as well as to depth recordings from anesthetized rodents. In each case, the model robustly estimates the peak frequency, bandwidth, and power of each constituent oscillation more accurately than traditional bandpass methods. We also illustrate the ability to perform rigorous Bayesian statistical inference and goodness-of-fit analyses, not possible with traditional methods.

Conclusion: By developing a fully Bayesian framework for modeling EEG oscillation dynamics, we provide a pathway towards a statistically-principled, robust, flexible, and continuous characterization of brain dynamics during sleep, which is essential to characterizing the vast heterogeneity observed across both healthy and pathological populations.

Support (If Any): NINDS R01 NS-096177 (M.J.P.).

0115

STRIVING FOR A OBJECTIVE STANDARD: A DATA-DRIVEN APPROACH TO SPINDLE DETECTION AND CHARACTERIZATION

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Introduction: Sleep spindles are typically characterized as intermittent, oscillatory activity observed between 11-16Hz in electroencephalography (EEG) data. Accurate identification of spindles is valuable, not only to the identification of the stages of healthy sleep, but also to the characterization of disorders, such as schizophrenia, in which spindle activity and morphology is altered. Developing accurate spindle detectors has been challenging due to absence of an objective "ground truth" and reliance on the highly-variable results of visual scoring. Furthermore, automated spindle detectors are typically based on features of visually identified spindles, rather than principled analysis of the properties of the time-varying oscillations and their relationship to known correlates of spindle function. It is thus crucial to develop principled methods for establishing an objective, data-driven spindle definition, which would greatly facilitate our understanding of sleep dynamics as well as provide biomarkers of disease.

Methods: We propose a novel approach that uses the topography of the EEG spectrogram to identify and characterize spindles in the time-frequency domain. For each significant time-frequency peak found in the spectrogram, we compute a set of time-frequency features, which provides a high-dimensional description of that peak. By placing constraints on these features, we can select subsets of related spectral peaks. We explore several data-driven approaches to defining these constraints so as to identify and characterize the peaks corresponding to spindles.

Results: In this preliminary work, we analyzed EEG data from the DREAMS database with technician-scored spindles. We outlined a statistical framework for quantifying the distribution of peak features that are being scored by a given technician or automated method. These distributions can be used to evaluate inter- and intra-scorer consistency, as well as adherence to a given standard. We also developed an unsupervised learning framework for data-driven characterization of spindles, identifying clusters of related peaks, and illustrated how additional features robust to noise, such as coherence, can greatly facilitate spindle cluster separation.

Conclusion: This work provides strong proof-of-concept for a rigorous quantitative analysis and characterization of spindle properties, and paves the way for further experimental work.

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0116

ACTIVE ENSEMBLE LEARNING FOR EEG EPOCH CLASSIFICATION

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Introduction: Manual classification of epochs, such as for scoring of sleep and detection of artifacts and spindles, is time-consuming and expensive. Automated classification methods often exist but have limited accuracy. An *ensemble* of such automated classifiers can be used to boost overall accuracy. For acceptable accuracy, however, traditional ensemble learning methods require a large set of manually labeled samples for training. We have developed a novel Active Learning (AL) method that boosts classification accuracy of the ensemble by using only a small selective set of training samples.

Methods: A total of 8700 two-second EEG epochs (4.83 hours total) collected during three-minute eyes-open Karolinska Drowsiness testing episodes from nine healthy individuals were manually classified by a RPSGT as artifactual or non-artifactual. Six unique automated artifact detection algorithms, each with individual accuracy ranging from 80 to 91%, were used to form an ensemble input to our AL algorithm to classify the epochs. A set of training samples, totaling 10% of the epochs, was optimally selected using a novel iterative algorithm based upon a generative probabilistic model that results in use of each detector to its maximum capacity. Accuracy (epochs correctly classified/total epochs), false positive rates (FPR) and false negative rates (FNR) from this method were compared with that of eight traditional ensemble supervised/semi-supervised learning methods that used random sets of 10% epochs as training samples and five unsupervised ensemble methods.

Results: Our method achieved 97.5% accuracy, 0.5% FPR and 1% FNR, which was considerably better than the best traditional ensemble classifier tested (which was supervised, support vector machine based) that had 94.2% accuracy, 3.2% FPR and 3.5% FNR.

Conclusion: Our novel AL algorithm can be can used to enhance accuracy in detecting artifacts in EEG using an ensemble of automated detectors, none of which has high accuracy. Our algorithm is computationally simple and requires very few training samples. This method may be applied also to automated sleep staging or detection of sleep spindles and disordered breathing, where an accuracy boost of even 3% can lead to significant cost reduction.

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0117

GENETIC DISSECTION OF NEURAL PATHWAYS INVOLVED IN REM SLEEP REGULATION BY MELANIN-CONCENTRATING HORMONE NEURONS

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Introduction: Available evidence indicates that neurons containing melanin-concentrating hormone (MCH) in the lateral hypothalamus (LH) promote rapid eye movement (REM) sleep although the neural pathways and mechanisms mediating this function remain unclear. To test our hypothesis that MCH neurons promote REM sleep by inhibiting the 'REM-off' ventrolateral periaqueductal grey (vlPAG) and lateral pontine tegmentum (LPT), we selectively inhibited MCH terminals in the vlPAG/LPT while concurrently activating the MCH cell bodies in the LH and studied changes in sleep-wake.
Methods: We injected a mixture of two cre-dependent adeno-associated viral vectors (AAV) - one coding for the excitatory hM3 DREADD (AAV-hM3Dq-mcherry) and the other for the inhibitory opsin, ArchT (AAV-ArchT-GFP) into the LH of MCH-Cre mice. We then implanted the mice with EEG/EMG recording electrodes and optical fibers bilaterally targeting the vlPAG/LPT. Four weeks after the surgery, all mice were intraperitoneally (i.p.) injected with saline or CNO (control/stimulation of the MCH cell bodies expressing DREADDs, respectively) in conjunction with sham or yellow light (593.5nm) illumination (control/inhibition of MCH terminals expressing ArchT) using the implanted optical fiber targeting the vlPAG/LPT. Sleep-wake recordings were performed for 4hr following i.p injections and photo-inhibitions were applied after 30s of stable non-REM (NREM) sleep until the next wake period.
Results: We confirmed the co-expression of hM3 DREADD and ArchT in MCH neurons by labelling brain sections for GFP and mCherry. Activation of MCH neurons by CNO increased the number of REM sleep bouts by 55%. By contrast, photo-inhibition of MCH terminals in the vlPAG/LPT during baseline conditions (i.p. saline) and following activation of MCH cell bodies (i.p. CNO) significantly reduced REM bout numbers (by 52% and 60% respectively) when compared to sham inhibition, but did not alter the mean duration of REM bouts.
Conclusion: REM sleep regulation by MCH neurons may primarily be mediated by vlPAG/LPT.
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0118

DISTRIBUTION OF MCH NEURONS AND THEIR PROJECTIONS IN A CLARITY CLEARED MOUSE BRAIN

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Introduction: We are familiar with cutting tissue, such as the brain, on a cryostat or sliding microtome and then mounting the sections onto microscope slides for visualization under a microscope. The new approach is to make the tissue transparent, scan it with a light-sheet microscope, and then the software compiles a 3D image of the scanned images. The appeal of the new approach is that it allows visualization of the cellular network in the intact brain. This may yield new information that may not be readily evident from 2D images. We now use the advanced CLARITY method (Tomer *et al.*, 2014) to visualize the distribution of MCH neurons in 3D.
Methods: A mouse brain containing MCH-EYFP neurons was cleared and then equilibrated in media to allow light to pass through with little or no scattering. The transparent tissue was scanned (896 sheets in 3 um increments; hypothalamus) with a Zeiss LightSheet microscope, and the images were stitched to yield a final image.
Results: Viewing the MCH somata and their fibers in a single block of tissue revealed for the first time a pattern of MCH somata and projections: Some MCH somata project to anterior brain regions, while other clusters project to brainstem regions. This indicates a topographical difference in the efferent projections of the MCH neurons.
Conclusion: This is the first study to reconstruct neurons implicated in sleep in the intact brain. The impact of the results is that the 3D image revealed a pattern not evident in traditional microtome based histology methods. The potential of the new tissue clearing methods is that it accelerates the discovery of brain circuits underlying sleep. Tomer, R., Ye, L., Hsueh, B. & Deisseroth, K. (2014) Advanced CLARITY for rapid and high-resolution imaging of intact tissues. *Nature protocols*, **9**, 1682–1697.
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0119

A DEDICATED BRAINSTEM CIRCUIT CONTROLS REM SLEEP

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Introduction: It remains unclear which neural circuit triggers REM sleep and REM sleep atonia, but glutamate neurons in the subcoeruleus ($SubC_{GLUT}$) are hypothesized to control REM sleep as well as REM sleep atonia by activating GABA neurons in the ventral medulla (vM_{GABA}). Here, we aimed to determine how optogenetic activation and inhibition of the $SubC_{GLUT}$-vM_{GABA} circuit impact REM sleep and REM sleep atonia.
Methods: To control the neuronal activity of the glutamatergic SubC neurons, we bilaterally infused 200nL of an adeno-associated viral vector (AAV) containing either a light-sensitive excitatory opsin (AAV-EF1α-DIO-ChETA-eYFP) or a light-sensitive inhibitory opsin (AAV- EF1α-DIO-ARCH-eYFP) or an inert control protein (AAV-EF1α-DIO-eYFP) into the SubC of 33 Vglut2-cre mice. Animals were instrumented for EEG and EMG recordings. $SubC_{GLUT}$ neurons were activated or silenced specifically during REM sleep. In another set of animals, the $SubC_{GLUT}$-vM_{GABA} circuit was inhibited continuously during REM sleep at the level of the vM. Only animals that had histological verification of eYFP expression in the SubC region and projection fibers in the vM were used for analysis. We used Vglut2 fluorescent *in situ* hybridization and/or Vglut2-tdTomato expressing mice to confirm the specificity of our virally-mediated opsin expression.
Results: We found that activation of $SubC_{GLUT}$ neurons increased the length of REM sleep episodes by 77±3% (n=5, $p<0.01$), and further decreased motor activity during REM sleep (n=5, $p<0.01$). In contrast, inhibition of SubC cells shortened the duration of REM sleep episodes (n=6, $p<0.01$), and increased overall motor activity by 26% (n=5, $p<0.01$). Importantly, silencing $SubC_{GLUT}$ transmission at the vM ($SubC_{GLUT}$-vM_{GABA}) increased overall motor activity during REM sleep (n=3, $p<0.05$) without affecting REM sleep amounts (n=3, $p=0.639$).
Conclusion: These results support the hypothesis that neurons in the $SubC_{GLUT}$-vM_{GABA} circuit control both REM sleep and REM sleep atonia.
Support (If Any): This research was funded by the Natural Sciences and Engineering Research Council of Canada (NSERC), the Canadian Institutes of Health Research (CIHR), and the CIHR Sleep and Biological Rhythms Toronto.

0120

SUPRA-SPINAL NEURAL CIRCUITRY REGULATING REST LEGS SYNDROME (RLS)

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Introduction: RLS occurs in sleep-wake transitions and during sleep as uncomfortable sensation causes leg movements (sometimes other parts of the body). We propose that corticospinal and rubrospinal tract, and hypothalamic A11 dopaminergic projection to the spinal cord are involved in RLS. Because basal ganglia strongly regulate the cerebral cortex including motor cortex, we hypothesize that the basal ganglia, via the cortex and corticospinal tract, is involved in regulation of RLS.
Methods: To dissect the roles of three supra-pontine descending projections in RLS, we systemically made lesions of corticospinal tract and its sources (motor cortex and somatosensory cortex), red nucleus (RN) and its afferent cerebellar interposed nucleus (IP) and hypothalamic A11 dopaminergic descending projections and examined RLS like movements and sleep-wake structure following ablating these projections. Finally, we injected dopamine agonist pramipexole, a drug of choice for RLS, to examine if RLS like movements are reduced. To investigate the roles of the basal ganglia in RLS, we examined the effects of selective lesions in substantia nigra pars compacta (SNc), striatum, globus pallidus externa (GPe), and pallidocortical neurons on RLS-like movements.
Results: Damaging corticospinal tract (CST), rubrospinal tract and A11 and their afferent sources (motor and somatosensory cortex and cerebellar interposed nucleus) induced abnormal (twitching and jerking) movements (RLS-like movements) during sleep and its transitions into quiet wakefulness (N->W and R->W). Overall, more number of RLS-like movements with more vigorous were seen during night than daytime. Dopamine D2 agonist pramipexole, a drug for RLS treatment, reduced RLS like movements significantly, which indirectly indicates that RLS-like movements resemble RLS. Finally, we revealed the neural pathways of the basal ganglia involved in control of RLS-like movements. In particular, we identified the pallidocortical neurons in GPe as a key node for basal ganglia control of motor cortex regulating RLS-like movements.
Conclusion: Corticospinal, rubrospinal and A11 descending projections are engaged in regulation of motor activity during sleep and sleep transitions. Basal ganglia, via GPe-cortex-spinal cord pathway, regulate RLS.
Support (If Any): NS061849 and NS09586.

0121

A LOCAL GABAERGIC CIRCUIT CONTROLLING OREXIN NEURONS

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Introduction: The orexin neurons are essential for the maintenance of prolonged periods of wakefulness. Their activity is controlled by ascending and descending inputs and by local circuits. The lateral hypothalamus perifornical (LH/PF) region contains a large population of wake active neurons. Accordingly, lesions of the LH/PF region produce hypersomnia whereas stimulation of the same area increases wakefulness for several hours. Single unit recordings have found that the LH/PH region also contains a significant number of neurons that are active during NREM and REM sleep. These sleep-active neurons are intermingled with orexin neurons and they comprise of MCH-containing neurons as well as GABAergic neurons. These sleep active neurons may inhibit the surrounding wake-active neurons including the orexin neurons during NREM and REM sleep. In this study we applied channelrhodopsin-2 (ChR2) assistant circuit mapping (CRACM) to test whether orexin neurons are under inhibitory control by local GABAergic neurons.
Methods: We stereotaxically injected *vGAT-cre* mice in the LH/PF region with a mixture (1:1) of a cre-dependent AAV-ChR2-YFP and an AAV-h-orexin-tdTomato. This resulted in the expression of ChR2-YFP in GABAergic neurons and tdTomato in orexin neurons. We then performed whole-cell recordings in orexin neurons (td-Tomato-positive) while photostimulating local GABAergic neurons expressing ChR2.
Results: Photostimulation of LH/PF GABAergic neurons evoked inhibitory postsynaptic currents (IPSCs) in orexin neurons. Bicuculline abolished the photo-evoked IPSCs, indicating that they were mediated by the release of GABA and activation of $GABA_A$ postsynaptic receptors. Carbachol (15uM) and Dynorphin (500nM) reduced the amplitude of the photo-evoked IPSCs, whereas orexin had no effect.
Conclusion: Local GABAergic neurons inhibit orexin neurons through the release of GABA and $GABA_A$ signal. This local GABAergic input is depressed by the cholinergic signal, and is unaffected by orexin and it is inhibited by dynorphin. We propose that during wakefulness orexin neurons can be disinhibited by acetylcholine and by their own release of dynorphin.
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0122

HYPOCRETIN AFFECTS THE EXCITABILITY OF CORTICAL NNOS/NK1 NEURONS

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Introduction: Cortical neuronal nitric oxide synthase (nNOS) neurons, identified by co-expression of the neurokinin-1 (NK1) receptor, are thought to play a role in sleep homeostasis. The proportion of activated cortical nNOS/NK1 cells directly correlates with homeostatic sleep drive. Hypocretin/orexin (Hcrt) neurons affect arousal state and sleep deprivation (SD) enhances c-FOS expression in Hcrt neurons. We investigated whether Hcrt neurons affected cortical nNOS/NK1 neuron activity.
Methods: Coronal mouse brain slices (250μm) were prepared for whole-cell patch-clamp recording in voltage clamp and current clamp modes. Cortical nNOS/NK1 neurons were readily identifiable after a brief application of the fluorescent NK1 agonist, tetramethylrhodamine (TMR).To assess whether Hcrt input contributes to the putative role of cortical nNOS/NK1 neurons in sleep homeostasis, we utilized *orexin-tTA;TetO DTA* (DTA) mice and littermate controls. Mice were implanted with EEG telemetry devices and, following dietary doxycycline removal (6–8 weeks) to fully ablate Hcrt neurons, were subjected to either 4hr SD (SD group) or 4hr SD followed by a 2hr sleep opportunity (SD/RS group) prior to sacrifice. The percentages of time spent in NREM sleep (%NR) and cortical nNOS/NK1 neurons expressing c-FOS (%FOS/NOS) were analyzed for each cohort.

Results: Hcrt-1 (100nM) applied in vitro produced an inward current (-8.83 ± 2.72pA, n=10 of 14) and membrane depolarization (+3.82 ± 1.07mV, n=9 of 11) in 76% of nNOS/NK1 cells. Excitation also occurred in the presence of tetrodotoxin (-7.56 ± 1.08pA and +4.00 ± 1.40mV; n=8 and n=4), but the proportion of responders was reduced (n=12 of 21).Littermate controls (n=4) and DTA mice (n=5) in the SD group had 2.1 ± 1.0% and 3.1 ± 1.3%NR and 11 ± 2% and 14.0 ± 1.0%FOS/NOS, respectively. With sleep opportunity (SD/RS), %NR in littermate controls (n=3) and DTA mice (n=7) was 77.8 ± 3.6% and 68.7 ± 4.7%, respectively. %FOS/NOS rose significantly in both genotypes to 77.0 ± 2.0% and 73.0 ± 4.0%, respectively. The loss of Hcrt innervation did not significantly affect measures of rebound sleep (NREM delta power or NREM delta energy).
Conclusion: These data suggest that a subset of cortical nNOS/NK1 neurons are affected by Hcrt innervation but this input does not affect the ability of cortical nNOS/NK1 neurons to detect sleep pressure.
Support (If Any): NIH R01 HL059658 and NIH R01 NS077408.

0123

A CIRCUIT FOR THE CIRCADIAN CONTROL OF AGGRESSION

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Introduction: Circadian rhythm disruption is a prominent feature of numerous neurodegenerative, neurodevelopmental, and neuropsychiatric diseases that are also associated with verbal and physical aggression. However, whether the central circadian clock directly regulates aggression, a complex motivated behavior, and the circuit basis by which it may do so remains unknown. We hypothesized that the propensity towards aggressive behaviour varies across the 24 h day, and that the central circadian clock, located in the suprachiasmatic nucleus of the hypothalamus (SCN), regulates this rhythm. Estrogen receptor 1 (Esr1)-expressing neurons within the ventrolateral part of the ventromedial hypothalamus (VMHvl) are known to directly control attack behavior in male mice, but it is unknown if the activity of these neurons is under temporal regulation by the SCN clock. We thus hypothesized that circadian regulation of aggression may depend upon a polysynaptic pathway from the SCN to Esr1-expressing VMHvl neurons.
Methods: We utilized the resident intruder paradigm (a well-established assay for territorial aggression in male mice) administered at four different circadian time points in conjunction with genetically-targeted neuronal manipulations focused on the GABAergic subparaventricular zone (SPZ), an obligate relay for most SCN clock synaptic output. We then used a series of channelrhodopsin assisted circuit mapping experiments to investigate functional connectivity between SCN, SPZ, and VMH neurons.
Results: Here we demonstrate, for the first time, that aggression propensity in male mice exhibits a daily rhythm. We also found that this rhythm in aggression propensity requires normal functioning of SPZ GABA neurons and is independent of locomotor and plasma corticosterone rhythms. Finally, we uncovered a novel and functional polysynaptic circuit connecting the SCN clock with an intra-VMH circuit that, on activation, drives attack behavior.
Conclusion: Our work reveals that aggression propensity exhibits a robust daily rhythm and that a circuit, spanning four synaptically coupled hypothalamic nodes, directly modulates this daily rhythm of aggression, primarily by inhibiting aggressive behavior in a circadian phase-dependent manner.
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0124

BIDIRECTIONAL CHEMOGENETIC CONTROL OF GABA NEURONS IN THE VENTRAL TEGMENTAL AREA MODULATES AROUSAL IN MICE

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Introduction: Many sedative and anesthetic drugs potentiate $GABA_A$ receptors in the brain, but their neuroanatomic sites of action are less clear. GABA neurons in the rostromedial tegmental nucleus (RMTg) of the ventral tegmental area (VTA) inhibit neighboring dopamine neurons that have been shown to promote wakefulness. Using bidirectional chemogenetics, we tested the hypothesis that GABA neurons in this region modulate arousal.
Methods: Vesicular GABA Transporter (VGAT)-Cre mice (n=10) underwent bilateral RMTg injections of viral constructs that elicit Cre-dependent expression of Designer Receptors Exclusively Activated by Designer Drugs (DREADDs). A mixture of two constructs was used to induce co- expression of stimulatory (Gq-coupled) M3-DREADDs and inhibitory (Gi-coupled) kappa opioid receptor DREADDs (KORD) in GABA neurons. Control VGAT-Cre mice (n=9) were injected with a null viral construct that encodes neither receptor. Co-expression of M3 and KORD DREADDs in the same neurons allows for activation by clozapine-N-oxide (CNO) and inhibition by salvinorin B (SalB). The open field test and rotarod were used to assess motor activity and coordination.
Results: In the open field test, CNO decreased the total distance traveled in the M3/KORD group (3.7 ± 4.5cm) compared to the control group (11.0 ± 4.5cm, $p<0.01$), and SalB had the opposite effect (M3/KORD group=19.7 ± 4.4cm; control group=14.6 ± 3.4cm, $p=0.01$). On the rotarod, the total run time decreased after CNO in the M3/KORD group (baseline=162 ± 53sec, CNO=71 ± 56sec, $p<0.01$) but SalB had no statistically significant effect. In control mice, neither CNO nor SalB produced statistically significant changes on the rotarod.
Conclusion: Activation of RMTg GABA neurons decreases behavioral signs of motor activity and coordination suggesting that the VTA may be an important neuroanatomic site where sedatives and anesthetics act to decrease arousal. It is likely that the behavioral effects of GABAergic activation are primarily due to inhibition of neighboring VTA dopamine neurons that promote wakefulness. However, inhibition of GABA neurons only produced a modest increase in arousal during the awake state, suggesting that these neurons are already quiescent during wakefulness.
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0125

A METHOD FOR STUDYING NEURAL CIRCUITS DURING ALL-NIGHT FUNCTIONAL MAGNETIC RESONANCE IMAGING SLEEP STUDIES

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Introduction: The spatial resolution of fMRI allows for a detailed description of brain activity during sleep and presents a unique opportunity to gain a deeper understanding of the functions of sleep. However, the adverse sleep conditions of the MRI have made the continuous observation of an entire night's sleep opportunity difficult. We have assessed the feasibility of a method for promoting and measuring sleep in the MRI across an entire night.

Methods: Volunteers for the two-night inpatient protocol were thoroughly screened with the use of psychometrically validated questionnaires to ensure they could sleep in the MRI environment. Prior to the inpatient visit, volunteers were habituated to an ~23:00-07:00 sleep schedule for 14 days, verified by actigraphy, and were given the opportunity to acclimate themselves to the MRI acoustic noise. Hearing safety was assessed by baseline and post-MRI audiology examinations. Volunteers slept on a clinical-grade memory foam mattress and were equipped with active noise cancellation headphones, in addition to standard hearing protection. EEG data acquired during scans were artifact-corrected in real-time to allow for sleep scoring. Other peripheral signals were measured such as variations in cardiac and respiratory cycles and eyelid position.

Results: On the second night, seven of eleven volunteers were successfully recorded in the scanner for 317–505 minutes. Preliminary review of audiology data found no clinically relevant changes in pure-tone thresholds or early auditory evoked potentials. Real-time EEG scoring approximated that these subjects spent 45–240 minutes in SWS and 40–90 minutes in REM. EEG data were scored offline with optimized artifact correction algorithms in one volunteer so far. This volunteer exhibited 54 minutes of SWS, 39 minutes of REM, and 279 minutes of total sleep. Total recording time was 369 minutes, and 63 minutes were unscorable.

Conclusion: These results demonstrate that all-night continuous fMRI scanning is a viable technique for measuring sleep. This opens many potential future directions for studying the neural circuits associated with sleep phenomena such as state cycling.

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0126

NEUROIMAGING OF CIRCUIT-SPECIFIC PROTEIN SYNTHESIS IN HUMAN SUBJECTS DURING SLEEP-DEPENDENT MEMORY CONSOLIDATION

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Introduction: The notion that memory consolidation depends on protein synthesis is based on demonstrations that protein synthesis inhibitors prevent consolidation. We sought to demonstrate directly that protein synthesis is affected during sleep-dependent memory consolidation. We used L-[1-(11)C]leucine positron emission tomography (PET) to measure circuit-specific brain protein synthesis during a daytime nap opportunity.

Methods: Subjects completed the texture discrimination task (TDT) before and after the nap opportunity. We randomized 34 subjects to either wakefulness or sleep and counterbalanced training to either left or right visual field. In accord with the retinotopic specificity of the TDT, we considered ipsilateral V1 as the untrained within-subject control. Following training on the TDT, subjects underwent the PET scan with simultaneous polysomnography. V1 was drawn on magnetic resonance volumes and transferred to corresponding PET volumes to compute average rates of protein synthesis in left and right V1.

Results: If we disregard visual field trained (left, right), the Condition (wakefulness, sleep) x Local State (untrained, trained) interaction was not statistically significant (F[1,32]=0.07,p=0.79,f^2=0.002). Consideration of visual field trained indicates that the Condition x Visual Field Trained x Local State interaction was statistically significant (F[1,30]=9.08,p=0.00 5,f^2=0.30). Side-to-side differences were statistically significant only in the sleep condition: protein synthesis in the trained hemisphere was significantly higher if training was in left visual field and significantly lower if training was in right visual field. Another way to view these results is protein synthesis was higher in the right V1 during sleep-dependent memory consolidation regardless of the location of training.

Conclusion: If we disregard visual field trained, our study could indicate sleep-dependent memory consolidation depends on processes other than protein synthesis such as synaptic renormalization. Consideration of visual field trained, however, may indicate that each hemisphere has inherent properties requiring either reduced or elevated protein synthesis for memory consolidation to occur during sleep.

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0127

RELATIONSHIP BETWEEN ADENOSINE AND GLUTAMATE DURING SLEEP DEPRIVATION

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Introduction: Recently, we described a biochemical cascade which is triggered during sleep deprivation (SD) including the induction

of inducible nitric oxide synthase (iNOS) and NO, followed by an increase in adenosine (AD). This cascade is critical in promoting recovery sleep (RS); however, it's triggers are unknown. We hypothesized that iNOS induction is triggered by an increase in extracellular glutamate (Glu), and that increase in AD prevents a prolonged toxic increase in Glu. This is because of the activation of the inhibitory AD A1 receptor (A1R). To test this hypothesis, we: 1) examined the time course of Glu and AD during 8h SD in the basal forebrain (BF) and prefrontal cortex (PFC); and 2) blocked A1R in the BF and PFC using the selective antagonist **8 cyclopentyltheophylline** (CPT) during SD, and examined whether this treatment effects Glu level.

Methods: Male rats were implanted with EEG/EMG recording electrodes and microdialysis guide cannulae targeting the BF and PFC. Microdialysis samples were collected during 8h SD or SD combined with CPT infusion. AD and Glu were measured using high performance liquid chromatography (HPLC) and ultra HPLC.

Results: In the BF, Glu dramatically increased at the beginning of SD by 660±130% (p=0.002, N=5), followed by increases in AD at 2nd h of SD. When AD maximized at 4thh of SD, Glu levels concurrently decreased to 76±32% of baseline. High AD levels were maintained till the end of SD. In the PFC, Glu increased by 769±155% (p=0.02, N=4) within 2h of SD. Similar to BF, when AD increased at 5thh of SD, Glu returned to the baseline (-10±12%). Infusion of CPT to the BF and PFC induced dramatic increases in Glu till the end of SD (BF: 488±250% of baseline, p<0.001 and PFC: 684±222%, p<0.001).

Conclusion: A rapid increase in Glu during SD may be a trigger for the induction of iNOS-NO-AD cascade in both the BF and PFC. AD via A1R exerts a negative feedback on Glu neurotransmission, preventing its further rise and potential toxicity during long-term SD.

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0128

SENSORY DEPRIVATION SUPPRESSES CORTICAL ACTIVITY IN A STATE AND ENVIRONMENT DEPENDENT MANNER

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Introduction: Monocular deprivation (MD), a well-established tool for studying plasticity in the visual cortex, induces a biphasic response in neural activity. Initially, neuronal firing rates (FRs) are suppressed by widespread Hebbian LTD. Following FR suppression in extended MD, homeostatic mechanisms restore spiking precisely to baseline levels. We recently demonstrated that the homeostatic return to the set-point is expressed during waking and not sleep. Here we address the role of arousal-states and environmental variables in gating the Hebbian depression of activity that characterizes early MD.

Methods: To answer this question, we recorded activity from ensembles of cortical single units in juvenile rats (postnatal days 24–34) continuously for 10 days during a monocular deprivation (MD) paradigm.

Results: As expected, amongst neurons that were "online" for the at least the first 6 days of the recording, firing rates dropped during early MD. Under normal conditions (12:12 light/dark cycles), automatically detected decreases in neuronal activity clustered around the ZT0 ("lights on") and a significantly greater portion of the decrease occurred during light hours than dark. To further probe this causality of dark to light transitions in initiating the FR depression, we manipulated the light cycles of animals at critical points in early MD. Preliminary data suggest that animals must be awake for the FR suppression to start, but subsequent sleep/wake states are not correlated with changes in FR.Cortical activity in control hemispheres was stable across light/dark transitions.

Conclusion: Taken with our previous data, these results suggest that individual forms of cortical plasticity have specific environmental and behavioral rules governing their expression and segregation.

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0129

LOCAL THALAMIC RETICULAR NUCLEUS INHIBITION OF T-TYPE CALCIUM CHANNELS REDUCES SLEEP SPINDLES IN MICE

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Introduction: Parvalbumin (PV)-containing GABAergic thalamic reticular neurons (TRN) express Cav3.3 T-type calcium channels that are thought to generate burst firing necessary for spindle generation. Cav3.3 is a risk gene for schizophrenia, where spindle abnormalities are present. The role of Cav3.3 in the control of sleep and spindles has been examined using global Cav3.3 knockout mice but not with acute, local pharmacological blockade. Therefore, here we examined the inhibitory effect of a selective T-type inhibitor, TTA-P2, in TRN on sleep and spindles.

Methods: *In vitro* recordings were made from identified TRN PV neurons in slices from mice (13-22d) expressing a red fluorescent protein in PV neurons. *In vivo*, mice (N=8) were implanted with bilateral microdialysis cannulae targeting TRN (AP -0.7, ML ±1.3, DV -4.0) and electrodes (EEG/EMG) for sleep-wake recordings. A custom Matlab script detected individual spindles (10-15Hz) in the EEG, allowing analysis of drug effects on spindle density (spindles/min) during NREM sleep. Data was compared with the ACSF-day values and related to the histological location of the probe.

Results: TRN-PV neurons exhibited low-threshold spikes/inward currents after removal of hyperpolarizing currents/voltage steps respectively, which were blocked by TTA-P2 (3 μM, n=4), confirming the expression of low threshold T-type Ca channels in TRN PV neurons. In 6/8 mice with probe locations in TRN (uni- or bi-lateral), TTA-P2 infusion at ZT2-6 significantly decreased (-27.0±11.6%, p=0.008) spindle density (ACSF: 4.25±0.19; TTA-P2: 3.13±0.37) without any significant effect on amplitude or duration. There was no effect on NREM sleep duration, delta (0.5-4Hz) or slow-wave activity (0.5–1.5Hz).

Conclusion: Localized pharmacological inhibition of T-type calcium channels within TRN selectively decreased NREM spindle density without an effect on NREM sleep. These results contrast with those observed with a constitutive, global knockout of Cav3.3, where sleep fragmentation was observed in addition to reduced spindles (Astori et al., 2011).

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0130

ROLES OF GAD67 IN THE THALAMIC RETICULAR NUCLEUS FOR REGULATING SLEEP SPINDLE GENERATION

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Introduction: Schizophrenic (Sz) patients exhibit a reduction in sleep spindles. The genesis of this spindle deficit is unknown. The

GABAergic neurons of the thalamic reticular nucleus (TRN), most of which contain the calcium-binding protein, parvalbumin (PV), are involved in spindle generation. The expression of the GABA synthetic enzyme, glutamate decarboxylase 67 (GAD67), is decreased in cortical PV GABAergic neurons of Sz brains examined postmortem. Thus, one possible explanation for the spindle deficit in Sz is a reduction of GAD67 levels in TRN neurons. Thus, here we selectively deleted GAD67 in the TRN and tested the effect on sleep spindles.

Methods: An adeno-associated virus constitutively expressing a Cre recombinase-Green fluorescence protein (GFP) fusion protein (AAV-Cre-GFP) was injected into TRN of homozygous GAD67 floxed mice. The time course of reduction in GAD67 after viral injection was evaluated by immunohistochemistry. Sleep-wake activity (EEG/EMG electrodes) was recorded and sleep-wakefulness states were analyzed according to standard procedures. A custom-designed script (Matlab) was used to detect individual spindles (10-15Hz) during non-REM (NREM) sleep.

Results: 1 week after viral injection GAD67 expression in TRN was similar to control (83.3% of control, n=2). However, a pronounced reduction was observed two (11.5%, n=2) and three weeks (6.9%, n=2) after viral injection. In one animal with confirmed unilateral viral transduction in the TRN, NREM spindle density (Spindles/min NREM sleep) during the light period was decreased after 2 weeks of AAV injection (64.3% of control) when compared to a non-transduced control mouse (N=1) or to the same mouse recorded one 1 week after injection.

Conclusion: Our results suggest we can successfully delete the GAD67 gene in TRN neurons. Our preliminary data further suggest that reduced GAD67 in TRN neurons leads to a decreased spindle density, similar to that observed in schizophrenia patients.

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0131

EFFECTS OF CRF RECEPTOR-1 AGONIST AND ANTAGONIST ON SLEEP AND NEURONAL C-FOS EXPRESSION IN THE PREOPTIC HYPOTHALAMUS

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Introduction: Corticotropin releasing factor (CRF) neurons in the hypothalamic paraventricular nucleus and extended amygdala regulate endocrine and behavioral responses to stress. Sleep suppression frequently accompanies the stress response. Wake-promoting effects of CRF are mediated, in part, by excitation of hypocretin neurons in the lateral hypothalamus and noradrenergic neurons in the locus coeruleus. The extent to which CRF acts on sleep-promoting neuronal systems is not clear. We examined the effects of subarachnoid infusion of a CRF agonist and antagonist on sleep and on GABAergic neuronal activity in sleep regulatory nuclei in the rat preoptic hypothalamus, the median preoptic nucleus (MnPO) and ventrolateral preoptic area (VLPO).

Methods: Adult Sprague Dawley rats were chronically implanted for electrographic sleep-wake state recording and a guide cannula targeting the ventral subarachnoid space rostral to the optic chiasm. In experiment 1, groups of rats were administered either vehicle (n=7) or one of two doses of CRF-receptor1 (R1) antagonist, Antalarmin (ANT; 2 μg; n=7 or 6 μg; n=7) by subarachnoid infusion (0.2 μl/min over 3 hrs starting at ZT 8). In experiment 2, groups of rats were administered subarachnoid infusion of either vehicle (n=6) or one of two doses of CRF-R1 agonist, Stressin (STR; 0.3 μg; n=6 or 1μg; n=6; 0.2 μl/min over 3 hrs starting at ZT 2). Sections through the MnPO and VLPO were harvested and immunostained for c- Fos protein and glutamic acid decarboxylase (GAD).

Results: Infusion of 6μg ANT decreased waking and increased NREM and REM sleep compared to vehicle and, and increased in percentage of GAD+ neurons expressing Fos in the MnPO (10.6 ± 1.1% versus 18.0 ± 1.9%) and the VLPO (11.2 ± 1.6% versus 22.3 ± 1.9%). Infusion of 1 μg STR increased waking and decreased NREM and REM sleep compared to vehicle. High dose STR infusion also decreased the percentage of GAD+ neurons expressing Fos-IR in MnPO (18.1 ± 9.9 versus 9.9 ± 1.5%) and VLPO (22.1 ± 1.3% versus 12.1 ± 1.8%).

Conclusion: Vigilance state changes occurring in response to increased CRF-R1 signaling may be mediated by suppression of preoptic sleep-promoting neuronal systems as well as by activation of arousal promoting neurons.

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0132

EFFECTS OF FOOD RESTRICTION ON STABILITY AND FRAGMENTATION OF DAILY ACTIVITY RHYTHMS

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Introduction: Locomotor activity in rodents displays robust daily/circadian rhythms in synchrony with light/dark cycles. Restricted feeding (FR) in a fixed and limited time period each day also affects daily activity rhythms, causing increased activity a few hours before the feeding period — food anticipatory activity (FAA). Here we tested whether FR during the dark phase affects the stability and fragmentation of daily activity rhythms, as mediated through the dorsomedial hypothalamic (DMH) nucleus — a neuronal node involved in the FAA.

Methods: Locomotor activity was collected under 12h:12h light-dark cycles from18 Wistar rats in three groups. (Group 1) Six intact rats had ad libitum food access for >2 weeks. (Group 2) Six intact rats underwent a 16-day FR protocol in which food was only available between Zeitgeber time (ZT) 6–8 h. (Group 3) Six rats with the DMH lesion (DMHx) underwent an ad-lib protocol of >12 days followed by a 16-day FR protocol. Inter-daily stability (IS) and intra-daily variability (IV) were calculated using the last 7 days under each condition. To determine whether FR affects activity patterns outside the FAA-feeding period, IS and IV after excluding data between ZT3-8h were also obtained.

Results: In the intact rats, FR caused a decrease of 15.7%±5.3%(SE) in IS ($p=0.015$) and an increase of 58.6%±15.5% in IV ($p=0.0036$). The FR effects remained after excluding the 5-hour FAA-feeding period. The DMH lesion did not affect IS and IV with ad-lib food access (both $p>0.1$). In the DMHx rats, FR did not affect IS ($p>0.1$) and caused an increase of 29.5% (±10%) in IV ($p = 0.037$). But the FR effect on IV disappeared when excluding the FAA-feeding period (change=8.5%±6.5%; $p>0.1$).

Conclusion: Restricted feeding during the inactive phase leads to unstable and fragmented daily activity patterns across the 24 hours. Lesioning the DMH eliminates these FR effects.

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0133

OREXIN MEDIATES FEED-FORWARD INHIBITION OF VLPO SLEEP-ACTIVE NEURONS - A MECHANISM FOR CONTROLLING AROUSAL

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Introduction: The ventrolateral preoptic area (VLPO) plays an essential role in the initiation and maintenance of sleep. It contains a cluster of sleep-active neurons that are GABAergic and co-expresses galanin ($VLPO^{GABA/Gal}$). VLPO is innervated by wake-promoting neurons and the $VLPO^{GABA/Gal}$ neurons are strongly inhibited by noradrenaline, carbachol and serotonin. VLPO also receives input from orexin neurons and administration of orexin in VLPO arouses mice from sleep suggesting that orexin might be inhibiting the sleep-active $VLPO^{GABA/Gal}$ neurons. However, orexin is an excitatory peptide, thus orexin's effect in the VLPO remains unclear. In this study we investigate the effect of orexin on VLPO neurons in brain slices.
Methods: We recorded VLPO neurons in brain slices from WT and *Vgat-IRES-cre* mice. We filled the recorded cells with biocytin for anatomical localization. We recorded from VLPO GFP-labelled GABAergic neurons in *Vgat-IRES-cre* mice that were injected in VLPO with an AAV-*flex*-GFP. We identify VLPO-sleep active neurons based on the inhibitory responses to noradrenaline or carbachol and/or by the presence of VGAT and galanine mRNAs using single cell RT-PCR.
Results: We found a dual response to orexin in VLPO. About 60% of VLPO neurons were excited by orexin but 40% were inhibited through release of GABA. The VLPO neurons that were inhibited by orexin were also inhibited by carbachol or noradrenaline suggesting that they could be the $VLPO^{GABA/Gal}$ sleep-active neurons. We tested this hypothesis by recording VLPO GABAergic neurons (GFP-labelled). Orexin increased the frequency of spontaneous IPSCs in 50% of the VLPO GABAergic neurons and these neurons expressed galanin mRNA.
Conclusion: Orexin inhibits $VLPO^{GABA/Gal}$ sleep-active neuron by increasing GABAergic afferent input. This GABAergic input could originate from the local neurons that are directly activated by orexin. We propose that during wakefulness $VLPO^{GABA/Gal}$ sleep-active neurons are strongly and directly inhibited by wake-promoting signals, such as noradrenaline, carbachol and serotonin. Whereas, orexin could act by activating local GABAergic neurons that in turn produce feed-forward inhibition of $VLPO^{GABA/Gal}$ sleep-promoting neurons.
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0134

OXYTOCIN FIBERS IN THE LATERAL HYPOTHALAMUS PROMOTE AROUSAL IN A MOUSE MODEL OF PWS

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Introduction: Daytime sleepiness, disrupted sleep, and cataplexy-like falling episodes are common in Prader-Willi Syndrome (PWS), but the cause of these symptoms is unknown. The effects of oxytocin on sleep/wake behavior are not well understood, but orexins activate the oxytocin neurons, and oxytocin activates the orexin neurons. We hypothesize that this positive feedback loop normally plays an essential role in promoting wakefulness and regulating sleep. Furthermore, patients with PWS, have fewer oxytocin neurons which we hypothesize reduces orexin signaling, resulting in daytime sleepiness, abnormal REM sleep and cataplexy.
Methods: Using optogenetics and EEG, EMG, with video recordings, we have examined sleep/wake behavior in wild type, orexin null and MAGEL2 null, a model of PWS, mice. We have selectively expressed a light sensitive channel, ChR2, in oxytocin neurons of the PVH and have targeted optical fibers to illuminate the oxytocin fibers of the lateral hypothalamus.
Results: Our results indicate activation of oxytocin positive fibers wake mice from sleep and increase the amount of wake during the day.
Conclusion: Enhancing the activity level of the oxytocin system may help people with PWS to maintain wakefulness throughout the day. Further research with these mice should provide helpful insights into the daytime sleepiness people with PWS experience.
Support (If Any): Foundation for Prader-Willi Research.

0135

GABAERGIC NEURONS IN THE PREOPTIC HYPOTHALAMUS PROJECT TO MIDBRAIN STRUCTURES INVOLVED IN REM SLEEP CONTROL

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Introduction: GABAergic, sleep-active neurons in the preoptic hypothalamus are key components of hypothalamic-brainstem circuits that regulate sleep and arousal. Many sleep-active neurons recorded in the median preoptic nucleus (MnPO) and the ventrolateral preoptic area (VLPO) exhibit elevated discharge rates during both nonREM and REM sleep compared to waking. A population of neurons in the dorsal lateral preoptic area (DLPO) exhibit REM-active discharge. Preoptic nonREM/REM-active neurons may participate in control of the nonREM-REM cycle. To evaluate this, we examined projections of GABAergic neurons in the preoptic area to midbrain nuclei implicated in REM sleep control, the ventrolateral periaqueductal gray (vlPAG) and the dorsal raphe nucleus (DRN).
Methods: Adult Sprague-Dawley rats received unilateral injections of the retrograde anatomical tracer, cholera toxin subunit-b Alexa Fluor 594 conjugate (CTb), targeting the vlPAG or DRN. After a 14-day survival period to allow for retrograde transport of tracer, rats were euthanized and tissue sections through the preoptic hypothalamus were processed for visualization of CTb and of glutamic acid decarboxylase (GAD), a marker of GABAergic neurons.
Results: CTb injections that successfully targeted the vlPAG resulted in a moderate density of CTb-labeled cell bodies in the VLPO with co-localization of GAD occurring in ~30% CTb+ neurons. The density of CTb labeling in the MnPO and DLPO was somewhat lower, with co-localization of GAD occurring in ~15–20% of CTB+ neurons. CTb injections in the DRN yielded moderate to high density of retrogradely labeled neurons in the VLPO, with co-localization of GAD in ~40–50% of CTb+ neurons. Compared to VLPO, co-localization of CTb and GAD in the MnPO and DLPO was low.
Conclusion: This study confirmed anatomical connections between GABAergic neurons in sleep-regulatory regions of the preoptic area to REM sleep-regulatory regions in the midbrain, with the highest density of GABAergic projection neurons originating in the VLPO. These connections may functionally integrate neuronal systems that control sleep onset and nonREM sleep to brainstem REM sleep generating circuits.
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0136

OPTOGENETIC STIMULATION AND INHIBITION OF THE CENTRAL NUCLEUS OF THE AMYGDALA ALTERS FIRING IN LOCUS COERULEUS NEURONS

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Introduction: The amygdala, via the CNA, has direct projections to the LC and other regions (e.g., LDT, PPT, DRN, and subcoeruleus) in the mesopontine brainstem that play significant roles in regulating both sleep and arousal and the stress response. Here we used optogenetics to assess how CNA regulates neural activity in LC in anesthetized rats.
Methods: To specifically target CNA projections to LC, CNA was infected with AAV-EF1a-DIO-hChR2(H134R)-EYFP and/or AAV-EF1a-DIO-eNpHR3.0-EYFP and the LC with AAV-EF1a-mCherry-IRES-WGA-Cre that mediates bicistronic expression of mCherry and WGA-Cre. Vectors in CNA coded for double floxed and inverted open reading frame opsins, hChR2 or eNpHR3.0. When a neuron in the LC/peri-LC zone synapses with neurons in CNA and expressed WGA-Cre, it is transneurally transferred to CNA neurons, where Cre activity flips the opsin gene(s) into its correct orientation thereby allowing its translation. Subsequent expression of the opsin(s) gene enables excitation of ChR2 expressing neurons/projections by blue light or inhibition of the NpHR expressing neurons/projections from CNA by yellow light. For recording, the rats were anesthetized with isoflurane, and optic fibers and recording electrodes were stereotaxically lowered into place. When stable recordings of single neurons were obtained, either CNA or terminal fibers were presented with blue or yellow light for stimulation or inhibition, respectively.
Results: Ninety-six cells were recorded in seven rats. Responses of ≥25% change in firing rates were found in 58 neurons that received stimulation. Blue light stimulation of different durations suppressed firing in neurons in the vicinity of LC (1 sec (n=3), 2 sec (n=12) and 5 sec, (n=13)). By comparison, yellow light stimulation of 30 sec enhanced, firing in neurons in vicinity of LC (n=30).
Conclusion: These data demonstrate that CNA can influence activity in LC/peri-LC zone with potential relevance for its role in sleep, arousal and the stress response.
Support (If Any): MH1057701, MH64827.

0137

AMYGDALAR REGULATION OF PONTINE REM REGULATORY REGIONS: EFFECTS OF SLEEP

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Introduction: The central nucleus of the amygdala (CNA) projects to brainstem regions that generate and regulate REM. However, synaptic mapping of the circuitry and the actual influence of the CNA on these regions has not been determined. In this study, we used optogenetic methods to assess the influence of CNA inputs into the oral pontine reticular nucleus (PnO), the pedunculo-pontine tegmentum (PPT) and the nucleus subcoeruleus (SubC) on REM.
Methods: Twelve male Wistar strain rats were stereotaxically injected with an excitatory optogenetic construct (AAV5-EF1a-DIO -hChR2(H134R)-EYFP) into the CNA and with AAV5-EF1a-mCherry-IRES-WGA-Cre into PnO (n=4), PPT (n=4), or SubC (n=4). These constructs were designed such that only those CNA neurons that were synaptically connected to the specific brainstem region would express the light sensitive opsin, hChR2-EYFP. The animals were implanted with bilateral optrodes for light delivery into the CNA, and with electrodes for recording the electroencephalogram (EEG) and electromyogram (EMG) to allow determination of sleep. After recovery, sleep was recorded under non-stimulated and under blue light stimulation of opsin expressing CNA neurons.
Results: Stimulation with blue light into CNA during the dark period resulted in significantly higher REM amounts and REM episodes in animals with paired constructs injected into CNA and PnO, compared to baseline sleep. Stimulation of CNA in animals with paired injections into CNA and PPT or CNA and SubC did not significantly affect sleep parameters. NREM did not differ significantly between groups.
Conclusion: These data demonstrate that activation of CNA can influence REM and demonstrate that PnO is an important projection area in mediating CNA's effects on REM sleep. CNA modulation of PPT or SubC alone was not sufficient to alter REM thereby indicating that optogenetics can be useful for delineating functional components of the circuitry underlying the influence of the amygdala on REM.
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0138

DIFFERENTIAL C-FOS EXPRESSION IN GABAERGIC NEURONS OF THE NUCLEUS PONTIS ORALIS DURING WAKEFULNESS AND CARBACHOL-INDUCED ACTIVE SLEEP

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Introduction: Previous studies have demonstrated that GABAergic processes in the nucleus pontis oralis (NPO) play an important role in the generation and maintenance of active sleep and wakefulness. However, the location of cell bodies and neural activity of this pontine GABAergic system during wakefulness and active sleep are unknown. Accordingly, the present study was undertaken to determine the distribution of activated GABAergic neurons within the NPO during wakefulness and carbachol-induced active sleep (active sleep-carbachol) using c-Fos immunocytochemistry as a functional marker of neuronal activity.
Methods: Adult cats that were prepared for monitoring behavioral states were used in this experiment. In the awake group, animals were kept awake for 2 hours following the microinjection of saline into the NPO before being euthanized. In the active sleep-carbachol group, animals were euthanized after prolonged episodes of active sleep that was induced by the microinjection of carbachol into the NPO. Subsequently, brainstem sections were immunostained with a GABA antiserum in addition to a Fos polyclonal antiserum in order to double-label neurons that were both GABAergic and Fos immunoreactive.
Results: In awake cats, there was a large number of GABAedrgic neurons that expressed c-Fos in the NPO. These GABA+/c-Fos+ neurons were small to medium-sized and were located mainly within the lateral part of the NPO. In contrast, in active sleep-carbachol cats, the numbers of c-Fos expressing GABAergic neurons were decreased in the NPO. Specifically, there were only few GABAergic neurons in the lateral part of the NPO that expressed c-Fos during active sleep-carbachol.
Conclusion: The present results demonstrate that there exists a discrete group of GABAergic neurons in the NPO that are activated during wakefulness and inactivated during active sleep. We therefore suggest that these local GABAergic cells may be the neurons that comprise the pontine GABAergic system which functions to promote wakefulness and suppress active sleep by inhibiting active sleep-generator neurons in the NPO during wakefulness and disinhibiting them during active sleep.
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0139

COMPUTATIONAL MODEL OF BRAINSTEM CIRCUIT FOR STATE-DEPENDENT CONTROL OF HYPOGLOSSAL MOTONEURONS

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Introduction: In patients with obstructive sleep apnea (OSA) compensatory mechanisms keep the upper airway open allowing patients to breathe normally when awake. However, during sleep the pharyngeal muscles become relaxed, which leads to a partial or complete closure of airway. In this study, we developed a computational network model to investigate the impact of monoaminergic drive that is mediated by hypothetical interneurons (Fenik, 2015) on hypoglossal motoneurons (HMs) during REM sleep.

Methods: The network model included five distinct populations of cells: serotonergic raphe neurons (RN), noradrenergic A7 neurons, perihypoglossal GABAergic interneurons (PGI) and excitatory interneurons (PEI), and HMs. HMs were indirectly controlled by A7 neurons through the populations of PEI. Medullary/pontine RN provided inhibitory serotonergic projections to PGI that sent GABAergic projections to PEI.

Results: The model captured the changes in the firing rate of the studied neuronal groups across sleep stages. The firing rate of HMs was very low (~ 15 Hz) during REM sleep compared to NREM sleep (~ 50Hz) as observed in in vivo experiments. The model predicted two distinct mechanisms for reduced activity of HMs during REM sleep: (i) decrease of firing rate of noradrenergic A7 neurons leading to disfacilitation of PEI, (ii) silencing of serotonergic RN leading to disinhibition of PGI, which, in turn, inhibited PEI.

Conclusion: Using a biophysical model of the brainstem neural network, we predict that the state-dependent control of hypoglossal motoneuron excitability can be mediated by perihypoglossal interneurons, which integrate the noradrenergic and serotonergic drives to HMs and may serve as new potential targets for treatment of OSA.

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0140

CO-LOCALIZATION OF SEROTONIN AND CANNABINOID RECEPTORS IN THE NODOSE GANGLIA

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Introduction: Pharmacological treatments for obstructive sleep apnea are limited due to incomplete knowledge of the neurochemical properties of respiratory circuits. The afferent vagus nerves provide key respiratory modulating feedback to the brainstem. The nodose ganglia (NG) of the vagus nerves are neurochemically diverse containing many receptors, including serotonin type 3 receptors (5-HT_3), and cannabinoid type 1 (CB_1) and/or type 2 (CB_2) receptors. In anesthetized rats, a cannabinoid (CB) agonist attenuates serotonin (5-HT)-induced reflex apnea via activation of CB receptors located on the NG. However, it is unclear how 5-HT_3 receptors colocalize with CB_1 and CB_2 receptors. Here, we examine the localization of these three receptors in the rat NG.

Methods: NG were extracted from anesthetized adult male Sprague-Dawley rats, fixed with 4% paraformaldehyde and 20% sucrose, processed and embedded in paraffin and sectioned using a microtome. Sections were covered with primary antibodies for 5-HT_3 and CB_1 receptors or 5-HT_3 and CB_2 receptors. After rinsing the sections were covered with fluorescent secondary antibodies. The sections were rinsed and coverslipped with anti-fade glycerol. The immunohistochemical specificity was verified by omitting the primary antibodies. The slides were scanned using a Vectra automated quantitative pathology imaging system. Data are presented as mean ± SEM of percentage of fluorescent pixels observed for the entire sectioned ganglion.

Results: The NG were 31.37 ± 5.8% fluorescent for 5-HT_3 receptors. A tiny percentage of the NG was fluorescent for CB_1 (0.03 ± 0.02%) or CB_2 (0.03 ± 0.01%) receptors. Colocalization of 5-HT_3 and CB_1, or 5-HT_3 and CB_2, was 0.03 ± 0.01% or 0.03 ± 0.01%. In other words, those NG cells that expressed CB receptors also expressed 5-HT_3 receptors.

Conclusion: Only a small percentage of NG cells express CB receptors, and most of those cells are colocalized with 5-HT_3.

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0141

DORSAL RAPHE SEROTONINERGIC NEURONS ARE PART OF THE NEURONAL CIRCUITRY REGULATING CO2 - INDUCED AROUSALS

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Introduction: Serotoninergic (Sert) raphe (Dorsal and medullary) neurons are CO2- responsive, and mice lacking these neurons have impaired arousal to CO2. However, CO2 responsiveness can be restored by 5HT2A agonist, suggesting that serotonin may be a neuromodulator. We have shown previously that the external lateral parabrachial nucleus (PBel) regulate the hypercapnia induced arousal. PBel also receive substantial serotoninergic innervation from dorsal raphae (DR), therefore, we hypothesize that Sert-DR mediate CO2 arousals at least in part by its input to the PBel.

Methods: To test the role of Sert-DR, we conducted optogenetic inhibition of DR neurons selectively in Sert-cre mice (n=5) and tested their arousal responses to 10% CO2. We injected an adeno-associated virus containing the gene for Archaerhodopsin TP009 T in a Cre-inducible FLEX cassette (AAV-FLEX-ArchT-GFP), that expressed ArchT in Sert+-DR cells. These mice were also instrumented for sleep and optogenetics. To model cyclic hypercapnia as seen during sleep apnea, we investigated EEG arousals to 10% CO2 given for 30s every 300s and compared them with and without the 593nm laser light that inhibits Sert-DR neurons.

Results: Without the laser, mice showed normal responses to CO2 (arousal latency- 12.6 ± 0.9 sec), and woke-up on every CO2 trial. In 3 mice in which we histologically confirmed both the expression of ArchT and the placement of the glass fiber in the Sert-DR nucleus, with the 593nm laser-ON, the arousal latency doubled (33.88 ± 0.76 sec) and in 19.04 ± 1.9% of the trials mice did not wake up to CO2 stimulus. In these mice, a dense fiber and terminal field of ArchT-GFP was also observed in the PBel nucleus. Comparison of Sert-DR inhibition to that of inhibition of CGRP-PBel, shows that the latter is almost 2 fold higher.

Conclusion: These results suggest that Sert-DR neurons are part of the neural circuitry that regulates the cortical EEG arousals to hypercapnia, presumably by projecting to the CGRP-PBel. Current studies are underway to dissect the role of Sert-DR on the CGRP-PBel neurons in causing CO2 induced-arousal.

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0142

DECREASED REGIONAL HOMOGENEITY IN THE DEFAULT MODE NETWORK IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) subjects show structural brain injury in a set of interacting cortical sites, the ventral medial prefrontal (vMPF), inferior parietal lobule (IPL), and posterior cingulate cortices (PCC). These areas constitute a unique resting-state circuit dubbed the "default mode network" (DMN), involved in thoughtless behavior, self-referential processing, sleep, and mood regulation. However, the relationship between OSA severity and the DMN integrity remains unclear, a concern, since mood disorders are common in OSA. Our aim was to examine DMN and the relationships with apnea-hypopnea index (AHI) using regional homogeneity (ReHo) procedures in OSA.
Methods: We acquired resting-state functional MRI scans from 67 newly-diagnosed, treatment-naïve OSA (age 48.0±9.2years; AHI, 35.6±23.5 events/hour; 51 male) and 73 healthy controls (age 47.1±9.3years; 56 male) using a 3.0-Tesla scanner, and assessed mood (Beck Depression Inventory II, BDI-II; Beck Anxiety Inventory, BAI) as well as sleep variables (Epworth Sleepiness Scale, ESS; Pittsburgh Sleep Quality Index, PSQI). After standard pre-processing steps, we calculated whole-brain ReHo maps of each subject by evaluating homogeneity similarity between each voxel and nearest neighbours, normalized to a common space. The ReHo maps were compared between groups using ANCOVA, and correlated with AHI using partial correlation procedures within OSA subjects (FDR corrected $p<0.05$; covariates: age and gender).
Results: No significant differences in age or gender appeared between groups. Both sleep (ESS, 9.8±4.9 vs 5.1±3.5; PSQI, 8.8±4.1 vs 3.6±2.4) and mood scores (BDI-II, 8.4±8.1 vs 3.7±4.9; BAI, 9.4±11.0 vs 3.4±4.5) were significantly higher in OSA over control subjects ($p<0.01$). Significantly reduced ReHo appeared in multiple sites of the DMN, including the vMPF, IPL, and PCC in OSA compared to controls. Lower ReHo in the PCC was associated with higher AHI within OSA subjects ($r=-0.526$, $p<0.001$).
Conclusion: DMN is compromised in OSA, indicating that this resting-state network may mediate affected mood and sleep issues. The finding of a negative relationship between AHI and regional synchrony of neural activities in the DMN indicates that disease severity can contribute significantly to DMN integrity, and consequently, mood behaviors mediated by that circuitry.
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0143

CARBACHOL INHIBITS GLUTAMATERGIC INPUT TO MOUSE HYPOGLOSSAL MOTOR NEURONS - A MECHANISM FOR REM SLEEP SUPPRESSION OF GENIOGLOSSUS ACTIVITY

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Introduction: In REM sleep, the genioglossus (GG) muscle undergoes a dramatic suppression of activity. A current hypothesis is that the loss of GG activity during REM sleep is mediated by a combination of 1) monoaminergic disfacilitation and 2) a cholinergic inhibition of hypoglossal motor neurons. Strikingly, blockade of cholinergic receptors in the hypoglossal motor nucleus fully restores REM sleep tonic and inspiratory-modulated components of GG activity (Grace et al., 2013), suggesting that the cholinergic signal is largely responsible for the REM sleep suppression of GG activity. Respiratory rhythm generator neurons of the pre-Bötzinger complex drive the activation of hypoglossal motor neurons through glutamatergic premotor neurons in the parahypoglossal region (PH). In the current study, we investigate how cholinergic signaling affects the PH glutamatergic input to hypoglossal motor neurons.
Methods: We stereotaxically injected the PH region of vGluT2-*cre* mice with a cre-dependent AAV-ChR2-mCherry to expressed channelrhodopsin2 (ChR2) in PH glutamatergic premotor neurons. We then performed whole-cell recordings in hypoglossal neurons while photostimulating PH glutamatergic inputs expressing ChR2.
Results: Photostimulation of the glutamatergic PH input evoked AMPA-mediated EPSCs in hypoglossal motor neurons. These photoevoked EPSCs were maintained in TTX, indicating direct connectivity between stimulated terminals and recorded hypoglossal motoneurons. Bath application of carbachol strongly inhibited the PH glutamatergic excitation of hypoglossal neurons via muscarinic receptors. The effect of carbachol on photoevoked EPSCs was maintained when 1) we blocked postsynaptic G-mediated effects by adding GDP-β-S in the recording pipette and 2) when we blocked action potential mediated transmission by adding TTX in the extracellular bath solution. These results indicate that carbachol inhibits PH input to hypoglossal motoneurons through a presynaptic mechanism.
Conclusion: Our results provide a possible mechanism for cholinergic inhibition of the hypoglossal motor neurons in REM sleep. We propose that the cholinergic presynaptic suppression of the excitatory drive from the PH premotor neurons can be responsible for the reduction in activity of hypoglossal motor neurons in REM sleep.
Support (If Any): P01HL095491.

0144

ACTIVATION OF GLUTAMATE CELLS IN THE SUBCOERLEUS NUCLEUS TRIGGERS CATAPLEXY-LIKE ATTACKS IN WILD-TYPE MICE

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Introduction: Cataplexy is characterized by the sudden uncontrollable loss in skeletal muscle tone during wakefulness and is hypothesized to be triggered by the same brainstem circuits that generate REM sleep. Recently, we determined that glutamate neurons in the subcoeruleus nucleus (SubC) are an important neural substrate for controlling REM sleep. Here, we aimed to determine if optogenetic activation of glutamate neurons in the SubC could produce cataplexy in wild-type mice.
Methods: To manipulate glutamate neurons of the SubC we bilaterally infused 200nL of an adeno-associated viral vector (AAV) containing a stabilized step-function opsin (AAV-EF1a-DIO-hChR2(C128S/D156A)-mCherry) into the SubC of mice expressing cre-recombinase in glutamate cells (vglut-cre). Animals were instrumented with EEG and EMG electrodes in order to monitor sleep-wake behaviors. SubC neurons were stimulated with brief pulses of blue light (50ms) applied every 10s for 1 hour, after which a single pulse of green light (50ms) was applied to terminate neuronal activation. Only animals with opsin expression and optic fibres targeted to the SubC were used for analysis.
Results: Under baseline conditions mice exhibited typical amounts of wake, non-REM and REM sleep and showed no evidence of cataplexy. However, activation of glutamate cells in the SubC triggered repeated behavioural arrests that strongly resembled cataplexy attacks in narcoleptic mice. During the 1-hour stimulation period mice experienced

42 ± 4 (n=2) cataplexy-like attacks that were 65 ± 5s in length. However, cataplexy-like attacks disappeared, and normal sleep-wake behaviours resumed, after SubC stimulation was optically terminated.
Conclusion: Our results suggest that glutamate cells in the SubC are a potential neural substrate for triggering muscle paralysis during cataplexy.
Support (If Any):

0145

CATAPLEXY PRODUCES MUSCLE PARALYSIS BY RECRUITING THE REM SLEEP CIRCUIT

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Introduction: Cataplexy, a symptom of narcolepsy, is defined as the abrupt and uncontrollable onset of skeletal muscle paralysis during wakefulness. It has been hypothesized that cataplexy results from inappropriate intrusion of REM sleep paralysis into wakefulness. The mechanism of muscle paralysis in cataplexy is unclear, but is thought to result from pathological recruitment of the subcoeruleus nucleus (SubC) that generates REM sleep paralysis. Here, we show that activation of SubC neurons promotes cataplexy in narcoleptic mice, whereas, its inhibition reduces it.
Methods: We bilaterally infused 400nL of an AAV harboring a modified G-protein coupled receptor (AAV-HSYN-hm3D(Gq)-mCherry or AAV-HSYN-hm4D(Gi)-mCherry) or an inert fluorophore (AAV-HSYN-GFP) into the SubC region of narcoleptic mice. Animals were instrumented for EEG and EMG recordings. Administration of clozapine-N-oxide (CNO, 0.5mg/kg and/or 5mg/kg) was used to activate/inhibit SubC neurons expressing modified receptors. Sleep/wake data was analyzed for 3 hours following CNO administration.
Results: SubC activation in narcoleptic mice triggered a dose dependent increase in the number of cataplexy episodes (0.5mg/kg CNO: hm3D(Gq) x=25 ± 4.1, n=9 vs. control x=2 ± 0.6, n=3, $p<0.05$; 5mg/kg CNO: hm3D(Gq) x=64 ± 12.4, n=9 vs. control x= 3.3 ± 0.9, n=3, $p<0.05$) and in overall time spent in cataplexy (0.5mg/kg CNO: hm3D(Gq) x=14.6 ± 2.9% vs. control x= 0.6 ± 0.14%, $p<0.05$; 5mg/kg CNO: hm3D(Gq) x=33.3 ± 6.9% vs. control x= 0.9 ± 0.34%, $p<0.05$). Consistent with our hypothesis, inhibition of SubC neurons resulted in a 58% reduction in cataplexy (n=4, $p<0.05$).
Conclusion: These results support our long-standing hypothesis that a REM sleep mechanism modulates muscle paralysis during cataplexy.
Support (If Any): This research was funded by the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Ontario Graduate Scholarship (OGS).

0146

IMMUNIZATION WITH HEAT-KILLED MYCOBACTERIUM VACCAE INCREASES TOTAL SLEEP AND REM SLEEP, AND CHANGES NREM ARCHITECTURE IN MICE

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Introduction: Recent evidence has revealed host-microbe interactions to be important in many physiological and psychological processes. Immunization with heat-killed Mycobacterium vaccae, an environmental bacterium and known immunomodulator, has been shown to alter the gut microbiota and promote stress resilience in mice. The mechanisms by which M. vaccae exerts these effects, however, are unknown. We sought to investigate the effects of heat-killed M. vaccae immunization on sleep, aspects of which are crucial to emotional memory processing and stress coping.

Methods: Mice (C57BL/6N; Charles River) were surgically implanted with EEG/EMG recording devices, allowed to recover for one week, then given three weekly injections of heat-killed M. vaccae preparation (n=10) or vehicle control (n=6). Sleep was recorded in the mice before, during, and after the three injection weeks. Sleep files were scored by custom automated sleep scoring software, then manually reviewed.

Results: There were no differences between groups until after the third M. vaccae injection, at which point mice immunized with M. vaccae slept 33.4 min more per 24 hr than mice given vehicle control injections (620.5 ± 10.5 min vs 586.8 ± 6.5 min; p=0.03). This increase in overall sleep was accompanied by a significant increase in REM sleep (82.3 ± 1.9 min vs 71.0 ± 5.1 min; p=0.02). Total 24 hr amount of NREM sleep was non-significantly increased by M. vaccae (538.0 ± 10.5 min vs 515.8 ± 9.8 min; p=0.17), though timing of NREM was changed as evidenced by a treatment by time interaction on two-way ANOVA (p=0.004).

Conclusion: This study shows that Mycobacterium vaccae, an immunomodulator that is known to affect the gut microbiota and increase stress robustness, also alters sleep in mice. This includes an increase in REM sleep, which is thought to be an essential and adaptive part of emotional memory processing. Importantly, the result provides more evidence that host-microbial interactions are involved in crucial physiological and psychological processes and that effective counter-measures targeting the microbiota provide a promising avenue to promote health and performance.

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0147

FROM THE HOME TEAM TO HOME RUNS: HOW JET LAG IMPACTS MAJOR LEAGUE BASEBALL

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Introduction: Understanding the impact of misalignment of circadian clocks with 24 h environmental cycles outside of the laboratory has been challenging. The quantitative examination of athletic performance after long distance east-west jet travel provides a ripe opportunity to reveal these effects.

Methods: Here we examined data from over 40,000 games over a 20-year period of the data-rich sport of Major League Baseball (MLB). In part by applying a multivariable regression analysis, we accounted for the confounding variables of team/stadium, travel direction and home/away status to isolate the effects of jet lag on performance measures.

Results: As expected for circadian misalignment, the impact of travel was more evident after eastward travel than westward travel. Eastward travel however more strongly affected the home team offense, i.e., upon travel returning home, but much less so the away team offense. In contrast, eastward travel strongly impacted defensive performance of both home and away teams. In fact, we found that virtually the entire effect could be explained by an increase in the number of home runs allowed by jet-lagged teams. The size of this effect is large enough to essentially negate the home field advantage.

Conclusion: Our analysis of this extensive MLB dataset reveals that jet lag assessed under natural conditions impairs specific features of human performance.

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0148

ASSOCIATION BETWEEN LATE-NIGHT TWEETING AND NEXT DAY GAME PERFORMANCE AMONG NBA BASKETBALL PLAYERS

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Introduction: The adverse effects of sleep deprivation on athletic performance are widely accepted, especially among sports requiring motor coordination, tactical decision-making, and aerobic physical exertion. However, there is limited research assessing the real-world effects (e.g., points scored) of sleep deprivation on elite athletes.

Methods: We combined two publicly available databases to assess the association between late-night tweeting behavior and next-day performance among 90 National Basketball Association (NBA) players. Twitter© account activity was obtained using the Twitter REST API, while Yahoo Sports (Inc.) provided statistics from NBA players during in-season games. Starting from a set of 581,190 tweets on Twitter's NBA-related list, we filtered the dataset down to 19,705 tweets from verified Twitter accounts from real NBA players with who played in recent seasons, between 2009–2016. We focused on East Coast teams playing on the East Coast to avoid the potentially confounding effects of prolonged travel and jetlag on tweeting behavior and performance. Late-night tweets were defined as those occurring between 11:00 pm on the night prior to gameday and 7:00 am on gameday. Performance variables included total points scored, shooting percentage, assists, defensive rebounds, turnovers and player fouls. Within-subjects analysis was performed.

Results: Preliminary analyses show that late-night tweeting was associated with fewer points scored per game (8.2 vs. 9.2, $p<0.01$) and a lower shooting percentage for both field goals (36% vs. 41%, $p<0.01$) and free throws (39% vs. 44%, $p<0.01$). Planned additional analyses include assists, defensive rebounds, turnovers and player fouls.

Conclusion: Late-night tweeting behavior among a relatively large cohort of professional basketball players across multiple seasons is significantly associated with decreased next-day performance. Furthermore, the use of Twitter account activity may have broad utility as a readily accessible tool in the investigation of sleep deprivation in a variety of epidemiological contexts.

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0149

SLEEP DEPRIVATION INCREASES THE COSTS OF ATTENTIONAL EFFORT: PERFORMANCE, PREFERENCE AND PUPIL SIZE

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Introduction: Vigilance performance is experienced as effortful and relies on limited cognitive resources. Recent theories propose that effort allocation is regulated through a continuous cost-benefit analysis, in which effort is considered a cost that is weighed against potential benefits (e.g. monetary reward). The willingness to exert effort is higher when expected benefits are larger. Conversely, rewards are considered less attractive if more effort is required to obtain them (effort discounting). As vigilance performance is heavily affected by sleep deprivation (SD), it is important to examine how SD impacts on this cost-benefit weighting of effortful attention.
Methods: Two methodological approaches were used to investigate this matter. First, we tested whether incentives improved vigilance performance, and whether this was altered after a night of SD. Participants (N=25) performed the Psychomotor Vigilance Task (PVT) under different incentive conditions (1, 5, or 15 cent/fast response [individually defined]). Subsequently, reward devaluation was measured using a discounting task in which participants indicated their preference for rewards that were available upon performance of different durations of PVT (1, 5, 10, 20 or 30 min). All tasks were performed once after a night of sleep, and once after SD (in counterbalanced order). During PVT performance, pupil diameter was monitored as a measure of attentional effort and arousal.
Results: Overall, PVT performance improved in higher reward runs. This effect was accompanied by increased pupil size, indicating higher attentional effort. Although performance was poorer during SD for all runs, this SD-effect was most pronounced when rewards were low. Results form the discounting task showed that participants clearly devalued rewards that were contingent on longer task performance. Importantly, this discounting effect was steeper after SD.
Conclusion: Findings from both tasks confirm that the allocation of attentional effort in vigilance performance is subject to a cost-benefit analysis, and that the subjective costs of vigilance are increased after SD.
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0150

MISALIGNED MEALS COMPROMISE REPRODUCTIVE SUCCESS IN MICE

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Introduction: Shift work has deleterious effects on reproductive health and has been linked to irregular menstrual cycles, endometriosis, reduced fertility, increased miscarriage, and low birth weight. These effects may be due to disruptions of the circadian timing system. Therefore, we tested the hypothesis that mis-timed food, a common disruptive feature of shift work, would impair reproductive success in mice.
Methods: Male and female Per2::Luc mice that carry a fusion protein of Per2 and luciferase were fed either during their active or inactive phases. Circadian desynchrony was verified by in vivo imaging of antiphase Per2 oscillations in the liver. Prior to pairing, estrus cycling was monitored in all females for three weeks. Males and females, balanced for age and body weight, were then paired. Copulatory behavior (inferred from copulatory plugs), pregnancy, litter sizes, and uterine implantation sites (stained with ammonium sulfide), were measured in both groups. Reproductive tissues were collected for phase assessment by real time PCR.
Results: Food timing determined the phase of the circadian clock in the ovary and uterus, suggesting that internal desynchrony caused by restricted feeding extends to the reproductive system. Mice fed during their inactive phase had significantly fewer litters (25% versus 73%, Chi2 test, $p<0.05$). This was likely due to a reduction in mating behavior, as the number of females with copulatory plugs was similarly reduced in the inactive phase feeding group (42% versus 82%, Chi2 test, $p<0.05$). Surprisingly, there was no evidence of a difference in estrus cycle stability. Litter size and the number of spontaneous abortions did not differ between groups.
Conclusion: Mis-timed feeding disrupts circadian phase in reproductive tissues and inhibits reproductive success in mice by reducing copulatory success.
Support (If Any): Oregon Institute of Occupational Health Sciences Pilot Project Grant.

0151

COMPARISON OF THE EFFECTS OF ACUTE TOTAL SLEEP DEPRIVATION, CHRONIC SLEEP RESTRICTION AND RECOVERY SLEEP ON POSITIVE AFFECT

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Introduction: Positive affect helps people in coping with difficult situations. People with high positive affect have been shown to be happier, have more success in life and better relationships than people scoring low. Positive affect is reduced during chronic and acute sleep loss. The aims of the present study were 1) to establish the adverse effect of 5 days of sleep restriction on positive affect, 2) to test whether one night of recovery sleep reverses this effect, and 3) to test whether the combined effects of prior sleep restriction and acute sleep deprivation are cumulative.
Methods: In an ongoing investigation, 27 healthy volunteers completed two baseline nights (8h TIB) and either five nights of sleep restriction (experimental group: 5h TIB, N=18, mean age 26 ± 3 years, 9 females) or regular sleep (control group: 8h TIB, N=9, mean age 25 ± 5 years, 3 females). Thereafter, all participants had 8h of recovery sleep and 38h of total sleep deprivation. Participants filled out the mood scale PANAS at 9 a.m. on all days. Differences in the positive affect subscale between experimental days and the second baseline day were calculated.
Results: Wilcoxon signed-rank tests with Bonferroni-adjusted alpha-level showed a decrease in positive affect after one night of sleep restriction ($\Delta 5.06 \pm 3.78$; $p<.001$). Positive affect scores of the last day of chronic sleep restriction and of the day after recovery sleep did not differ ($\Delta 1.33 \pm 4.67$; $p=.18$). Positive affect decreased from the last day of chronic sleep restriction to acute sleep deprivation ($\Delta 4.11 \pm 4.27$; $p=.001$) for the experimental group. No significant difference was found between chronic sleep restriction (last day) in the experimental group and total sleep deprivation in the control group (Mann-Whitney-U-Test, $z(26)=-1.24$; $p=.5$).
Conclusion: Chronic sleep loss for five days exhibited long-lasting effects on the reduction of positive affect which were not reset by one recovery night. Positive affect decreased further following acute sleep deprivation, indicating that people's sleep curtailing lifestyles

make them more vulnerable to additional acute sleep loss. Five days of chronically reduced sleep exhibited a comparable reduction in positive affect as a sleepless night.
Support (If Any):

0152

SLEEP DEPRIVATION INCREASES COCAINE SEEKING

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Introduction: The role of sleep or lack of it in substance abuse is not well understood. There is evidence of a bidirectional relationship between drug and sleep loss in the development of or persistence of substance abuse. Drug use alters sleep and conversely sleep alterations are likely to alter drug related behavior. We sought to determine whether sleep loss was sufficient to influence the rewarding properties of cocaine in drug naive animals and tested the hypothesis that acute sleep deprivation would increase preference for cocaine.
Methods: Adult male mice underwent unbiased conditioned place preference (CPP) training using a three chambered CPP box. The protocol consisted of a pre-test to ensure a lack of side bias, followed by alternating daily cocaine and saline pairings, and a 20 min post-test. Doors between compartments were open during the pre and post-tests and closed during the pairings. Mice were sleep deprived via a slowly moving treadmill belt or allowed to sleep undisturbed. For CPP expression, mice were deprived of sleep immediately prior to the post-test (experimental) or allowed to sleep undisturbed (control). Alternatively, for CPP acquisition, mice were deprived of sleep immediately prior to the cocaine-paired trials (experimental) or prior to saline-paired trials (control). Two doses of cocaine were used; a medium, reinforcing, dose (8mg/kg) and a low, non-reinforcing, dose (3mg/kg).
Results: As expected, control mice showed preference for the cocaine-paired side under both CPP expression and acquisition with a medium dose of cocaine, but did not show preference to a low dose of cocaine. Sleep deprivation enhanced CPP expression and acquisition compared to control conditions at the medium dose and preliminary evidence suggests that sleep deprivation induces CPP acquisition to a low dose of cocaine.
Conclusion: These results support the hypothesis that acute sleep deprivation increases drug seeking.
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0153

FATIGUE RISK MANAGEMENT BY PRIOR SLEEP WAKE MODEL (PSWM): TOO EASY TO BE RELIABLE?

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Introduction: Fatigue from sleep loss and circadian misalignment degrades performance and jeopardizes workplace productivity and safety. Mathematical models have been developed to help predict and manage fatigue, but data needed to inform model predictions are often not available. This constraint has inspired a simple rule of thumb approach, the Prior Sleep Wake Model (PSWM), to determine when fatigue becomes an unacceptable risk in the workplace. The PSWM is based on three simple criteria: <5h sleep in prior 24h; <12h sleep in prior 48h; current time awake exceeds amount of sleep in prior 48h. When these criteria are met, an individual is assumed to be operating with an unsafe level of fatigue. We investigated the effectiveness of the PSWM in a naturalistic field study of commercial motor vehicle drivers.
Methods: Sleep and performance were measured in N=105 truck drivers (ages 24–69; 6 females) for two consecutive duty cycles. Sleep was measured continuously by means of wrist actigraphy. Performance was measured three times per day with a 3min Psychomotor Vigilance Test (PVT-B), for which lapses (RT>355ms) were determined. Mixed-effects ANOVA was used to compare PVT-B performance by whether or not drivers were operating with an unsafe level of fatigue according to the PSWM.
Results: There were 2,589 performance measurements, of which 6.8% were classified as unsafe due to fatigue per the PSWM. Performance was significantly worse under conditions classified as unsafe due to fatigue (F=8.14, P=0.004). However, for 20.6% of performance measurements not classified as unsafe, performance was worse than the mean of performance measurements classified as unsafe. Conversely, for 51.2% of performance measurements classified as unsafe, performance was better than the mean of performance measurements not classified as unsafe.
Conclusion: Based on PVT-B performance during a naturalistic field study of commercial motor vehicle drivers, the PSWM exhibited low sensitivity and poor specificity to differentiate relatively safe from unsafe levels of fatigue. The rule of thumb approach of the PSWM does not offer a suitable alternative to mathematical models developed to help predict and manage fatigue.
Support (If Any): FMCSA award DTMC75-12-J-00049.

0154

IMPAIRED COGNITIVE FLEXIBILITY DUE TO SLEEP DEPRIVATION PREDICTS DEGRADED DEADLY FORCE DECISION-MAKING IN HIGH-FIDELITY LAW ENFORCEMENT SIMULATIONS

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Introduction: Sleep deprivation (SD) poses risks to safety and effectiveness in a wide range of critical decision-making contexts. Using high-fidelity simulators, we investigated whether SD impairs response flexibility to potential threats in deadly force decision-making (DFDM) scenarios.
Methods: In a laboratory study involving 34h total SD (n=37) or well-rested control (n=20), healthy civilians (22-37y; 28F) participated in DFDM test sessions during a baseline day and a SD / control day. In the DFDM simulator, subjects took the perspective of a law enforcement officer responding to scenarios (domestic disturbances, vehicle stops, suspicious persons) leading to deadly force decision points. Subjects were to use force to minimize danger to bystanders or themselves and neutralize threats from assailants, but only when appropriate for the simulated situation. Each session contained four scenarios introduced with a cue regarding whether to expect a threat. Half the cues were congruent with the scenario's threat level and half were incongruent. DFDM performance was quantified with hits and false alarms across scenarios. Prior to each DFDM session, subjects performed an AX-continuous performance test (AX-CPT) of cognitive flexibility. They were to respond to a target letter, but only if it was preceded by a valid cue letter. After 40 trials, the target and valid cue changed; cognitive flexibility was quantified by error rate across 48 trials after the change. Every 2h while awake, subjects performed a psychomotor vigilance test (PVT) of behavior alertness. Each day's performance (10:00-22:00) was quantified by average number of lapses (response times >500ms).

Results: AX-CPT cognitive flexibility was significantly reduced by SD (F=13.75, P<0.001) and predicted DFDM performance (F=4.65, P=0.036). PVT behavioral alertness was also significantly reduced by SD (F=38.74, P<0.001) but did not predict DFDM performance (F<0.01, P=0.95).
Conclusion: SD impaired cognitive flexibility, which predicted degraded DFDM in high-fidelity law enforcement simulations with congruent and incongruent cues.
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0155

SLEEP WHILE ON-CALL OVERNIGHT DOES NOT RESTORE PERFORMANCE AMONG FIRST-YEAR RESIDENT PHYSICIANS

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Introduction: It has recently been reported that providing resident physicians with 3- or 5-hour protected windows for sleep during an on-call night increases the amount of sleep obtained and improves next-day performance relative to an on-call night with no protected window, in contrast to earlier findings. These studies have not reported, however, the relationship between the amount of sleep during this protected window and the degree of improvement in performance, and whether performance is sufficiently restored to warrant such an intervention. Here, we explored the dose-response relationship between amount of sleep during an on-call night and next-day performance.
Methods: We analyzed data from 34 postgraduate-year 1 resident physicians (23 males; 28.0 ± 1.8 years old) studied for 3 weeks on a Q3 schedule (24-30-hour on-call extended duration work shift [EDWS] every other shift). Resident physicians completed daily sleep/work logs (validated by ambulatory polysomnography) and 10-min psychomotor vigilance tests (PVTs) every ~6 hours during each EDWS. We used a generalized estimating equation to examine the correlation between spontaneous sleep amounts (0, >0–1, >1–2, >2–3, >3–4, and >4 h bins) overnight during the EDWS (23:00-07:00) and next-day (05:00-19:00) PVT attentional failures (reaction time >500 ms). Time of day of PVT and study week were included as covariates.
Results: A total of 296 PVTs were analyzed. Compared to no sleep overnight, >4 hours of actual sleep (4.15–6.33 h) was required before a significant reduction in next-day PVT attentional failures was observed (p=0.0237). Sleeping <4 hours did not significantly improve performance (p>0.05). Even following >4 hours of sleep, PVT performance remained impaired, with 2 or more attentional failures on 68% of tests and 5 or more attentional failures on 39% of tests.
Conclusion: Our data show that resident physicians need >4 hours of sleep on-call overnight to improve next-day PVT performance. Performance remained suboptimal despite this relative improvement, highlighting the substantial sleep deficiency inherent in EDWS. Given that 3- and 5-hour 'protected' windows result in far less than 4 hours of total sleep, our findings challenge reports that such protected time during an on-call shift is sufficient to maintain optimal next-day performance.
Support (If Any): NHLBI-4U01HL111478/NIOSH-R01OH07567/AHRQ-R01HS12032/NCRR-M01RR02635/UL1-RR025758/NHLBI-T32HL079010/NSBRI-NASA-NCC-9–58.

0156

ADDITIVE EFFECTS OF THE NUMBER OF COMPLETED FLIGHTS AND TIME AWAKE ON FATIGUE IN SHORT-HAUL AIRLINE PILOTS

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Introduction: Time awake more so than the duration of the flight duty period affects airline pilots' fatigue, consistent with current models of sleep-wake regulation. It is less clear, however, whether the quality of the time awake impacts fatigue. Although current flight time limitations take the number of flights within a duty period as a measure of workload into account, quantitative evidence for its fatiguing effect is scarce.
Methods: Fatigue (Samn-Perelli 20-point scale) and workload ratings (NASA-Task-Load-Index) were obtained at the end of each of 553 short-haul flights from 37 pilots operating regular rosters. Pilots also checked off from a predefined list the hassles (e.g. critical fuel status, unforeseen aircraft change, bad weather, no break between flights etc.) experienced during each flight. A linear mixed-model with fatigue as dependent variable was adjusted for time awake, number of completed flights, number of hassles, and pilot's responsibility (flying/monitoring). In addition, we tested (linear mixed-model) the influence of number of hassles, number of flights, time awake, and pilot's responsibility on subjective workload. Linearity of the predictors, and absence of multicollinearity were verified.
Results: Fatigue was influenced by time awake, number of flights and pilot's responsibility (p<0.05), whereas no effect was found for number of hassles. Fatigue increased by 0.4 points with every hour awake, and by 0.3 points with every completed flight (other variables kept constant). Fatigue was lower by 0.4 points when the pilot was flying instead of monitoring. Assuming one completed flight fatigue exceeded the critical threshold of 12 points (flying duty not recommended) after 17.1h awake, whereas with four completed flights this threshold was crossed already after 14.7h. Subjective workload increased with number of hassles, but not with number of flights or time awake.
Conclusion: Objective workload measured by the number of completed flights contributes to fatigue, adding to the time-awake effect. Subjective workload assessed by the NASA-Task-Load-Index increases with the number of hassles, but not with the number of flights, indicating that this instrument is not sensitive to this type of objective workload.
Support (If Any): This research was supported by the Air Traffic Program of the German Aerospace Center.

0157

A BRAIN-SPECIFIC LIPID TRANSPORTER MODULATES NEURONAL AND BEHAVIORAL AROUSAL

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Introduction: Phosphatidylinositol transfer proteins (PITPs) regulate phosphoinositide metabolism and play diverse roles in multicellular organisms, from cancer regulation to sensory neuron signal

transduction. One class II PITP family member, Piptnc1, has been implicated in cancer metastasis yet is also expressed in the developing and adult vertebrate brain. Its endogenous function is unknown. We have discovered that zebrafish mutants that lack Piptnc1a are behaviourally hyperactive due to the hyper-activation of neurons implicated in arousal and found small molecule inhibitors capable of rescuing these phenotypes.

Methods: Using Crispr/Cas9 mediated gene editing, we deleted the zebrafish ortholog *piptnc1a.* To discover neurological phenotypes, we then video monitored *piptnc1a* mutants and wild type sibling behaviour. We examined neuronal activity patterns via expression of immediate early genes and brain-wide changes in phosphorylated ERK, a readout of neuronal activity. Morphing these maps onto reference brains identified discretely affected neuronal populations. Finally, we discovered drugs capable of rescuing the neuronal and behavioural mutant phenotypes by testing the *piptnc1a* mutants' responses to a dose series of small molecules.

Results: Compared to wild type and heterozygous siblings, *piptnc1a* mutants are behaviourally hyperactive across the 24 hour day/night cycle. Consistent with the behaviour, piptnc1a mutants show a dramatic upregulation *c-fos* as well as elevated P-ERK levels in several arousing nuclei, including the hypocretin/orexin neurons. *In vitro* characterization of mammalian PIPTNC1 function revealed that knockdown of PIPTNC1 levels led to a strong induction of the Pi3 kinase-AKT signal transduction pathway. Remarkably, at doses with no discernible effect on wild type siblings, both Pi3K and AKT small molecule inhibitors return *piptnc1a* mutant *c-fos* levels to baseline and also rescues mutant behavioural hyperactivity.

Conclusion: We conclude that *piptnc1a* is required to maintain proper signalling via the Pi3K-AKT pathway in neurons involved in vertebrate arousal. When this pathway is upregulated, neurons that increase arousal are hyper-activated, leading to an improper setpoint for behavioural activity.

Support (If Any):

0158

CHRONOTYPES IN THE US - INFLUENCE OF AGE AND SEX

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Introduction: Chronotype reflects how the circadian system embeds itself into the 24-h day with rhythms in physiology and behavior occurring accordingly earlier or later. As the number of workers with unusual work schedules increases, the wide range in chronotypes may provide opportunities to allow people to work (and sleep) at times that are in synch with their circadian physiology. Before such interventions can be designed, it is critical that we describe the distribution of chronotypes at the population level and how chronotype changes with age.

Methods: 12 years (2003–2014) of diary data from the American Time Use Survey (ATUS) were pooled to calculate chronotype based on the mid-point of weekend sleep (MSF^{We}). Employed, unemployed or retired respondents were included; for chronotype calculation, only the longest sleep bout (3-14h) within each individual was considered and mid-sleeps during the daytime (12:00-20:00) were excluded. All analyses used ATUS weights to compensate for the survey's oversampling of certain demographic groups.

Results: 53,689 respondents (56.3% female) met the inclusion criteria. We observed a near-normal overall distribution (spanning ~10h) and within each age group, indicating that very early and very late chronotypes are present at all ages. The distribution's mean changes systematically with age: chronotype (MSF^{We}) grows later during adolescence reaching its peak in 'lateness' at ~19y, and advances steadily thereafter. Males delay faster between ages 15 and 20 and advance more slowly from 20 to 40, resulting in a later chronotype on average than females during this period. This pattern is reversed after 40 years of age, when males show earlier chronotypes than females (by the same magnitude of ~15min). Both genders experienced the greatest changes during adolescence and early adulthood covering more than 50% of the lifelong change in chronotype. While the variability of chronotype decreases with age, it is generally greater in males than females.

Conclusion: This is the first study of the US population to estimate the distribution of individual chronotypes in a large-scale, nationally representative cohort from the ATUS. Distinct age- and sex-specific patterns are observed that will inform optimal school and work times.

Support (If Any): N/A.

0159

LABORATORY-BASED SLEEP RESTRICTION ENHANCES THE CORTISOL AWAKENING RESPONSE IN HEALTHY ADULTS

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Introduction: Sleep restriction is related to risk for stress-related symptoms and disease processes. The cortisol awakening response (CAR) is the increase in cortisol observed immediately post-awakening in the morning. CAR is an indicator of an individual's readiness to maintain alertness and psychological function in response to demands of the upcoming day. CAR is affected by insufficient sleep, though the direct effect of extended sleep restriction on CAR is not known. We examined profiles of CAR of healthy good-sleeping young adults in response to extended moderate sleep restriction and subsequent sleep recovery.

Methods: Healthy participants [N=48; M(SD) age: 25.4(3.9); 39.4% Female] underwent sleep satiation (5 nights/10h time in bed [TIB]), extended sleep restriction (5 nights/5 h TIB; 0200-0700), and sleep recovery (3 nights/8h TIB). Salivary cortisol was collected 5-, 30-, and 45-minutes post-awakening following sleep satiation (baseline), and every morning following sleep restriction and recovery evenings. CAR was quantified using area under the curve relative to ground (AUC-G).

Results: Linear mixed effects models were used to examine baseline-to-sleep restriction and baseline-to-recovery AUC-G trends. AUC-G increased linearly from baseline across sleep restriction (b=.06, SE=.02, t=2.8, p=.007), and remained elevated relative to baseline following the sleep recovery (b=.03, SE=.01, t=2.4, p=.02). Model fit was not improved including age and sex as covariates.

Conclusion: Increased CAR across the restricted sleep period supports the notion that the CAR may represent an adaptive response to restricted sleep associated with arousal and anticipation to meet the demands of the upcoming day. We also observed a lack of recovery to baseline following 3 nights of recovery sleep. While acute increases in CAR may be related to the ability to effectively cope with the demands of a day following sleep loss, more prolonged or chronic sleep restriction and concurrent elevations in CAR may be related to health-compromising hypothalmic-pituitary-adrenocortical (HPA) function.

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0160

WAKE PROMOTION BY SUPRAMAMMILLARY NITRIC OXIDE NEURONS CRITICALLY DEPENDS ON GLUTAMATE RELEASE

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Introduction: The caudal hypothalamus contains a key node of the ascending arousal system, with lesions causing more profound somnolence than can be accounted for by involvement of nearby hypothalamic orexin and histamine cell groups.
Methods: We used chemogenetic manipulations and Cre-lox glutamate release disruption in anatomically- and genetically-targeted neuronal groups of the caudal hypothalamus and recorded EEG and EMG, with subsequent histological analysis of injection sites and terminal fields of transduced neurons. ANOVA was used for statistical analysis of sleep physiology and non-parametric statistical mapping was used to objectively determine the region that was wake-promoting in the caudal hypothalamus.
Results: Activation of glutamatergic supramammillary (SuM_{vglut2}) neurons or a subset of them that also express nitric oxide synthase (Nos1, $SuMV_{glut2/Nos1}$) is potently wake-promoting. Genetic disruption of glutamatergic neurotransmission from SuM_{vglut2} neurons nearly completely abolishes the effects of SuM activation. Targeted chemogenetic inhibition of SuM_{vglut2} neurons produced fragmented wakefulness and increased sleep, akin to drowsiness following caudal hypothalamic injury.
Conclusion: $SuM_{vglut2/Nos1}$ neurons exert potent control over behavioral wakefulness, with these effects depending critically on glutamate release. Glutamate neurons of the SuM, including a key subset that contain nitric oxide, likely represent the long-sought caudal hypothalamic component of the ascending arousal system.
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0161

ACTIVE AND PASSIVE BEDTIME SOCIAL TECHNOLOGY USE RELATED TO DAYTIME SLEEPINESS AND SLEEP

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Introduction: Social technology use today is virtually ubiquitous among younger cohorts resulting in students frequently sleeping with their smartphone in the bedroom, on the bedside table, on the bed, or under the pillow. We examined the relationship of active and passive social technology use with daytime sleepiness and sleep. Active social technology use was defined as initiating social technology use during bed time, whereas passive social technology use was defined as the potential for social technology sleep interruption in the absence of user action.
Methods: 258 university students (M=19.9 years old, SD=4.89) were recruited from introductory psychology courses and given extra credit for participation. Each participant completed the SHI with an additional question assessing active social technology use during bedtime: I check e-mail, texts, or social media during my sleep time (between going to bed and waking up), and a question addressing passive social technology use during sleep time: I sleep with my phone sounds or vibrations turned on where I could hear it if I were awake. Scores on the active and passive technology use questions were analyzed separately, and were combined to create a single combined bedtime technology use score. Participants also completed the Epworth Sleepiness Scale (ESS), the Pittsburg Sleep Quality Index (PSQI), additional questions regarding associated features of inadequate sleep hygiene, and demographic information.
Results: 60.5% and 70% of students reported frequently or always using active or passive bedtime social technology, respectively. More frequent combined bedtime social technology use was significantly related to greater daytime sleepiness (ESS) ($r(251)=.284$, $p<.05$), higher global PSQI scores ($r(237)=.201$, $p<.05$), and higher scores on the associated features of inadequate sleep hygiene including daytime sleepiness ($r(255)=.279$, $p<.05$), preoccupation with sleep ($r(253)=.237$, $p<.05$), mood disturbance ($r(253)=.230$, $p<.05$), avolition ($r(255)=.281$, $p<.05$), and reduced cognition ($r(255)=.291$, $p<.05$)).
Conclusion: Students were found to be frequent users of bedtime social technology. Active and passive bedtime social technology use was found to be related to poorer sleep quality, greater sleepiness, and increased features associated with inadequate sleep hygiene. Future research should investigate whether bed partner active and passive social technology use disrupts sleep.
Support (If Any): none.

0162

PILOT STUDY EXAMINING THE EFFECTS OF AIRCRAFT NOISE ON SLEEP IN COMMUNITIES NEAR PHILADELPHIA INTERNATIONAL AIRPORT

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Introduction: Aircraft noise can disturb sleep and impair recuperation. Field studies need to be conducted to develop exposure-response models that are representative of noise exposed communities around multiple airports to inform policy. A methodology of monitoring sleep and identifying awakenings based on ECG and actigraphy has been developed. This approach is non-invasive and study participants can use the equipment unattended which greatly reduces the methodological cost compared to polysomnography. To evaluate its feasibility, this methodology was implemented in a pilot field study conducted in the vicinity of Philadelphia International Airport.
Methods: Eighty participants were enrolled in the study; 39 exposed to nighttime aircraft noise (41% male, 22–77 years) and 40 from a control region (48% male, 22–68 years) completed measurements. Baseline sleep and health characteristics were obtained subjectively on the first day. The participants then completed three consecutive nights of unattended ECG and actigraphy measurements with concurrent sound recordings in their bedroom. Blood pressure and brief questionnaires subjectively assessing their sleep were additionally completed each morning.
Results: Linear mixed models were calculated, controlling for age, gender, and BMI, to examine differences between the two groups of participants. Individuals living near the airport reported poorer sleep quality on the PSQI ($p=0.0180$) and worse health on the SF-36 ($p=0.0074$) surveys. No statistically significant differences were found for the morning sleep assessments, diastolic ($p=0.7108$) and systolic ($p=0.3255$) blood pressure, or sleep fragmentation index ($p=0.6986$) (calculated based on the ECG and actigraphy data). A random effect logistic regression was calculated to examine whether the indoor noise level of single aircraft events related to objective measurements of awakenings. The coefficient for noise level was positive and statistically significant ($p=0.0094$).
Conclusion: This study demonstrates the feasibility of unattended physiological and noise measurements. The conflicting results between single event and cumulative sleep assessments require further investigation.

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0163

AMPLITUDE OF LIGHT EXPOSURE IS ASSOCIATED WITH MATERNAL HOSTILE ATTRIBUTIONS AND CHILD BEHAVIORAL PROBLEMS.

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Introduction: Light has potent effects on entraining circadian rhythms, including sleep and daily variations in cognitive performance. Additionally, light acutely influences cognition (e.g., alertness, cognitive flexibility) and mood-states. However, little work has examined associations between light and higher-order social cognition. In parent-child dyads, social cognitive factors have been linked to maladaptive parenting and poor child outcomes. If light exposure influences child behavior and social cognitive factors linked to parenting, light may have potential as a novel intervention for improving family functioning. The present study examines whether amplitude of light exposure is associated with maternal hostile attributions and child behavior in disadvantaged mother-child dyads.
Methods: Pilot study of 22 low-income mother-child dyads (mean ages mother = 29.08, child = 4.46 years). Light data were collected via wrist-worn photic sensors for 7 consecutive days. Circadian parameters were calculated with cosinor in R. Maternal hostile attributions and punishment were assessed with Child Vingettes and child behavior was assessed by the Child Behavioral Checklist.
Results: In children, lower light amplitude was significantly associated with parent- and teacher-reported withdrawn behaviors ($r = -.47$, $p = 0.02$ and $r = -.51$, $p = 0.03$, respectively) and showed trend-level associations with more anxious/depressed and aggressive behaviors. Higher light amplitude in mothers was associated with increased reports of children's anxious, depressed and emotionally reactive behaviors. Maternal light amplitude was associated with hostile attributions ($r = -.32$, $p = 0.08$) and punishment ($r = -.29$, $p = .10$) at trend levels, suggesting mothers may have overly negative perceptions of their children's behavior.
Conclusion: Findings suggest lower light amplitude in children is linked to more withdrawn and anxious/depressed behaviors. Lower maternal light amplitude was associated with increased maternal ratings of problem behavior in their child and tended to be associated with increased maternal hostile attributions and punishment. These findings suggest that light exposure may impact parent-child relationships by directly affecting specific aspects of parental social cognition as well as child behaviors. Consequently, light may have potential as a novel intervention to improve mother-child interactions.
Support (If Any): NICHD #R21HD082555, PSU Child, Youth and Family Consortium, PSU Social Science Research Institute.

0164

EFFECT OF A DAYLIGHT LED VERSUS A CONVENTIONAL LED SOLUTION ON VISUAL COMFORT, DAYTIME ALERTNESS AND SLEEP

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Introduction: Conventional LED light sources have a discontinuous light spectrum with a prominent "blue" peak between 450-480nm, which potentially impacts on human circadian physiology and sleep. Thus, we investigated the effects of an advanced LED source simulating the natural daylight spectrum on visual comfort, daytime alertness and sleep.
Methods: Twelve male young good sleepers spent twice 2.5-days in the laboratory once under a conventional (convLED) and once under a daylight simulating LED (dayLED) condition (16 hours LED exposure during scheduled wakefulness) in a balanced cross over design flanked by a 8-h baseline and a post-light exposure night. The same light settings were used for convLED and dayLED (100 photopic lux at the eye level with a color temperature of 4000K). However, the light spectrum and the color rendering index differed considerably between convLED and dayLED. Subjective visual comfort and sleepiness were continuously rated on conventional scales, and the PSGs were quantified for sleep stages and EEG spectral power density during nonREM sleep.
Results: The volunteers rated the light quality of the dayLED as being more pleasant than the convLED ($p=0.07$). They also felt significantly more alert during the dayLED condition compared to convLED ($p<0.01$), particularly in the morning/midday hours between 9 and 13h. In comparison to the baseline night, convLED significantly decreased the proportion of NREMS (-4.4 %, $p<0.03$) at the cost of REM sleep (+5.2%, $p<0.004$) and reduced EEG power density in the lower spindle frequency range between 11.5- 13.5 Hz ($p<0.04$), while such changes in sleep were not presented for dayLED.
Conclusion: We have preliminary evidence that a daylight LED lighting solution has beneficial effects on visual comfort and daytime alertness and does not affect all-night sleep EEG activity when compared to a conventional LED solution.
Support (If Any): This study was supported by Toshiba Materials.

0165

REPORTED LIGHT IN THE SLEEP ENVIRONMENT: VALIDITY OF A SLEEP DIARY

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Introduction: Light is the primary cue for the circadian system, and even relatively dim light can exert effects on the biological clock. Thus, measures of light exposure in the sleeping environment are critical for evaluating sleep health. While sleep diaries are an inexpensive, albeit subjective, alternative to actigraphy devices, they typically do not include light information. The addition of several questions addressing perception of light in the sleep environment may provide a crude yet affordable metric of relative photic intensity and photoreceptor stimulation in the sleeping environment.
Methods: 7–14 days of concurrent actigraphy and sleep diary data were collected from Emergency Room nurses and corpsmen (N=12, 133 nights). Four questions regarding perception of light, whether it was natural or artificial, and whether objects and color were visible in both the bedtime and waking environment were added to the Consensus Sleep Diary, Morning administration (CSD-M). Utilizing linear mixed models, responses were evaluated against actigraphy-derived sleep and photosensor measures from the beginning and end of each rest interval (± 2h).
Results: In our predominantly day-working sample (start time 0600), affirmative answers to all questions regarding the waking environment were associated with higher Total Sleep Time (all $p < 0.01$), and perception of natural light was associated with greater Wake After Sleep Onset ($p < 0.05$). Additionally, reported natural light and color in the waking environment were both associated with a greater number of minutes above 100 lux (both $p < 0.05$). No associations with questions regarding the bedtime lighting environment were found.

Conclusion: The addition of a few items to sleep diaries may provide meaningful information about light in the sleep environment and relate to sleep measures. Future analyses will examine light exposure more extensively, including exposure under additional thresholds and intervals.
Support (If Any): This research was supported by TriService Nursing Research Program grant number N16-503.

0166

MOVEMENT IMPAIRMENT AND SLEEP DISORDER CAUSED BY BILATERAL GLOBUS PALLIDUS EXTERNUS (GPE) INJECTION OF COPPER IN RATS

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Introduction: Copper accumulation in brain is common in many neurological diseases, such as Wilson's disease. However, the effect of copper in specific brain regions remains unclear.
Methods: 20 div of $CuCl_2$ (500 μM) was injected into bilateral globus pallidus externus (GPe) in Rats. EEG/EMG and the behavior using real-time video were recorded. The sleep and movement-related parameters and the behaviors monitored by the video were analyzed and quantified by the software.
Results: For sleep, compared with the control rats, the wakefulness of copper-treated rats was significantly decreased in 24h, and the NREM was significantly increased in the light period and 24 h, while the REM did not change significantly. For the movement, compared with the control rats, the movement of copper-treated rats in the transformation period from NREM to wake was significantly increased in the light period, dark period and 24 h. The movement in the transformation period from REM to wakefulness was significantly increased in dark period. The movement of REM was not significantly changed.
Conclusion: These data demonstrated that copper accumulation in GPe could cause movement deficits and sleep disorder, reminiscent of behavioral and sleep disorders as observed in Wilson's disease and Parkinson's disease. Our data suggested that GPe could be a crucial brain region involved in behavioral and sleep disorders in some neurological diseases such as Wilson's disease and Parkinson's disease. (Dr. Xifei Yang and Dr. Fei Qi have contributed equally to this work.)
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0167

INFLUENCE OF SUNLIGHT EXPOSURE ON DAYTIME COGNITIVE PERFORMANCE IN AN OFFICE SETTING

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Introduction: Traditional office buildings use a variety of primary light sources (e.g., LED/fluorescent lights). As interest in LEED certified office buildings increase and research has shown that enhanced lighting design improves human performance and alertness, more office buildings are incorporating a daylighting design. We investigated the differences between employee performance and alertness in two different building types (daylight vs. artificial light). We hypothesized that employee performance and alertness would be improved in a building designed to increase exposure to natural daylight compared to traditional office settings.
Methods: Participants were recruited from a LEED certified sustainable building (SUS), which used sunlight as its primary light source, and traditional office buildings (TRA), which used overhead florescent lights with varying exposures to natural light as their primary light source. Age and gender matched participants completed daily sleep diaries, wore actigraphy (Actiwatch II), and completed the Psychomotor Vigilance Task (PVT) three times a day (early morning, midday, afternoon) over a five-day period.
Results: Data from 40 participants were analyzed using *R* (mean age: 35.23 ± 11.97; 16 female). Paired t-tests performed for mean reaction time (SUS: 249.13 ± 29.93 vs. TRA: 244.51 ± 24.64; $t = .53$, $p = .60$, $d = .16$), lapses (SUS: 2.64 ± 2.00 vs. TRA: 1.83 ± 1.58; $t = 1.46$, $p = .16$, $d = .36$), and slowest 10% reaction time (SUS: 405.86 ± 104.12 vs. TRA: 359.44 ± 52.81; $t = 1.81$, $p = .09$, $d = .56$) revealed no significant differences between participants in the sustainable building and those in traditional office buildings.
Conclusion: No significant differences in PVT performance were seen between employees in the sustainable building and traditional office buildings. Further studies are required to determine whether exposure to sunlight during day work provides benefits to other aspects of health and wellness.
Support (If Any): N/A

0168

SLEEP DISRUPTION DUE TO ENVIRONMENTAL NOISE EXPOSURE INCREASES BODYWEIGHT GAIN AND FOOD INTAKE IN FEMALE RATS

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Introduction: Noise pollution is a public health concern that disturbs sleep and increases obesity risk with inherent sex differences. Women are more sensitive to noise, have worse sleep quality, more daytime somnolence and greater obesity risk relative to men. Independent of sleep or noise exposure, obesity and certain sleep disorders including insomnia are more prevalent in women. There is no pre-clinical model to identify mechanisms contributing to these sex-differences. We have shown that chronic exposure to environmental noise (8h/d, 9-d) reduces sleep time and quality and increases weight gain and food intake in male rats. Whether female rats exhibit similar responses to noise is unknown. Therefore, we determined the effect of noise exposure on weight gain and feeding in female rats. We hypothesized that like males, noise exposure would increase weight gain and feeding.
Methods: Female Sprague-Dawley (n=10/group) rats slept undisturbed (control) or were exposed to noise (8h/d, 17-d during the light cycle). Bodyweight, food intake and uneaten food were measured every 48 hours. Data were analyzed with two-way repeated measures ANOVA followed by Fisher's test to determine differences between treatments at each time point.

Results: There was a significant interaction between time and treatment for bodyweight gain ($F_{(8,144)}$=2.7, P < 0.0082) and food intake ($F_{(8,144)}$=6.1, P < 0.0001). Noise-exposed females gained significantly more weight and had greater food intake after 17-days of noise exposure compared to controls (weight gain (g): 29.8 ± 4.7 vs. 12.8 ± 3.0, P < 0.0001. food intake (g): 367.2 ± 5.0 vs. 335.3 ± 7.6, P < 0.0001, respectively). Weight gain and food intake was significantly greater in noise-exposed females on all treatment days (P < 0.05) excluding treatment day 5 for weight gain and treatment days 3 and 5 for food intake.
Conclusion: The increase in weight gain and feeding due to noise-induced sleep disruption is similar in male and female rats. These data have implications for future therapies to combat disordered sleep and obesity among women and identify mechanisms underlying sex-dependent differences in sleep disparities due to noise and obesity.
Support (If Any): Department of Veterans Affairs, USDA, University of AZ.

0169

SLEEP PATTERNS DURING DUTY PERIODS AND DURING OFF-DAYS BETWEEN DUTY CYCLES IN HOSPITAL EMPLOYEES WORKING 12-HOUR NIGHT SHIFTS

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Introduction: Around-the-clock operations are common in hospital settings. Employees working nights are forced by their work schedules to work at times when their circadian clock promotes sleep, and sleep at times when the circadian clock promotes wakefulness. Little is known about hospital night workers' sleep patterns during days off when not constrained by work schedules. We compared the sleep patterns of 12-hour night and day workers at two regional hospitals during duty cycles and during intervening off-days.
Methods: An online survey was accessible for one month to the employees of two regional hospitals in the USA's Inland Northwest. 1,340 surveys were submitted. Following data quality control, responses of 12-hour shift workers with duty start times of either 07:00 or 19:00 were selected, yielding n=193 day worker surveys and n=134 night worker surveys. We investigated reported bedtimes during duty cycles and between-cycles; global scores on the Pittsburgh Sleep Quality Index (PSQI); and subjective sleepiness on the Epworth Sleepiness Scale (ESS).
Results: Night workers went to bed in the morning during duty cycles (mean ± SD: 08:53 ± 46min) and in the evening during off-days (23:53 ± 152min), whereas day workers maintained bedtimes in the morning during both duty cycles (22:00 ± 53min) and off-days (22:40 ± 63min) (mixed-effects ANOVA interaction: F=112.6, P<0.001). Compared to day workers, night workers exhibited greater PSQI scores (day: 7.1, night: 8.3; Wilcoxon signed-rank test: Z=2.89, P=0.004) and ESS scores (day: 6.9, night: 8.0; Z=2.18, P=0.030). PSQI scores were >5 (clinically relevant poor sleep quality) for both groups.
Conclusion: Among hospital employees working 12-hour shifts, night workers reported significantly poorer sleep quality and greater subjective sleepiness than day workers. Self-reported bedtimes revealed that during off-days between duty cycles, the vast majority of night workers reverted to a nighttime sleep pattern similar to that of day workers.
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0170

SLEEPINESS AND DRIVING INCIDENTS IN NURSES COMMUTING TO AND FROM WORK SHIFTS

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Introduction: Shift workers are at increased risk of sleepiness and motor vehicle accidents. This study aimed to assess sleepiness and adverse driving events during commutes to and from work shifts in intensive care unit (ICU) nurses.
Methods: 35 ICU nurses (age 33.2 ± 10.6 years, 28 Female) completed driving diaries for commutes to and from day (07:00-15:30 h), evening (13:00-21:00 h), and night shifts (21:00-07:00 h), consisting of a Karolinska Sleepiness Scale (KSS) pre- and post-drive and driving incidents. Optalert™ was used to monitor drowsiness during all drives. Linear mixed model analyses were conducted to investigate differences in pre-drive and post-drive KSS and driving incidents between shift types, controlling for number of drives per participant and drive duration.
Results: On the commute home from work, night shift was associated with the highest pre-drive KSS (6.31 ± 1.73), compared to evenings (3.92 ± 1.60) and days (3.80 ± 1.76, p<0.001). Significantly more driving incidents were reported on the commute home from night shift (3.01 ± 2.09) than on days (2.00 ± 1.53) or evenings (1.76 ± 1.27, p<0.01). In contrast, on commutes to work, pre-drive KSS scores were highest on day shift (5.06 ± 1.79), followed by nights (4.10 ± 1.60) and evenings (2.61 ± 1.36, p<0.001). Post-drive KSS was significantly higher on the drive to day (4.63 ± 1.67) and night shifts (4.78 ± 1.53) compared to evening shifts (2.72 ± 1.42, p<0.001). The most frequently reported driving incidents were: being distracted (13%), fighting to stay awake (10%), and fixation on interior/exterior objects (10%).
Conclusion: Nurses driving home from night shift are at increased risk of sleepiness and adverse driving events. Increased sleepiness was also observed during commute to day shifts compared to other shift types, likely due to the combined effects of the circadian drive for sleepiness and sleep restriction due to evening- to day-shift rotations (reported in 74% of participants). Identification of high-risk commutes may assist in the development of sleepiness monitoring and intervention strategies.
Support (If Any): The study was supported by the Cooperative Research Centre for Alertness, Safety and Productivity.

0171

WORK AND SLEEP PATTERNS IN MILITARY SHIFT WORKERS: PROMOTING HEALTH AND WELLNESS THROUGH INFORMED SHIFT SCHEDULES

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Introduction: Reduced manning, extended work hours, and circadian misalignment are some of the factors which contribute to the sleep debt and degraded alertness observed in much of the military population. This study compared fatigue levels, sleep, and real time performance measures (e.g., reaction time) of military shift workers.
Methods: Working either 8-hour (daytime, evening, or overnight) or 12-hour (day, overnight) shifts, military shift workers (N=75) serving

in various locations around the world participated in the 2-week study. Participants wore actigraphs, completed activity logs, and performed a three-minute Psychomotor Vigilance Task (PVT) before and after standing watch. In addition, they completed sleep habits and mood states questionnaires at the beginning and end of the study.
Results: Participants slept 6.74 hours/day, with 19% sleeping less than 6 hours on average. At the outset of the study, ~62% of the participants reported insomnia symptoms and were classified as poor sleepers. Although sleep duration did not differ between schedules, participants on the 8-hour shifts made fewer errors and showed less variability in PVT (e.g., fewer lapses combined with false starts) compared to those individuals working on 12-hour shifts. Participants on 12-hour shifts were nearly twice as likely to be identified as poor sleepers compared to those on 8-hour shifts. Finally, many more participants reported personal preference of the 8-hour over the 12-hour shift schedule. The top three issues identified as interfering with sleep were temperature, light, and noise.
Conclusion: Results show that sleep quality, quantity, and sleeping conditions remain problems for these military shift workers. Preliminary findings suggest that the 8-hour shift schedule is preferable to the 12-hour one, both in terms of personal preference and performance. Efforts are underway in this population to assess the use of High Energy Visible (HEV) blue light-blocking glasses to facilitate circadian entrainment and improve sleep during daytime hours. The views expressed are those of the authors and do not necessarily reflect the official policy or position of the DoN, DoD, or the U.S. Government.
Support (If Any):

0172

PREVALENCE OF INSOMNIA AND EXCESSIVE DAYTIME SLEEPINESS IN US NAVY SAILORS

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Introduction: The most common sleep-related complaint in civilian populations is insomnia. Workers in the U.S. Navy regularly experience significant levels of sleep deprivation and circadian misalignment due to long workdays and chronic shiftwork. This study assessed the prevalence of insomnia and elevated daytime sleepiness of crewmembers underway on a United States Navy ship while working.
Methods: Crewmembers (N=166, n=90 working on a fixed watchstanding schedule, n=76 on a rotating schedule) from the Reactor Department of the USS NIMITZ volunteered in this study. Sleep was assessed with actigraphy. Insomnia was assessed with the Insomnia Severity Index (ISI), and the Epworth Sleepiness Scale (ESS) was used to assess sleepiness.
Results: Participants slept an average 6.75 ± 0.94 hours/day. ESS scores were negatively correlated with sleep duration (r=-0.175, p=0.033); ISI scores were positively correlated with the number of sleep episodes per day (r=0.221, p=0.007). ESS scores (mean=9.91 ± 4.66) indicated that 45% of the participants had excessive daytime sleepiness—EDS (ESS score>10). ISI scores (mean=11.5 ± 5.20) indicated that 66% of the participants have symptoms of insomnia (ISI score≥10). Approximately 36% of the participants had EDS and comorbid insomnia symptoms, 30% had insomnia without EDS, while 9% had EDS without insomnia symptoms. The prevalence of EDS and insomnia was modulated by the type of the watchstanding schedule. For participants on the fixed schedule, the prevalence of insomnia was 57% for the EDS group and 35% for the normal sleepiness group (p<0.001). In the rotating schedule, however, the prevalence of insomnia was ~86% for both EDS and normal sleepiness groups (p>0.9).
Conclusion: Both excessive daytime sleepiness and insomnia remain problems for crewmembers working at sea. Results show that, as expected, sleepiness increased with level of sleep deprivation. The prevalence of insomnia increased dramatically when crewmembers worked rotating, non-circadian schedules in which their sleep was split into multiple episodes during the day. The latter result suggests that these rotating non-circadian schedules induce insomnia symptoms due to circadian misalignment and irregular sleep patterns.
Support (If Any):

0173

CHANGES IN SLEEPINESS RATINGS ACROSS SHIFTS AMONG MOTORCOACH DRIVERS

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Introduction: The timing of shift start affects motorcoach drivers' ratings of sleepiness. Here we compare the start of work sleepiness ratings to those made at the end of work among commercial motorcoach drivers.
Methods: Seventy-eight commercial motorcoach drivers were monitored for approximately one month as they completed their usual work and rest schedules. Drivers kept a sleep/work diary, continuously wore an actigraph to record sleep/wake, and self-rated their sleepiness with the Karolinska Sleepiness Scale at the start and end of work periods. Sleep duration within each 24-hour period preceding duty start was summed, and shift end times were binned into morning (06:00 to 13:59), afternoon (14:00 to 21:59), and night (22:00 to 05:59). Changes in sleepiness ratings were analysed using linear mixed-effects models.
Results: During the study period 1,518 work periods were observed, though pre- and post- work ratings for both measures were available for only 1306 shifts. Work periods tended to end in the afternoon (mean = 17:24 ± 5:46) and averaged 9.2 (± 3.0) hours in duration. Drivers obtained a mean of 6.4 (± 1.6) hours of sleep during the 24 hours prior to duty start. Subjective sleepiness ratings were highest following shifts that ended in the night. Post-shift sleepiness ratings were predicted by rating at shift start, duration of shift, and timing of shift end. Total sleep time in the 24 hours of shift start did not predict end-of-shift sleepiness ratings.
Conclusion: Duration of pre-work sleep did not predict sleepiness scores at the end of the shift, while operational factors such as shift length, shift timing, and the pre-work sleepiness ratings were important in determining end-of-shift sleepiness levels. Though shift timing is usually dictated by commercial demands in motorcoach operations, these data suggest that shift timing is an important consideration in managing sleepiness.
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0174

THERE AND BACK AGAIN: CIRCADIAN MODULATION OF SLEEP IN PILOTS FLYING ULTRA-LONG RANGE FLIGHTS

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Introduction: Ultra Long Range (ULR; 16+ hour) flights cross multiple time zones. Therefore during layover (26–40 hours), the light/dark cycle is radically out of phase relative to home base time. The question is to what degree do pilots shift or readjust their sleep/wake cycle during layover and post-flight days as measured by synchronization to home base time.
Methods: Pilots' sleep/wake history was recorded by actigraph and a sleep/work logbook from three days prior to the outbound flight through three days following the inbound flight. The sleep/wake

history was then plotted as number of pilots sleeping in consecutive hour blocks. The flights studied originated either in 1) San Francisco (SFO), California and flew non-stop to Sydney (SYD), Australia or Taipei (TPE), Taiwan; or in 2) Los Angeles (LAX), California and flew non-stop to Melbourne (MEL), Australia or Shanghai (PVG), China.
Results: Pilots anchored their sleep around the base time Windows of Circadian Low (WOCL; 0200-0600 h and mini-WOCL; 1500–1700 h) except when delayed by an early morning arrival (relative to home base time) or truncated by an early morning departure (relative to home base time).
Conclusion: Generally, pilots appear to favor naps and main sleep periods that fall within the normal home base sleep time, with the center of mass of sleep being around 0300 h. During the outbound flight, layover, and inbound flight strict synchronisation of sleep to home base time is lost and sleep is likely modulated more by social factors including scheduling, meal timing, and interpersonal cues. Upon arrival at their home base, pilots immediately return to their normal base time circadian synchronisation of sleep, again with the center of mass of sleep around 0300 h. To answer the question posed in the introduction, pilots do not appear to shift or readjust their circadian rhythms during ULR flights associated with layovers of up to 40 hours.
Support (If Any): The study was supported by United Airlines.

0175

THE CURVILINEAR RELATION BETWEEN SLEEPINESS AND RISK-TAKING: THE MODERATELY SLEEPY TAKE MORE RISKS THAN THE ALERT OR VERY SLEEPY

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Introduction: While sleep loss has been implicated in impacting risk-taking behavior, it is unclear how individuals' current propensity to fall asleep, known as sleepiness, influences risk-taking. Because sleepiness is not only driven by recent sleep loss but also by factors such as circadian rhythm and current stimulation, sleepiness may be important for risk-taking by more holistically capturing current sleep-wake state.
Methods: To assess if sleepiness predicted behavioral risk-taking, 125 student participants completed a short personality survey and reported their current sleepiness on the Stanford Sleepiness Scale. Afterwards, participants completed the Balloon Analog Risk Task, a computerized risk-taking measure. In this task participants were rewarded with actual money by pumping up balloons to increase earnings at the risk of exploding the balloons and losing all the money.
Results: Although a linear relation between sleepiness and risk-taking was not supported, evidence indicated a consistent curvilinear relation. Even after controlling for recent sleep amount and quality, chronotype, time-of-day, the chronotype-by-time-of-day interaction, and trait sensation-seeking, individuals who were either low or high on sleepiness pumped balloons less (ΔR^2 = .05, B = -30.34, 95% CI: -52.2: -7.76), exploded less balloons (ΔR^2 = .03, B = -.64, 95% CI: -1.25: -.02), and tended to earn less money (ΔR^2 = .02, B = -.12, 95% CI: -.26: .02) than participants who were moderately sleepy.
Conclusion: Because sleepiness incrementally predicted risk-taking behavior over other sleep and risk-taking variables, sleepiness is as an important factor with unique implications for the link between sleep and risk-taking. Moreover, the degree of sleepiness predicted whether an individual would be more or less risky, dovetailing with findings that suggests the severity of sleep loss matters for whether risk-taking increases of decreases.
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0176

NIGHTTIME SLEEP AND NEXT-DAY PERFORMANCE IN NEW MOTHERS: BETWEEN- AND WITHIN-PERSON ASSOCIATIONS DURING THE EARLY POSTPARTUM MONTHS

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Introduction: Early postpartum sleep disturbance is common and has been linked to maternal neurobehavioural impairment, based on data averaged across multiple days. We micro-examined the relevance of nighttime sleep to next-day performance across the first 4 months postpartum.
Methods: Participants were N=94 (M±SD=27.4±4.9 years, 88.3% primiparous) women who wore actigraphy and completed 5-minute psychomotor vigilance tests (PVT) daily during postpartum weeks 2–13 (n=70) or weeks 9–16 (n=24). Multilevel models with continuous linear time examined the associations between nighttime sleep and next-day PVT, controlling for age, education, parity, and chronotype. Daily total sleep time (TST) and sleep efficiency (SE) were decomposed into between- and within-person variability. PVT outcomes included lapses-per-trial (using Poisson models), mean, fastest and slowest 10% reaction time (RT; log-transformed).
Results: All PVT outcomes worsened significantly over time (p<.001). Overall, shorter TST and lower SE were associated with worse next-day PVT performance. The significant effects of TST/SE within-person variability on performance were over and above between-person variability. Further, the strengths of associations between TST/SE and next-day performance (excepting TST and mean/fastest 10% RT) changed significantly over time (p-values<.05). Associations between TST and lapses/slowest 10% RT were strong initially (p-values<.001), but decreased to non-significance during later postpartum weeks. In contrast, associations between SE and all PVT outcomes were non-significant during the initial postpartum weeks, but strengthened to statistical significance later.
Conclusion: Early postpartum shorter and lower-quality nightly sleep (particularly in relation to one's own patterns), are related to poorer next-day functioning. Importantly, this pattern changes: shorter TST during early, and lower SE during later postpartum weeks were particularly detrimental to daytime functioning. These findings highlight long-term effects of postpartum sleep disturbance, and may inform family leave policies.
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0177

THE TRAIT OF INTROVERSION-EXTRAVERSION CONTRIBUTES TO SUSTAINED PERFORMANCE ON PLANNING AND SEQUENCING ABILITIES DURING SLEEP DEPRIVATION

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Introduction: The existence of consistent trait-like inter-individual differences in the ability to sustain objective psychomotor vigilance

and subjective alertness during periods of sleep deprivation has been well established. However, it has proven difficult to identify reliable cognitive, biological, or demographic variables that predict this capacity. In several different studies, our lab has found that the trait of introversion-extraversion appears to be predictive of this capacity, particularly for psychomotor vigilance. Here we explore whether this trait also predicts the ability to sustain higher-level executive functions of planning and sequencing abilities.

Methods: 17 males and 5 females (M_{age}= 25.05, SD= 3.98) participated in a double-blind drug study (placebo N= 11; caffeine 200 mg every two hours between 0100 and 0700, N= 11) during 3 nights of sleep deprivation. Participants completed the Tower of London (TOL), a measure of planning and sequencing, after 4, 52, and 76 hours of total sleep deprivation. Baseline measures of personality traits (NEO-PI-R inventory), state and trait anger (STAXI-2), and odor identification ability (UPSIT) were collected before sleep loss. Stepwise linear regression was conducted to predict change in TOL performance, as measured by throughput (i.e., the average number of correct bead placements per minute), above and beyond the effects of caffeine.

Results: At 52 hours of sleep deprivation, better sustained TOL throughput was predicted by lower Extraversion (higher introversion; β=-.41, p=.048), which was above and beyond the effects of caffeine (β=.32, p=.12). At 76 hours of wakefulness, higher TOL throughput was predicted again by lower Extraversion (higher introversion; β=-.50, p=.01) as well as higher Conscientiousness (β=.40, p=.04), above and beyond the non-significant effect of caffeine (β=.16, p=.38).

Conclusion: Consistent with prior work on psychomotor vigilance, the trait of introversion-extraversion was also predictive of the ability to sustain executive function capacities of planning and sequencing after two and three nights of sleep deprivation.

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0178

INDIVIDUALS SHOW DIFFERENTIAL VULNERABILITY IN NEUROBEHAVIORAL AND AFFECTIVE RESPONSES TO STRESS AND SLEEP LOSS IN NON-LABORATORY CONDITIONS

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Introduction: In highly-controlled laboratory studies, there are substantial individual differences (resilience and vulnerability) in neurobehavioral deficits from psychosocial stress and sleep loss. We determined whether highly-motivated subjects would show such individual differences in performance and affective responses to stress and sleep loss in non-laboratory, field-like conditions.

Methods: 32 adults (35.1±7.1y; 14 females) participated in a 14-day or 30-day mission in the NASA Human Exploration Research Analog facility at Johnson Space Center. Toward the end of the time in mission, crewmembers were part of a 5-day study consisting of 2 baseline nights (8h time in bed (TIB); 2300h-0700h), followed by 39h of total sleep deprivation (TSD) and 2 recovery nights (10h TIB: 2200h-0800h; 8h TIB: 2300h-0700h). The TSD day included a modified Trier Social Stress Test among other stressors. Compliance was verified by actigraphy. Crewmembers completed 11 neurobehavioral testing sessions during the 5-day study. The neurobehavioral sessions included tests measuring reaction time (the Psychomotor Vigilance Test [PVT]) and cognitive throughput (Digit Symbol Substitution Test [DSST]), and subjective scales measuring sleepiness (Karolinska Sleepiness Scale [KSS]), and fatigue, vigor and various aspects of mood (Profile of Mood States, Short Form [POMS-SF]). Paired t-tests compared performance and subjective ratings between baseline and TSD.

Results: Crewmembers showed significant performance deficits (PVT, DSST), increased sleepiness and fatigue (KSS, POMS-Fatigue), and greater negative affect (POMS-Anger, POMS-Depression and POMS-Total Mood Disturbance) during TSD compared to baseline (all p's<0.05). Notably, there were considerable individual differences in these responses to stress and sleep loss, as demonstrated by substantially larger standard deviations during TSD than at baseline.

Conclusion: Highly-motivated subjects showed robust individual differences in performance, sleepiness, fatigue and affective responses to stress and sleep loss, even with limited testing assessments. Our results are remarkably similar to those observed in controlled laboratory studies, permitting generalization of differential vulnerability to other environments and populations.

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0179

PERSONALITY TRAITS PREDICT OBJECTIVELY-RECORDED SLEEP YEARS LATER

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Introduction: Although personality traits have been implicated in the development of sleep problems, exactly what role personality traits play in specific aspects of sleep is unknown. Moreover, virtually all the evidence linking personality to sleep is based on self-reported sleep. To provide the first test of the power of personality in predicting a range of actual sleep characteristics, we examined prospective links between core personality traits (i.e., emotional stability, extraversion, conscientiousness, agreeableness, and openness) and week-long sleep, objectively-recorded years later.

Methods: Participants were drawn from the longitudinal study on Midlife in The United States (MIDUS) when they provided information on their personality traits in the second phase of the study and also participated in the subsequent Biomarker project which included a week-long actigraphic assessment of sleep. A total of 311 participants (55% female, age 34–83 years) provided data, with 1 to 5 years separating the two assessments. Personality traits were assessed with brief adjective scales (all reliabilities exceeded .70), whereas sleep was assessed via actigraphy over one week to yield indices of both week-long *average* and nightly variation in sleep amount and sleep quality (aggregate of sleep onset latency, wake after sleep onset, and sleep fragmentation).

Results: In terms of mean sleep tendencies, emotional stability and conscientiousness predicted better future sleep quality. In terms of sleep variability, emotional stability predicted less future variation in sleep amount, whereas conscientiousness and agreeableness predicted less future variation in all aspects of sleep. These links were robust to the impact of age and gender and stronger with sleep measured closer in time to the initial personality assessment.

Conclusion: These findings are the first to show that personality foreshadows actual sleep behavior and are also the first to implicate personality traits as powerful predictors of variability, not just general tendencies, of sleep characteristics. Critically, they could aid identification and treatment of individuals with sleep-related health problems.

Support (If Any): none.

0180

ADVERSE CHILDHOOD EXPERIENCES PREDICT POOR SLEEP DIARY MEASURED OUTCOMES IN COLLEGE UNDERGRADUATES

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Introduction: Individuals exposed to Adverse Childhood Experiences (ACEs) are more likely to experience negative sleep outcomes compared to those who have not experienced any. Less is known about the relationship between ACEs and sleep in the college student population. The goal of the present study is to investigate the association of exposure to ACEs with sleep parameters in a college-aged population.
Methods: Undergraduates (N=241) with a mean age of 18.72 years (SD=1.15) completed the ACE questionnaire and demographic data at baseline, and subsequently filled out a daily sleep diary over a seven-day period. Sleep quality was assessed daily on a 4 point Likert scale, with higher values indicating greater sleep quality. Sex, parental income, and race were examined as potential covariates, and regression analyses were utilized to test the relationship between ACEs and mean sleep parameters.
Results: In regression analyses, higher ACE scores were individually associated with less time in bed (B = -7.425, SE = 3.044, $p<.05$), higher sleep onset latency (B = 2.086, SE = .868, $p<.05$) and poorer sleep quality (B = -.053, SE = .027, p = .05) when controlling for income and race. ACEs were not correlated with total sleep time, sleep efficiency, or wake after sleep onset.
Conclusion: These findings suggest that ACEs may negatively impact sleep health in undergraduates. Since sleep health is especially important for academic success, students with ACEs may be an important target for sleep intervention. To our knowledge this is the first study to use a sleep diary, the "gold standard" for the subjective measurement of sleep, to examine the relationship between ACEs and sleep. Further research should corroborate findings with objective sleep measures.
Support (If Any): Not applicable.

0181

INFLUENCE OF CAFFEINE AND LIVING ARRANGEMENTS ON SLEEPINESS IN COLLEGE STUDENTS.

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Introduction: Previous research has found that individuals who do not practice healthy sleep hygiene are more likely to have poorer sleep quality, which has a negative influence on performance and academic success. Sleep hygiene is comprised of several factors, including living arrangements and caffeine intake, which influence college students' sleepiness and sleep quality throughout college. The current study explored the effects of living arrangements and caffeine intake on college students' sleepiness. It was hypothesized that college students living on campus would report having more sleepiness compared to living off-campus. It was also hypothesized that consuming more caffeine would lead to higher sleepiness levels.
Methods: Participants included 300 college students (187 women, 107 men, 6 no response) who completed a series of online surveys about their living arrangement and general sleep habits. The Epworth Sleepiness Scale (ESS), a validated questionnaire, assessed self-reported sleepiness.
Results: Preliminary results indicated that the overall average sleepiness score was 7.66. Two One-Way ANOVA tests were conducted to examine whether living arrangements or caffeine intake impacted sleepiness. Unexpectedly, there were no significance differences found between living arrangement groups (i.e. living on campus, off-campus, or living at home with family) when comparing sleepiness, $F(2, 293)=.960$, $p=.384$. Also unexpectedly, there were no significant differences between individuals who consumed different amounts of caffeinated beverages, $F(3, 254)=.219$, $p=.883$.
Conclusion: Results demonstrated that neither living arrangements nor caffeine consumption influenced sleepiness. However, the results showed that college students reported higher than normal sleepiness levels. It is possible that other factors could impact sleepiness, including sleep conditions, personal activities, or other sleep environmental factors (i.e. living conditions). Understanding what factors contribute to sleepiness are important during college as this is when college students face stress and academic pressure to succeed.
Support (If Any): None.

0182

INFLUENCE OF WEEKLY SLEEP REGULARITY ON SELF-REPORTED WELLBEING

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Introduction: Irregular sleep-wake schedules are commonplace in modern society. Recent studies have indicated the importance of sleep regularity, in addition to sleep duration. We studied in college students how weekly sleep regularity is predictive of daily self-reported happiness, healthiness and calmness, during one week and on the first day following that week.
Methods: 204 college students (aged 18–25, 132 male) participated in a 30-day field study. Sleep timing and duration were monitored using both actigraphy and daily morning and evening Internet-based diaries. Self-reports of wellbeing (happiness, healthiness, and calmness) were collected via daily diaries, morning and evening, with non-numeric visual-analog scales. The sleep regularity index was computed weekly, as the likelihood of being awake or asleep across all time-points 24-hours apart. We used generalized estimating equations that controlled for weekly average sleep duration to examine how sleep regularity relates with self-reported wellbeing. We also examined how the three wellbeing measures change with sleep regularity transitions (e.g. regular to irregular, irregular to regular) both in participants who had <7 hours and >= 7 hours average sleep duration. Bonferroni corrections were made for all analyses.
Results: Higher sleep regularity was statistically significantly related to higher morning and evening happiness, healthiness and calmness ($p < 0.01$) during the week. On the first day following the week, these results hold ($p<0.01$) for all but morning healthiness. For the sleep regularity weekly transitions, in sleepers who averaged < 7 hours, the irregular-regular sleep transition showed a greater increase in morning happiness and calmness ($p < 0.01$), and evening calmness ($p < 0.01$) than the regular-regular sleep transition.
Conclusion: Regular sleep patterns were found to be associated with better wellbeing in college students. A transition from irregular to regular weekly sleep patterns was associated with improved happiness and calmness both during the week of regular sleep and on the day following it. This work underlines the necessity of considering sleep regularity, in addition to sleep duration, as an important factor for understanding self-reported wellbeing.

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0183

POSITIVE AND NEGATIVE AFFECT BOTH CONTRIBUTE TO THE ENDOGENOUS CIRCADIAN RHYTHM IN MOOD

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Introduction: Circadian misalignment (e.g., shift work) is associated with worsened mood and mood has been shown to have a circadian rhythm. Notably, rhythmicity has been shown for feelings associated with reward-related motivation (positive affect) but not threat-related motivation (negative affect). We tested whether or not there exists a circadian rhythm in mood as assessed by the complete Positive and Negative Affect Scales (PANAS) and a questionnaire with validity in both psychiatric and normative populations.

Methods: 15 participants without chronic medical or psychiatric illnesses were studied (aged 41–63 years; 9 females). Following 1–3 weeks of a regular sleep/wake schedule participants underwent a laboratory forced desynchrony protocol that distributed all scheduled sleep/wake behaviors evenly across the circadian cycle (achieved by scheduling 10 identical, recurrent 5 h 20 min 'days' in dim light thereby desynchronizing the circadian and behavioral cycles). POMS-B and PANAS were completed ~30 min. after waking. Scores were converted to z-scores and analyzed by cosinor analysis. Circadian phase at each mood assessment was determined relative to the salivary dim light melatonin onset (DLMO, 3 pg/ml threshold).

Results: Both POMS-B mood score and PANAS positive affect items exhibited robust circadian rhythms (both $p < 0.001$) with the worst mood and lowest positive affect occurring during the biological night (~6 hours after the DLMO or ~2:45 am) and the best mood and greatest positive affect at the end of the biological day (~2 hours before the DLMO). Negative affect mirrored positive affect ($p = 0.01$) with a peak ~ 6 hours after the DLMO and minimum ~6 hours before the DLMO but with an amplitude that was 39% of the rhythm in positive affect.

Conclusion: Mood has an endogenous circadian rhythm driven principally by positive affect but also influenced by negative affect. Normative and clinical assessments of mood should take these rhythms into account. These rhythms may underlie the association between circadian misalignment and mood disorders and differences in rhythmicity of positive and negative affect might contribute to mood disorder risk.

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0184

IT'S IN THE EYES - A NOVEL, OBJECTIVE MARKER OF ALERTNESS AND PERFORMANCE IMPAIRMENT

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Introduction: Several devices are now commercially available to measure, monitor or predict alertness state. While leading technologies rely on signals from the driver (i.e., eye closure, brain activity) or vehicle (i.e., steering deviation), ocular parameters remain a primary candidate for accurately monitoring driver state. A novel ocular 'biomarker' known as 'pupillary unrest' reflects alterations in sympathetic nervous system activity via instability of pupillary response. The extent to which the pupillary unrest index (PUI) accurately predicts subsequent performance impairment is unknown.

Methods: Seven healthy young adults (4 men, 21.9 ± 0.6y) underwent a three night stay in the laboratory, comprising one night of baseline sleep, a 40-hour extended wake period, and a night of recovery. Two hours post habitual wake-time, and thereafter bi-hourly, participants completed a subjective rating of sleepiness (KSS), an 11-min test of PUI, and a 10-min visual PVT. Data were averaged across the first 16 hours to create a baseline period, and each time point compared for time awake effects. To examine the predictive capacity of PUI, compared to subjective ratings alone, each PVT was classified as "impaired' if lapses exceeded a 25% (mild), 50% (moderate) or 75% (severe) threshold increase above individual baseline levels. ROC analyses were then performed.

Results: PUI, PVT lapses and KSS showed a similar time course across the 40 hours of sleep deprivation. All metrics increased as a function of time awake ($p < 0.04$), peaking 26-30hours post wake. While the predictive capacity of both PUI and KSS were moderate-high (PUI: 0.66–0.79; KSS: 0.86–0.89), this was dependent on the level of impairment: PUI was a better predictor at lower levels of impairment [AUC 0.79 (25/50%) vs. AUC 0.66 75%), while KSS remained high for all (AUC > 0.86).

Conclusion: While self-reported sleepiness accurately predicts performance impairment, few drivers engage in self-monitoring and/or adaptive behaviours. Objective markers are therefore essential in combating drowsy driving. Our data provides evidence for the utility of this novel 'biomarker' to be developed as a predictor of performance impairment, particularly in the early stages of alertness failure.

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0185

SPEECH AS A RELIABLE MARKER OF ALERTNESS AND PERFORMANCE IMPAIRMENT UNDER CONDITIONS OF ACUTE SLEEP DEPRIVATION

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Introduction: The acoustic properties of speech are a reliable marker of changes in the central nervous system. Measures of speech timing and frequency have been used to assess impairment in clinical patient groups, including stroke, Huntington's disease, and depression. Associations between speech properties and impaired performance have also been described in healthy individuals under periods of sleep deprivation. In the current study, we aimed to compare the time course of speech outcomes to other objective measures of alertness during 40 hours of sleep deprivation.

Methods: Twenty-three healthy volunteers (18 males; mean age=25.41 ± 5.73 years) underwent 40 hours of acute sleep deprivation under constant routine conditions. Speech tasks were administered every four hours, beginning three hours after scheduled waketime. The Psychomotor Vigilance Test (PVT), Karolinska Sleepiness Scale

(KSS), and EEG collected during the Karolinksa Drowsiness Test (KDT) were measured bi-hourly. Objective measures of speech were derived using spectral, cepstral and timing analyses.
Results: Acoustic parameters displayed impairment across 40-h of sustained wakefulness. Measures of speech timing (e.g. speech rate) and frequency deteriorated significantly following 23 hours awake compared to baseline (first 16 hours awake). Impairment peaked around 31 hours of wakefulness before showing slight improvements. These findings were consistent with laboratory standard assessments of sleepiness and vigilant attention.
Conclusion: The time course of changes in the acoustic properties of speech are comparable to those changes observed in alertness and performance impairment across 40 h of sleep deprivation. These findings suggest the acoustic properties of speech may be a reliable indicator of alertness/drowsiness, with utility for development of objective and non-invasive systems to identify and manage sleep-related impairment in workplace settings.
Support (If Any): The study was supported by the Cooperative Research Centre for Alertness, Safety and Productivity.

0186

OCULOMOTOR BEHAVIOR METRICS CHANGE ACCORDING TO CIRCADIAN PHASE AND TIME AWAKE

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Introduction: There is a need for non-invasive, objective measures to forecast performance impairment arising from sleep loss and circadian misalignment, particularly in safety-sensitive occupations. Eye-tracking devices have been used in some operational scenarios, but such devices typically focus on eyelid closures and slow rolling eye movements and are susceptible to the intrusion of head movement artifacts. We hypothesized that an expanded suite of oculomotor behavior metrics, collected during a visual tracking task, would change according to circadian phase and time awake, and could be used as a marker of performance impairment.
Methods: Study participants completed two weeks of a stable schedule including 8.5 hours in bed at home, followed by a ~24-hour laboratory constant routine (CR) in semi-recumbent posture under < 4 lux of light. Snacks, saliva samples, and the psychomotor vigilance task (PVT) were collected hourly. The visual tracking task was collected at two, six, twelve, and sixteen hours after waking, then hourly. We assessed saccadic amplitude, pursuit latency, initial acceleration, steady-state pursuit gain, proportion of smooth tracking, noise in pursuit direction, noise in pursuit speed, and speed responsiveness. Melatonin was assayed and subjected to a best-fit cosine function to determine the acrophase. All data were analyzed using SAS and MatLab.
Results: Twelve participants (mean age 25.0 y [+/- 5.6]; 6F) completed the study. Steady-state pursuit gain, saccadic amplitude, proportion of smooth tracking, direction noise, and speed noise each showed robust slowing, followed by partial recovery, coinciding approximately with circadian phase changes in melatonin amplitude and performance on the PVT. Other oculomotor metrics did not show changes during the CR.
Conclusion: Several oculomotor behavior metrics change with circadian time of day and time awake. These measures show promise as indicators of performance impairment. Further study is required to determine whether such visual tracking tasks might be useful in determining fitness-for-duty in operational settings.
Support (If Any): This study was funded by the Office of Naval Research award number N0001416IP00027.

0187

STRESSOR REACTIVITY IN SLEEP-DEPRIVED NORMAL SLEEPERS AND SLEEP-ONSET INSOMNIACS

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Introduction: Exposure to stressors increases physiological arousal through the hypothalamic-pituitary-adrenal (HPA) axis. Sleep deprivation has been reported to potentiate HPA axis stressor reactivity in healthy adults. Insomnia has been linked with hyperarousal and chronic HPA activation, which may also potentiate HPA axis stressor reactivity. In a highly standardized study protocol, we measured responses to psychosocial and physical stressors in normal sleepers and sleep-onset insomniacs while well-rested or exposed to acute total sleep deprivation (TSD).
Methods: Twenty adults (9 sleep-onset insomniacs, 11 healthy normal sleepers; ages 22–39; 14 females) completed a 5-day (4-night) in-laboratory study. After an adaptation day and a baseline day (each 10h time in bed (TIB); 22:00-08:00), subjects were assigned to a 38h TSD condition (6 sleep-onset insomniacs, 6 healthy controls) or a matching control condition (10h TIB; 3 sleep-onset insomniacs, 5 healthy controls). After 36h TSD, subjects underwent the 10min Maastricht Acute Stress Test (MAST). This test involved 5 cold pressor trials, requiring subjects to submerge their non-dominant hand in cold water (0°C) for 60-90s. Between cold pressor trials, subjects performed a socially evaluated, difficult, mental arithmetic task. Salivary cortisol was measured just before and every 15 min after the MAST from 20:00 until 21:15, and at 21:45. Salivary cortisol was also collected at baseline 24 hours earlier.
Results: Cortisol levels, expressed relative to baseline, increased immediately following the MAST, peaked 30min later, and then gradually returned to pre-MAST levels ($F=7.31$, $P<0.001$). Relative to well-rested normal sleepers, the cortisol peak was dampened in the sleep-onset insomniacs and in the TSD condition, although this dampening did not reach statistical significance.
Conclusion: The MAST psychosocial and physical stressors elicited an HPA axis response in both normal sleepers and sleep-onset insomniacs and in both TSD and control conditions. However, the results did not support the idea that sleep deprivation and/or insomnia potentiate HPA axis stressor reactivity.
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0188

RELATIVE SLEEP DURATION VARIABILITY PREDICTS ATTENTIONAL PERFORMANCE

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Introduction: Attentional networks are sensitive to sleep deprivation. However, investigation of variation in attentional performance as a function of normal sleep parameters is under-studied. We examined whether attentional performance is influenced by 1) individual differences in mean sleep duration; and/or 2) inconsistencies in sleep duration over the course of a week using actigraphy.
Methods: 34 participants (71% female; mean age 34 years; SD 9.60) completed a questionnaire battery (including the Pittsburgh Sleep Quality Index [PSQI]), wore wrist actigraphy for one week, and completed the Attention Network Test (ANT) the day following the final night of actigraphy. The following key variables were derived from actigraphy: mean sleep duration over the week (TST) and the standard

deviation in mean TST as a measure of variability (TST variability). The ANT examined overall reaction time (RT) and the efficiency of three attentional networks - alerting, orienting and executive control/conflict.

Results: Mean weekly TST was 420.15 minutes (SD=33.89). TST variability was 65.78 minutes (SD=45.01). Mean PSQI score was 5.12 (SD=2.37). A series of linear regression analyses tested the main effects of TST, and TST variability as well as their interaction on overall RT, alerting, orienting and conflict. TST significantly predicted overall RT (R=.37, $R2$=.14, df(1,32), p=.03), such that shorter sleep duration predicted longer reaction times (b=-.65, t[32]=-2.28, p=.03). TST variability significantly predicted the efficiency of the alerting network (R=.52, $R2$=.27, df(1,31), p=.005), such that greater variability in TST predicted poorer alerting (b=.26, t[31]=3.02, p = .005). All other main effects and interactions were non-significant.

Conclusion: Our preliminary results suggest that whilst sleep duration is important for overall attentional performance, its influence depends on the specific attentional network under study: The ability of the alerting network is particularly sensitive to inconsistencies in preceding sleep duration. These findings highlight the importance of consistent sleep patterns for attentional performance.

Support (If Any):

0189
WITHDRAWN

0190
THE RELATION BETWEEN STRESS AND MAINTAINING A SLEEP SCHEDULE

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Introduction: Increased daily stress and negative affect are associated with subjective ratings of decreased sleep quality and increased daytime sleepiness in young adults (Blaxton, Bergeman, Whitehead, Braun, & Payne, 2015; Lund, Reider, Whiting, & Prichard, 2010). However, much of this research is conducted in settings that allow participants to moderate their own sleep schedules, potentially contributing to sleep deprivation. The present study sought to elucidate the relations between subjective stress, emotion, and subjective and objective measures of sleep in young adults when they were instructed to maintain regular sleep schedules.

Methods: College-aged participants completed questionnaires related to stress, mental health, and sleep including the Stress Management Questionnaire (SMQ), Positive and Negative Affect Schedule (PANAS), and Pittsburgh Sleep Quality Index (PSQI) upon enrollment. Participants were then monitored with actigraphy watches, completed daily sleep journals, and were instructed to maintain regular sleep schedules for the next several nights.

Results: Lower subjective ratings of overall sleep quality and increased daytime dysfunction due to sleepiness, as measured by the PSQI, were associated with higher SMQ scores, indicating poorer ability to manage stress. Higher ratings for stress-related items on the PANAS Negative Affect subscale were also associated with increases in daytime dysfunction due to sleepiness. However, increased scores on the SMQ were also associated with increased sleep efficiency (SE) and decreased wake after sleep onset (WASO) as measured by daily sleep journals and actigraphy data. Stress-related items on the PANAS Negative Affect subscale were also associated with increased SE.

Conclusion: Preliminary results reveal that when participants are instructed to follow a sleep schedule, there is a dissociation in how subjective and objective sleep metrics relate to subjective stress. While subjective metrics of sleep quality and daytime sleepiness correlate positively with stress, objective metrics of sleep quality (SE and WASO) have an opposite relation with stress.

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0191
IMPACT OF CHRONIC PARTIAL SLEEP RESTRICTION ON SLEEPING PATTERNS BEYOND THE LABORATORY

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Introduction: We investigated whether participation in a partial sleep restriction protocol results in changes to habitual sleeping patterns outside of the laboratory.

Methods: N=79 healthy adults completed the protocol. N=11 adults were randomized to a control condition (CON; 10h TIB). N=68 adults were randomized to repeated chronic partial sleep restriction (SR; 4h TIB). After five consecutive nights of SR, subjects were randomized to 1, 3, or 5 nights of recovery sleep opportunity (1R, 3R, 5R; 12h TIB), followed by 5 more nights of SR. Prior to leaving the laboratory, 1R subjects received 3 nights of recovery sleep opportunity (12h TIB), while 3R and 5R subjects received 1 night (12h TIB). Sleep data were obtained using actigraphy for one week preceding and following the protocol. Changes in total sleep time (TST), time of sleep onset (SO), and time of wake (WA) were compared between CON and SR subjects, and among the three recovery conditions. Age, sex, and ethnicity were used as covariates.

Results: TST, sleep onset times, and wake times across the week prior to study participation did not differ between CON and SR subjects ($p>0.20$). CON subjects were hypothesized to show a reduction in TST following sleep saturation across 18 days in the laboratory, while SR subjects were hypothesized to demonstrate increased TST as a result of accumulating sleep debt. However, there was no change in TST, SO, WA, or variability in the measures across 7 days following study participation within or between the two groups. Similarly, there was no difference in sleep patterns among the three recovery conditions within SR subjects.

Conclusion: This was the first effort to explore the impact of chronic partial sleep restriction on sleep patterns outside the laboratory. Results indicate that participation in a prolonged laboratory protocol does not have a lasting impact on individual sleep patterns. A 12h TIB recovery sleep opportunity may be sufficient to dispel any accumulated sleep debt in participants prior to leaving the laboratory. Further analyses are underway to explore this question within other sleep restriction protocols with varying lengths of recovery sleep opportunities.

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0192
PHYSIOLOGICAL SLEEP TENDENCY AND SLEEP REACTIVITY AMONG ELITE ATHLETES

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Introduction: Sleep quality in elite athletes is repeatedly challenged by demands arising from training, competition and international travel. Nevertheless, there is little reported evidence of performance decrements attributable directly to sleep dysfunction. One possible explanation is that, to an unknown extent, the impact of these challenges is offset by constitutional resilience and/or the ability to use compensatory strategies

like daytime napping. Elite sport might, therefore, may *select* for those with more robust sleep, and a propensity to sleep 'on demand'. Neither construct has been systematically explored in elite athletes. The present study, therefore, examines sleep reactivity and daytime sleep tendency in elite athletes and healthy non-athlete controls.
Methods: The three volunteer groups comprised: 11 healthy non-athletes (mean age±SD: 21.0±1.5; 45% female); 11 sub-elite athletes (22.6±4.7 y; 63% female); and ten elite-athletes (23.0±3.7 y; 30% female). Prior to experimental testing, all completed the Ford Insomnia Response to Stress Test (FIRST), with scores <16 indicative of 'unreactive' (i.e. robust) sleepers, and the Karolinska Sleepiness Scale (KSS). Using a conventional (AASM) MSLT montage and protocol, 15:00 afternoon physiological sleep tendency was assessed in the laboratory on two separate days ('adaptation' and 'follow up' assessments). Sleep latency (SL) was determined from lights-out to the first epoch of any stage of sleep (N1, N2, N3, REM). Mean values were compared in ANOVA models; proportions were compared using Fisher's exact test.
Results: Proportions of unreactive sleepers in the non-athlete, sub-elite and elite groups showed a significant gradient (28%, 40% and 80% respectively; $p<0.05$). Scores on KSS showed no significant differences between groups prior to each assessment ($p>0.05$). However, adaptation SLs were significantly higher among non-athletes (mean SL±SD: non-athlete = 16.3±5.0 min; sub-elite = 8.4±4.7 min; elite = 10.4±5.8 min; $p<0.05$). While follow-up SLs showed no significant differences across the non-athlete, sub-elite and elite groups ($p=0.20$), the pattern of sleep onset showed marked differences, with SLs ≤8 min recorded for 18%, 60%, and 70% respectively ($p<0.05$).
Conclusion: The results provide evidence suggesting greater sleep resilience in elite athletes amongst whom MSLT may be capturing sleep ability as well as sleep need.
Support (If Any): NA.

0193

SPRINT ABILITY AND REACTION TIME FOLLOWING A 2-HOUR NAP IN SOCCER PLAYERS.

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Introduction: Athletes may use daytime napping to supplement their night time sleep; however the time to optimal performance after waking from a nap is not known. The aim of this study was to examine sprint ability and reaction time at 30, 60, 90 and 120 minutes after waking from a daytime nap.
Methods: Twelve well-trained soccer players (18.3±1.0 years) completed two conditions in a randomised order. In one condition, participants had nine hours time in bed (22:00-07:00h) without napping the next day, and in the other condition participants had seven hours time in bed (00:00-07:00h) with a two-hour nap the next day (14:00-16:00h). Sleep was assessed using polysomnography. Each day, participants completed four 30-minute test sessions (every 30 min starting at 16:15h) that included a seven-minute warm up, two 10-metre sprints, and a 90-second reaction time task. Total sleep time was compared between conditions using a paired t-test. The effect of condition (no nap vs. nap) and test session (30, 60, 90, 120 min) on fastest sprint, and mean reaction time were assessed by separate repeated ANOVAs.
Results: Total sleep time was similar between conditions (no nap 8.1±0.7 h vs. nap 8.0±1.0 h, $p=0.87$). There was a main effect of test session ($p=0.02$) on reaction time, but no effect of condition ($p=0.84$) and no interaction between condition and session ($p=0.26$). Reaction time was faster at 120 minutes (211.3±20.0 ms) vs. 30 minutes (219.5±20.5 ms, $p=0.01$) and 60 minutes (219.8±20.8 ms, $p=0.01$). There were no main effects of condition ($p=0.17$) or time ($p=0.37$), and no interaction between condition and session ($p=0.84$) on sprint ability.
Conclusion: Based on these data sprint ability and reaction time are not inhibited by a daytime nap in the afternoon. Athletes may perform sprint and reaction time tasks within 30 minutes of waking from an afternoon nap. Time of day or previous exercise completed may influence reaction time.
Support (If Any): This study received funding from Central Queensland University and the Australian Institute of Sport.

0194

WEEKLY MET MINUTES SPENT EXERCISING IS ASSOCIATED WITH REDUCED SLEEP ONSET IN INDIVIDUALS WHO ARE INVOLUNTARILY UNEMPLOYED

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Introduction: Moderate intensity exercise has been shown to improve sleep quality in healthy older adults. However, few studies have examined the relationship between exercise and sleep in individuals who experienced a recent, stressful life event. Job loss is a stressful event that is associated with a variety of negative health outcomes, including poor sleep. We hypothesized that metabolic equivalent (MET) minutes per week spent exercising would be positively associated with sleep quantity and quality, which may be especially important for this vulnerable population.
Methods: Initial, cross-sectional data were gathered as part of the ongoing, prospective Assessing Daily Activity Patterns through occupational Transitions (ADAPT) study. Participants were 32 adults (10 male) who involuntarily lost their job in the last 90 days. The mean age of participants was 42.72 years (SD = 10.46). All individuals were administered the International Physical Activity Questionnaire and were instructed to wear an Actiwatch Spectrum for two weeks to assess their sleep. Bivariate correlations were used to assess whether exercise intensity levels were separately associated with total sleep time (TST), time in bed, sleep efficiency, wake time after sleep onset (WASO), sleep onset latency (SOL), and snooze time.
Results: Greater total MET minutes per week spent exercising was associated with reduced SOL, r=-.512, p=.003. Additionally, sleep efficiency and MET minutes per week spent walking were positively correlated, r=.429, p=.014. Individuals who engaged in vigorous activity had less TST, r=-.431, p=.014, and more WASO, r=.456, p=.003.
Conclusion: These findings suggest that exercise may facilitate sleep onset in a naturalistic sample of adults who have experienced a stressful life event. Randomized controlled trials are necessary to test this hypothesis. Future research is necessary to examine whether there is an interaction between exercise timing and exercise intensity on sleep.
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0195

ENERGY BALANCE RESPONSES SHOW PHENOTYPIC STABILITY TO SLEEP RESTRICTION AND TOTAL SLEEP DEPRIVATION IN HEALTHY ADULTS

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Introduction: Experimental studies have shown sleep restriction (SR) and total sleep deprivation (TSD) increase caloric intake, fat

consumption, and late-night eating. However, whether the same individuals show similar caloric intake responses to both SR and TSD is unknown. As such, we determined whether trait-like responses are observed during and after SR and TSD separated by recovery sleep in the same protocol.

Methods: 66 healthy adults (34.4±9.0y; 32 women) were randomized to receive 2 baseline nights (10h-12h time in bed (TIB), 2200h-0800h/1000h) followed by 5 SR nights (4h TIB, 0400h-0800h) or 36h TSD. Subjects then received 4 recovery (12h TIB, 2200h-1000h) nights followed by 5 SR nights (4h TIB, 0400h-0800h) or 36h TSD, in counterbalanced order to the first sleep loss condition sequence. Intraclass correlation coefficients (ICCs) were computed as the ratio of between-subjects variance to the sum of the between- and within-subjects variances using late-night intake data during the first night of SR from 2200h-0400h and during TSD from 2200h-0600h, and using daily intake data following the first night of SR from 0800h-2200h and following TSD from 0600h-2200h.

Results: Caloric and macronutrient (protein, carbohydrate, fat) intake during the day following SR and TSD were moderately to substantially consistent within individuals (ICCs: 0.34–0.75). During the late-night period of SR and TSD, both caloric and macronutrient intake consistency was slight to moderate (ICCs: 0.03–0.55).

Conclusion: This is the first evidence of moderate to substantial inter-individual variance and phenotypic stability of energy balance responses to two commonly experienced types of sleep loss. Our results indicate some individuals are more vulnerable to greater caloric intake and subsequent weight gain during and after sleep loss of varying durations, and herald the use of biomarkers and countermeasures for prediction and mitigation of this critical vulnerability.

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0196

ACTIGRAPHY-ASSESSED SLEEP AND CONSUMPTION OF HIGHLY PALATABLE FOOD IN CONTROLLED AND NATUALISTIC ENVIRONMENTS

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Introduction: Objectives: The present study examines whether naturalistic sleep measured by actigraphy is associated with greater consumption of calorie-dense food in controlled and free-living environments. It was hypothesized that shorter sleep duration, later bedtime, and later wake time would be associated with greater consumption of highly palatable food.

Methods: Data were obtained from 78 healthy young adults. Participants carried a wrist actigraphy and completed food dairies for seven days. They then completed a laboratory food tasting task in which their caloric consumption was measured. Regression models were conducted to examine the associations between the consumption of highly palatable food in the laboratory food tasting task and sleep in the prior night. Mixed models were used to examine the within-individual and between-individual effects of sleep on daily consumption of highly palatable food for breakfast, lunch, dinner, and snacks.

Results: Later wake time in the prior night was associated with lower consumption of highly palatable food in the laboratory food consumption task (b = -.85, p =.02). There was a decrease of 51 calories consumed for an hour later in wake time. Mixed modeling analysis showed that longer sleep duration was associated with greater likelihood of consuming highly palatable food for breakfast (γ = .007, p<.001) while later bedtime was associated with lower likelihood of consuming highly palatable food for breakfast (γ = -.011, p<.001). Later wake time was marginally associated with higher likelihood of consuming highly palatable food for dinner after adjusting for multiple comparisons (γ = .004, p=.041).

Conclusion: Shorter sleep duration and later sleep timing were associated with a distribution of energy intake characterized by lower consumption of calorie-dense food earlier in the day but potentially greater consumption of calorie-dense food later in the day. This distribution of energy intake might mediate the association between poor sleep and the risk of obesity.

Support (If Any): This research was supported by Indiana University.

0197

THE INCREASE IN HUNGER ACROSS A SLEEP AND FASTING PERIOD IS MODULATED BY THE CIRCADIAN SYSTEM

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Introduction: Appetite is affected by the size and time since a prior meal, the overnight fast, and possibly sleep itself. Additionally, there exists an endogenous circadian rhythm in appetite with a trough during the biological morning independent of calories consumed, time since prior meal, and time since waking. How these factors interact is unknown. Thus, we assessed how sleep and fasting affect appetite across the circadian cycle.

Methods: Eight healthy participants (mean age, 51 years; mean BMI, 25.3 kg/m^2; 4 females) underwent a laboratory protocol that balanced eucaloric meals and sleep periods evenly across the circadian cycle (by scheduling 10 identical, recurrent 5h 20min 'days' in dim light thereby desynchronizing the circadian and behavioral cycles). Participants ate one identical meal each wake period and rated hunger immediately prior to sleep (30 minutes after each meal), and at the end of each sleep opportunity. Sleep was assessed with polysomnography. Salivary melatonin was used to assess circadian phase (phase marker = dim light melatonin onset [DLMO]).

Results: Appetite increased across each sleep opportunity with a median increase of 32%. This increase was dependent upon circadian phase (p=0.009), with the greatest increase in hunger when participants awoke in the biological afternoon (~6hrs before DLMO; ~2:45 pm). The lowest increase in hunger across the sleep period occurred during the biological night (~2hrs after DLMO; ~10:45 pm). Group mean peak to trough difference was 8 % of the full range of the hunger scale. This circadian variation in increase in appetite across sleep was correlated with the number of arousals from sleep (p=0.038), but was not significantly associated with sleep efficiency.

Conclusion: The increase in appetite across a sleep and fasting period is modulated by the circadian system, with the greatest increase when sleep occurs across the biological morning and into the afternoon. The mechanism may be related to sleep quality (number of arousals). Such results may have considerable relevance to energy balance and diet planning in people with disturbed sleep, and night shift workers who have both disturbed sleep and misalignment between meal timing and circadian phase.

Support (If Any): R01 HL125893 (to SAS).

0198

THE EFFECTS OF SLEEP RESTRICTION ON FOOD INTAKE: THE IMPORTANCE OF INDIVIDUAL CHARACTERISTICS

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Introduction: Acute sleep restriction (SR) often leads to an increase in energy intake (EI). However, large variability in food intake is often observed, which suggests that individual factors may affect EI after SR. The objective of this study was to explore the influence of personality traits (excitement seeking, impulsiveness and sense of competence), implicit attitudes toward food, and sensitivity to reward and punishment on EI after sleep loss.
Methods: Seventeen subjects (11men; 18-33y) completed a personality inventory (NEO-PI-3), an Implicit Association Test (IAT; this test measures implicit attitudes toward healthy and unhealthy foods), and the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ). *Ad libitum* EI over 24h was assessed following an habitual sleep night and a 50% SR held during the second half of the night. The difference in EI between sleep conditions (ΔEI) was calculated for each subject. Correlations between ΔEI and subscales of the NEO-PI-3, IAT score and SPSRQ scores were computed. A multiple linear regression model was performed to examine the unique contribution of each variable that was significantly associated with ΔEI. We controlled for gender, resting energy expenditure and fat% in these analysis.
Results: ΔEI was associated with excitement seeking ($r=-0.70$, $p<0.01$) and IAT score ($r=0.70$, $p<0.01$), suggesting that less excitement seeking and more positive attitudes towards unhealthy food lead to greater EI after SR. Impulsiveness, sense of competence and SPSRQ scores were not associated with ΔEI. Multiple linear regression modeling demonstrated that excitement seeking and implicit attitudes collectively explain 62% of the variance in EI after SR ($p<0.001$). Excitement seeking was the largest predictor ($\beta=-0.63$, $p<0.01$), followed by implicit attitudes ($\beta=0.40$, $p<0.05$).
Conclusion: These results suggest that excitement seeking and implicit attitudes toward food are key factors in explaining variations in EI after sleep loss. Since implicit attitudes are strongly related to educational and personal beliefs/values and personality traits are shaped by early life experiences which tend to remain stable over time, addressing weight gain issues in sleep restriction settings (*e.g.* rotating shifts) may be more challenging than simply addressing eating behaviors.
Support (If Any):

0199

CHARACTERIZING SLEEP, CIRCADIAN RHYTHMS, AND EYE CLOSURE IN ACOMYS CAHIRINUS (CAIRO SPINY MOUSE)

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Introduction: In order to better understand the functions and origins of sleep, sleep should be studied across a variety of species. We aim to characterize sleep and wake in *Acomys cahirinus,* the Cairo spiny mouse. Few studies on the circadian activity of this species are available and nothing is known of their sleep behavior. Therefore, we have begun to characterize sleep, circadian rhythms, and eye closure for this species (*A. cahirinus*) in greater detail and alongside the well-studied house mouse (*Mus musculus).*
Methods: Sleep and wake states were determined using a piezoelectric system for individually housed mice for 7 days under 12:12 LD condition. Four infrared cameras were set up around the cage to monitor activity patterns of *A. cahirinus* in light and dark conditions. Starting with one mouse, two more were added to the cage every four days ending with a total of five to study the effect of group housing on activity. Then, mice were surgically instrumented for tethered electroencephalogram (EEG) recording. To research eye closure of *A. cahirinus*, we set up a light flashing experiment to challenge the eye.
Results: We found *A. cahirinus* and *M. musculus* to be primarily nocturnal, but with distinct behavioral patterns. The activity of *A. cahirinus* sharply increases at dark onset, but surprisingly, decreases sharply just one hour later. *A. cahirinus* is more active in the first half of the night than the second half in both single and group housing. Based on EEG analysis, *A. cahirinus* sleeps more than *Mus* during both day and night. The proportion of REM is significantly higher (nearly tripled). The proportion of wakefulness is more in the first half of the night. We also found that *A. cahirinus* do not close their eyes during sleep periods of the day or night, even with lights flashing.
Conclusion: *A. cahirinus* has different sleep and circadian behavior than the standard laboratory nocturnal mouse. They sleep more than Mus during both daytime and night time. REM percentage is significantly higher.
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0200

DIRECT ACTIVATION OF G-PROTEIN-COUPLED INWARD RECTIFYING K^+ CHANNELS PROMOTE SLEEP IN RODENTS

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Introduction: The most common type of sleep disorder is insomnia which is characterized by difficulty falling asleep and/or maintaining sleep. Chronic insomniacs respond poorly to current treatments including benzodiazepines and non-benzodiazepines. Activation of G-protein-gated inward rectifying K channels (GIRKs) by $GABA_B$ agonists baclofen or γ-hydroxybutyric acid (GHB) predominantly promote non-rapid eye movement (NREM) sleep in rodents and humans. GHB especially reduces sleep fragmentation in narcoleptic patients. The present study explored the link between direct GIRK activation and sleep regulation in rodents using our potent and selective GIRK channel activator ML297.
Methods: Whole-cell patch clamp recordings from hypocretin/orexin-EGFP neurons and extracellular recordings of mouse hippocampal CA1 area in mouse brain slices were made to study cellular and synaptic actions of ML297. Wake activity and locomotion were measured using the noninvasive behavior monitoring system SmartCage™. Furthermore, wakefulness, REM and NREM sleep were determined using the electroencephalogram/electromyogram (EEG/EMG) in wild type mice (C57BL/C) implanted with electrodes.
Results: Bath-application of ML297 (5μM) hyperpolarized resting potential, decreased membrane input resistance and blocked

spontaneous firing of action potentials in hypocretin/orexin neurons. These actions were reversed after prolonged washout. ML297 (5–50μM) produced no significant effects on normal synaptic activity measured by input-output of field postsynaptic excitatory potentials and an evoked single population of spikes in the hippocampal CA1 area, suggesting ML297 principally causes long-lasting postsynaptic inhibition. Using our noninvasive SmartCage™ system we observed that ML297 (30mg/kg, i.p.) caused a prolonged inhibition of wake activity and locomotion in mice. The EEG/EMG recordings confirmed that ML297 (30mg/kg, i.p.) significantly decreased wakefulness and revealed an increase in NREM sleep without affecting REM sleep in mice.

Conclusion: The present study for the first time has demonstrated that direct action of GIRK produces similar sleep regulation to $GABA_B$ receptor-mediated modulation. Since GIRKs channels are predominantly expressed in principal excitatory neurons, inhibition of neuronal excitability and depression of the arousal system may powerfully modulate sleep. Direct GIRK activators may present an innovative approach for treatment of chronic insomnia as well as other sleep disorders.

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0201

EFFECTS OF INTRAPERITONEAL INJECTION OF GINGKOLIDES AND BILOBALIDE ON SLEEP STUDY IN MICE

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Introduction: Ginkgo biloba extract is one of the most broadly used herbal medicines world wide. Ginkgolide A, B, C and Bilobalide are active ingredients of extracts from Ginkgo biloba leaves/nuts. They have various medical functions such as increasing cerebral blood flow, reducing metabolism, antiviral, hepatoprotective, and antidementia properties. Therapeutic benefits of this herbal medicine in neurological disorders and sleep disturbance of depressed patients were also reported. In mice, Ginkgolide B and Bilobalide shorten the sleep time induced by anesthetics and increases latency to sleep onset of barbital-induced narcosis. However to date, there are no reports on effects of Ginkgo biloba's active ingredients on physiological sleep. We therefore evaluated the effects of Gingkolides and Bilobalide on sleep in mice.

Methods: C57BL/6 male mice aged 15 weeks were surgically prepared for EEG/EMG electrodes. In order to evaluate the locomotor activity, a telemetry-implanting device was implanted each mouse. Each group of 8 animals were injected intraperitoneally with Gingkolide A, B, C and Bilobalide for two doses (0.5 mg/kg, 5.0 mg/kg and vehicle). The sleep stages of each 10-second epoch were scored for 6 hours.

Results: We found significant wake-promoting effects by Ginkgolide B; effects were dose-dependent and a 18% increase in wakefulness was observed after 5.0 mg/kg injection. NREM sleep declined accordingly, but no change in sleep latency was observed. Milder wake-promoting effects (8% increase at 5.0 mg/kg) were observed with Bilobalide. 5.0 mg/kg of Bilobalide shortened sleep latency (vechile, 26 min vs. 5.0 mg/kg, 14 min) and reduced locomotor activity. Ginkgolide A and C had little effects on sleep/wake amount, but both significantly prolonged sleep latencies (vehicle, 17 min vs. 5.0 mg/kg of A, 30 min; vehicle, 17 min vs. 5.0 mg/kg of C, 22 min).

Conclusion: We confirmed that extracts of Ginkgo biloba have pharmacological properties to modify sleep and wake. Interestingly, different effects on sleep/wake were observed depending on the active ingredients of extracts. Of note, wake-promoting effects of Ginkgolide B may be a relatively potent in foods, and further studies are warranted.

Support (If Any):

0202

OBJECTIVE AND SUBJECTIVE SLEEPINESS FOLLOWING DAYTIME NAPS UNDER CONDITIONS OF CHRONIC SLEEP RESTRICTION

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Introduction: Napping is a useful countermeasure to sleepiness resulting from acute sleep loss; however, the efficacy of naps to reduce sleepiness resulting from chronic sleep restriction is less well understood. This study assessed the impact of an afternoon nap on subjective and objective sleepiness during chronic sleep restriction.

Methods: Following one adaptation and two baseline nights (time-in-bed, TIB: 2200h-0800h), participants were restricted to six nights of 5 h TIB (0300h-0800h). N=10 young adult males participated in a no-nap condition; 9 others were assigned to a 45-min nap opportunity provided at 1300h following each night of sleep restriction. Sleepiness was assessed using multiple sleep latency tests (objective) administered every two hours from 0930h, and a visual analogue scale of sleepiness (subjective) administered every 30 min from 0800h. Nighttime and nap sleep were recorded using standard polysomnography. Sleepiness measures during the restriction protocol were normalized as a percentage each participant's baseline levels.

Results: Overall mean nap sleep time was 33.5 ± 11 min, with no change across days ($F(5,40)=1.25$, $p=0.30$). Sleep time across restricted-sleep nights did not differ between groups (overall mean: 33 ± 8 min; $F(5,85)=0.26$, $p=0.93$). Objective sleepiness was significantly improved ($F(2,34)=3.44$, $p=0.044$) in the nap group relative to the no nap group for 4 h after the nap (changes from baseline sleep onset latency: nap group = 0 ± 4 min; no nap group = -6 ± 5 min), but not for the later trials (nap group = -3 ± 4 min; no nap group = -5 ± 5 min). Objective sleepiness within the nap group did not differ from their baseline levels for the 4 h after the nap. Nap-related improvements in subjective sleepiness only emerged later in the day (9.5–12.5 h after the nap; $F(2,34)=3.73$, $p=0.034$). Critically, neither the immediate benefit to objective sleepiness nor the delayed subjective sleepiness gains, persisted in the morning after the next night of restricted sleep.

Conclusion: Daytime naps effected short-lived benefits to objective and subjective sleepiness under chronic sleep restriction. The profile of benefits showed immediate objective improvements following the nap and delayed subjective improvement. The brief daytime nap was not associated with improvements the following morning.

Support (If Any): Endeavour Research Fellowship.

0203

THE EFFECT OF EXPERIMENTALLY MANIPULATING NAP FREQUENCY ON NIGHTTIME SLEEP QUALITY: AN ACTIGRAPHY STUDY

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Introduction: Whether and how daytime sleep impacts nighttime sleep is unclear. Here, we examined the causal relationship between

napping and nighttime sleep quality using a habitual napping intervention.

Methods: Thirty-eight healthy adults (22F, age=22.1±3.1) recorded daily sleep diaries and wore an actigraph for five weeks. During the first week (baseline), participants reported if they napped each day, and were categorized as either habitual nappers (HN, *n*=17) or non-nappers (NN, *n*=21). Following baseline, all participants were randomly assigned to nap Practice (instructed to nap at least three times per week) or Restriction (instructed to not nap at all) conditions. We examined nighttime sleep measured by actigraphy during baseline and over the four-week intervention.

Results: During baseline, HN took 1.6±1.0 naps (*M*=64.9±51.1min per nap). Also, compared to NN, HN went to bed later at night (*M*=12:50am vs. 12:09am, *p*=.04) and had less total nighttime sleep (*M*=373.4±41.1min vs. 401.6±33.6min, *p*=.03). However, we found no difference in HN nighttime sleep on nights following a nap versus nights with no nap (*p*s>.47). During the intervention, HN+Restriction showed no differences in nighttime sleep duration compared to HN+Practice with no change from baseline [F(1,15)-0.49, *p*=.49]. NN showed no changes in nighttime sleep in the Restriction condition (*p*=.48). However, the NN+Practice showed an overall decrease in total sleep time (*M*=388.2±45.5min, *p*=.009), but with no difference between nap vs. no-nap nights (*p*s>.22).

Conclusion: We show differences in HN and NN and the impact of daytime sleep on nighttime sleep. Specifically, experimentally-manipulating nap habits did not change HN nighttime sleep characteristics. However, for NNs, the nap intervention decreased total nighttime sleep. These data suggest that nap habits may arise from differences in homeostatic and/or circadian regulation of sleep.

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0204

PSYCHOSTIMULANTS INCREASE SALIENCE OF NEUTRAL INFORMATION AT ENCODING, BUT DISRUPT MEMORY CONSOLIDATION DURING SLEEP

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Introduction: Emotional information undergoes preferential memory processing. Psychostimulants facilitate processing of emotional and neutral memories in rodents, though this effect is less clear in humans. Sleep is important for emotional memory consolidation, yet psychostimulants disrupt sleep. Here, we tested the hypothesis that daytime administration of psychostimulants (compared with placebo) would enhance emotional and neutral memory over wake, but would impair sleep consolidation of these memories. We further tested this hypothesis by combining stimulants with a hypnotic to examine whether boosting sleep would counteract sleep disruption and enhance memory.
Methods: In a double-blind, placebo(PBO)-controlled, crossover design, 25(13F) healthy subjects were tested in four conditions (dextroamphetamine(DEX)/PBO, DEX/zolpidem(ZOL), PBO/ZOL, PBO/PBO), one week apart. At 9:00AM, 20mg of DEX/PBO was administered. 75 minutes later subjects encoded 20 negative and 20 neutral IAPS pictures. At 9:00PM, a memory test was given including 20 pictures from encoding and 20 foils (TEST1). At 11:00PM, subjects received 10mg of ZOL/PBO, and slept in the lab with polysomnography. At 10:30AM, the remaining 20 images from encoding and 20 foils were tested (TEST2).
Results: We replicated the emotional enhancement effect, negative>neutral(p=.01). Unlike prior results, compared to PBO, DEX boosted memory for neutral images(p=.023), but not for emotional images(p=.78) at TEST1. After sleep, TEST2 maintained a marginal main effect for emotion, negative>neutral(p=.08). Furthermore, we found a main effect of drug, with the DEX/ZOL condition outperforming DEX/PBO(p=.02) and PBO/PBO(p=.013).
Conclusion: Here, we show a preference for emotional memory processing over wake and sleep. However, we found no benefit of psychostimulants for emotional processing across wake, yet stimulants did boost memory for neutral pictures, suggesting stimulants may augment saliency of neutral information. Furthermore, stimulant disruption of sleep may impair long-term memory consolidation, as the combined stimulant/hypnotic condition showed greatest long-term memory.
Support (If Any): Support: ONR N00014-14-1-0513.

0205

TO NAP OR NOT TO NAP? SLEEP-DEPENDENT MEMORY CONSOLIDATION IN TYPICALLY AND ATYPICALLY DEVELOPING PRESCHOOLERS

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Introduction: Little work has examined the processes of sleep-dependent memory consolidation in children with sleep disorders. Down syndrome (DS) - characterized by sleep disturbances and memory impairments - constitutes a good model to examine these links.
Methods: We assessed word learning in preschoolers with and without DS (25 DS and 24 typically developing (TD) controls) across delays including mid-day naps and wake. Sleep physiology was collected with home-based polysomnography.
Results: Our results show that, despite equivalent levels of baseline retention, children with DS retained less over sleep, but not after the wake period, compared to TD children who benefitted from the nap ($F(1, 47) = 74.68$, $p < 0.001$). While TD children showed interference across a delay containing wakefulness relative to the nap period ($t(23) = -6.59$, $p < 0.001$), those with DS retained more after wake ($t(24) = 5.76$, $p < 0.001$). These effects were confirmed at 24 hours. While total sleep time of the nap period did not differ across the groups ($t(33) = -0.98$, $p = 0.34$), children with DS spent significantly less time in REM sleep ($t(33) = -2.56$, $p = 0.015$). In children with DS, we found a positive correlation between 4-hr nap retention and amount of SWS ($rho = 0.55$; $p = 0.02$), a correlation that was not observed after 24 hours. In TD, % REM sleep was associated with retention over the 4-hr sleep period ($rho = 0.65$; $p = 0.005$). After 24 hours, the learning benefit related to % N2 ($rho = 0.56$; $p = 0.02$) and negatively with % SWS ($rho = -0.78$; $p < 0.001$).
Conclusion: While TD children show interference across a delay containing wakefulness, those with DS show the opposite pattern, and retain more after wake, questioning the value of naps in this group. Our results indicate that different physiological mechanisms underlie sleep-dependent memory processes in these two groups: a finding that adds to our understanding of the dynamics of these sleep stages in young children.
Support (If Any): This research was funded by the Lumind Research Down Syndrome Foundation and the Lejeune Foundation.

0206

THE EFFECT OF SLEEP INERTIA AND CHRONIC SLEEP RESTRICTION ON HUMAN COGNITIVE PERFORMANCE

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Introduction: Sleep inertia, experienced as grogginess felt upon awakening, results in cognitive performance impairments that dissipate with increasing time awake. It is unknown, however, how chronic sleep restriction (CSR, insufficient sleep duration over consecutive days) influences cognitive performance during sleep inertia immediately upon awakening and its dissipation. We therefore explored whether experiencing CSR causes significant decrements in digit symbol substitution task (DSST) performance during the first 1.5h after awakening as compared to control sleep conditions.
Methods: Seventeen (7-male) healthy participants participated in a 32-day inpatient protocol free of time cues and in dim-lighting (<4 lux). After 3-weeks of maintaining a consistent 10h sleep schedule at habitual timing, participants began 24-cycles of a 20h forced desynchrony (FD) protocol. Participants were randomized to CSR (4.67h sleep, equivalent to 5.6h per 24h, n=9) or Control (6.67h sleep, equivalent to 8h per 24h, n=8) FD conditions. Upon each scheduled awakening, the participant's bed was elevated to a semi-recumbent posture (~45 degrees) and DSST performance was assessed within 1-min of scheduled awakening and every 10-min thereafter for 1.5h. The number of correct responses on the DSST was analyzed using T-tests and mixed-effect model techniques.
Results: Performance was significantly impaired in the CSR condition immediately upon awakening (first test) as compared to the Control condition ($p<0.05$). There was a significant interaction between condition, duration of time since awaking, and time into protocol for fewer correct answers on the DSST in the CSR condition compared to the Control condition ($p<0.0001$), indicating that performance remained impaired in the CSR condition across dissipation of the sleep inertia and throughout the 24-cycles of FD.

Conclusion: These data suggest that CSR, commonplace in millions of Americans, can negatively impact cognitive performance immediately upon awakening and have prolonged effects across dissipation for at least one hour, even in the absence of extended wakefulness. These findings are important for individuals needing to perform tasks quickly upon awakening, especially those who do not regularly obtain sufficient sleep.

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0207

NESTING OF SPIKE SEQUENCE REPLAY WITHIN SLEEP OSCILLATIONS DURING NREM SLEEP

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Introduction: Replay of spike sequences has been thought to underlie memory consolidation during sleep. Using computational models, we identified the critical mechanisms for the sequence replay during spindles (N2) and slow waves (N3) of NREM sleep.

Methods: Biophysically realistic thalamocortical network models implemented conductance based neurons and state dependent effects of neuromodulators (acetylcholine, histamine and GABA) to generate N2, N3 sleep and awake states. Spike Timing Dependent Plasticity (STDP) were implemented between cortical neurons. To simulate sequence learning, multiple trials of sequential input were presented to a group of selected cortical neurons during awake state of the model. The number of trials was varied from 10 to 100 trials. Performance was measured by the success of the sequence completion after the training, before and after the sleep.

Results: We found that learned spike sequences were reactivated spontaneously during N2 and N3 states leading to performance improvement after the sleep. In N2, the sequence replay was nested within spindle oscillations. Using spike-phase coupling analysis, we found that each neuron within a sequence fired selectively at the specific phase of the spindle oscillations. The spike-phase coupling was significantly higher for neurons involved in the sequence-learning task compared to neurons not involved in the task ($p<0.05$). In N3, replay of entire sequences occurred during the Up states of slow oscillation. Replay led to synaptic weights increase between neurons in the direction corresponding to the sequence replay while reduction in the opposite direction. Synaptic reorganization facilitated completion of the sequences learned during initial training phase. Both number of replays and change in synaptic weights were higher in trials with longer initial training.

Conclusion: We conclude that spike sequence replays are nested within sleep oscillations during NREM sleep and the nature of nesting is different between spindle and slow oscillations.

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0208

CIRCADIAN MISALIGNMENT IMPACTS ON HUMAN COGNITIVE PERFORMANCE

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Introduction: Shift work increases the risk for disorders of sleep and human error. Overnight operations pose a challenge because our circadian biology promotes nocturnal sleep and daytime vigilance and performance, which may underlie cognitive vulnerability at night. Here we investigated if daily circadian misalignment, typical for night shift work, adversely impacts cognition across diverse cognitive domains.

Methods: Thirteen healthy young individuals (27.8 ± 9.5 y; 7 men) underwent two 8-day protocols including either 4 days of circadian alignment (day shifts) or misalignment (night shifts; 12-h inverted behavioral/environmental cycles). Cognitive testing included tasks of sustained attention (Psychomotor Vigilance Task; PVT), cognitive throughput (Addition Task; ADD), information processing (Digit Symbol Substitution Task; DSST) visual-spatial performance (Unstable Tracking-Task; TKT) and declarative memory (Probed Recall Memory; PRM), all of which are sensitive to increased sleep pressure and circadian phase.

Results: Circadian misalignment over successive days increased cognitive vulnerability by ~10–20% on sustained attention, cognitive throughput, information processing and visual-motor performance, as compared circadian alignment. Attention, as indexed by PVT performance, was acutely impaired during the first 2 days of misalignment with subsequent improvement after 3 days (interaction of "circadian alignment/misalignment", "day" and "time since awakening", $p=0.006$). Conversely, learning, as indexed by changes in ADD, DSST and TKT performance, significantly improved across multiple days of circadian alignment, while no improvement occurred under misalignment (interaction of "circadian alignment/misalignment" and "day", $p<0.05$). Lastly, we investigated if the effects of circadian misalignment on performance were also mediated by prior sleep-wake history. Accordingly, lower sleep efficiency in the sleep episode before cognitive testing significantly impaired performance (interaction of "sleep efficiency", "circadian alignment/misalignment" and "night"; $p<0.05$).

Conclusion: Our data indicate that daily circadian misalignment may explain cognitive vulnerabilities experienced by night workers, and provide a biological framework for the development of countermeasures against adverse cognitive effects in this vulnerable population.

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0209

OPTIMIZING SLEEP-RELATED MEMORY PROCESSES USING CLOSED-LOOP AUDITORY STIMULATION

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Introduction: Recent studies have shown that sensory stimulation can optimize memory consolidation in the sleeping brain for simple lab-based tasks. Based on these earlier results, we developed a closed-loop auditory stimulation (CLAS) system to more precisely target sensory stimulation and test whether this method can improve the more complex skill of spatial navigation in an urban environment.

Methods: Forty participants (Mean age = 26.2 years, F = 18) were trained to navigate within a large and detailed urban environment in virtual reality. Participants first learned the environment by freely navigating to specific points of interest (24 unique landmarks) in a virtual city. As participants navigated, they encountered different auditory cues (e.g., the barking of a dog near a park) associated with areas in the environment. Following learning, all participants underwent a

90-min polysomnographically-recorded nap, with half the participants receiving CLAS. CLAS detects slow oscillations during non-rapid eye movement (NREM) sleep using a minimum negative threshold criterion coupled with online automated sleep staging, to trigger delivery of short (700 ms) auditory cues during the down-state to up-state transition (DUPT). After sleeping, participants were tested in 6 of the previously trained routes.
Results: Compared with controls, the CLAS treated group was significantly faster in post-nap navigation ($p<0.01$). Additionally, CLAS participants showed an increase in DUPT phase-locked spindle activity in both the slow (9–12 Hz) and fast (12–16 Hz) frequency bands. No effect of the CLAS on sleep architecture was observed.
Conclusion: CLAS successfully improves the complex task of navigation in a virtual environment without any negative effects on sleep architecture.
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0210
INHIBITION OF PROTEASOME ACTIVITY MITIGATES THE EFFECTS OF SLEEP DEPRIVATION ON OPERANT MEMORY IN APLYSIA
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Introduction: Technological advances, societal changes and increased emphasis on longer working hours for individuals have resulted in rising incidences of sleep deprivation for adolescents and adults. Consequently, sleep deprivation represents a growing public health and economic concern due to adverse effects on individual health, cognition and productivity. Recent research in rodents suggests that sleep deprivation inhibits hippocampal dependent memory through suppression of protein synthesis; however, it remains unknown whether these interactions are conserved across learning paradigms or phylogeny. The marine mollusk Aplysia californica with a relatively simple nervous system and well-established learning paradigms has recently emerged as an excellent model system for studies of sleep deprivation and memory. Recently, we found that maintenance of steady state protein levels through concurrent inhibition of protein synthesis and protein degradation permitted the induction of long-term memory. To test the hypothesis that sleep deprivation impacts memory formation through regulation of protein levels, we investigated whether the inhibition of proteasome activity ameliorated the effects of sleep deprivation on memory.
Methods: Animals were sleep deprived for 9 hours using context changes and tactile stimulation. Three hours prior to the end of sleep deprivation, animals were injected with either the proteasome inhibitor MG-132 or vehicle. Animals were trained following sleep deprivation using the learning that food is inedible paradigm, wherein animals form an association between a specific seaweed and failure of the swallowing attempts.
Results: We found that pharmacological inhibition of proteasome activity during sleep deprivation permitted the induction of associative memory. Sleep deprived animals treated with MG-132 exhibited robust short-term memory whereas vehicle injected animals failed to exhibit memory. Experiments on long-term memory are ongoing.
Conclusion: Inhibition of proteasome activity ameliorates memory decrements caused by sleep deprivation suggesting that sleep deprivation may inhibit the induction of memory through increased protein degradation or limitations on protein synthesis.
Support (If Any): National Institute of Neurological Disorders and Stroke grant R21NS088835.

0211
ENHANCING MEMORY CONSOLIDATION WITH TARGETED MEMORY REACTIVATION DURING SLEEP
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Introduction: In young adults, memories can be strengthened during sleep through cued memory reactivation, a process whereby a sensory cue associated with prior learning is introduced again during sleep. It is unknown whether this procedure could be effective in older adults who typically exhibit memory decline. Thus, the purpose of this study is to replicate previous findings in young adults in order to develop a paradigm to test healthy older adults in the future.
Methods: Young adults (N=24, M=20.72 years) completed both an experimental and control condition. In both conditions, participants learned 30 picture-location pairs while wearing a nasal cannula. Two odors were administered during learning, Odor A (rose) and Odor B (mint), with half of the pairs being associated with each odor. Immediately after encoding, participants wore a polysomnography cap and nasal cannula during overnight sleep. One of the two odors was presented during sleep in the experimental condition, and a vehicle was administered during sleep in the control condition. The following morning, participants were tested on recall of all picture-location pairs without any odors.
Results: In both conditions, there was no significant difference in memory at the end of the learning session between cards associated with Odor A and those associated with Odor B ($p's>0.39$). In the experimental condition, memory accuracy improved between learning and recall for pairs associated with the odor presented during sleep ($p=0.003$) but not for the other pairs ($p=0.47$). Overall, memory accuracy was equivalent in the experimental and control conditions ($p=0.44$).
Conclusion: Results indicate that this cuing procedure does not enhance sleep dependent consolidation in general but rather in a stimuli-specific fashion. Future work will determine whether this procedure can enhance memory consolidation in older adults.
Support (If Any): This work was funded by NIH R01 AG040133 (PI: Spencer).

0212
CRITICAL WINDOWS OF WAKING: SLEEP-DEPENDENT MEMORY CONSOLIDATION REQUIRES A WAKING PERIOD PRIOR TO SLEEP
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Introduction: Sleep has consistently been shown to be beneficial for hippocampal-dependent declarative memory, such as memory for word pairs. Prior research has found that sleeping within 3 hours after learning is more beneficial for memory than delaying sleep for 15 hours. However, the ideal relationship between waking and subsequent sleep is unclear. The purpose of the current research was to investigate how information learned at various intervals prior to sleep was later affected by sleep.
Methods: During Encoding, participants learned 24 pairs of non-semantically related words and completed a cued recall test without feedback to assess learning. That night, participants recorded when they went to bed using a smartphone app. Twenty-four hours after Encoding, participants returned to the lab and completed a final cued recall test.

Results: We found that a quadratic, rather than a linear, relationship existed between time to sleep onset and performance on the final cued recall test. In other words, participants who delayed going to sleep by several hours (approximately 3–9 hours) performed better at test and lost proportionally fewer word pairs across the delayed retention interval than participants who went to sleep sooner than 3 hours after Encoding or later than 9 hours after Encoding.
Conclusion: Sleeping immediately after learning new information is not as beneficial as delaying sleep for several hours. However, delaying sleep for longer periods of time (more than 9 hours) is also less beneficial for memory. The critical window in which sleep is most beneficial for consolidating new declarative memory is approximately between 3 and 9 hours.
Support (If Any): None.

0213

BRIEF PERIODS OF NREM SLEEP DO NOT PROMOTE EARLY OFFLINE GAINS BUT SUBSEQUENT ON-TASK PERFORMANCE IN MOTOR SKILL LEARNING

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Introduction: Sleep has been shown to modulate motor learning, but its detailed impact on motor performance curves remains to be fully characterized. The aim of this study was to further determine the impact of brief daytime periods of NREM sleep on 'offline' (task discontinuation after initial training) and 'on-task' (performance within the test session) changes in motor skill performance (finger tapping task).
Methods: In a mixed design (combined parallel group and repeated measures) sleep laboratory study (n = 17 'active' wake vs. sleep, n = 19 'passive' wake vs. sleep), motor skill performance curves were assessed prior to and after a period of 90 min containing either sleep, active or passive wakefulness in healthy adolescents (aged 16 years).
Results: A highly significant, but state- (that is, sleep/wake)-independent early offline gain and improved on-task performance after sleep in comparison to periods of active and passive wakefulness was observed. Exploratory curve fitting suggested that the observed sleep effect most likely emerged from an interaction of training-induced performance improvement and detrimental 'time on-task' processes, such as fatigue.
Conclusion: The results indicate that brief periods of NREM sleep do not promote early offline gains but subsequent on-task performance in motor skill learning.
Support (If Any): The study was supported by a research grant provided by the German Research Foundation to UV and CN (Vo 542/ 9-1). JGM and MK have received PhD grants provided by the FAZIT Foundation.

0214

RELATIONSHIP OF SLEEP EFFICIENCY TO COGNITIVE PERFORMANCE AND CARDIOVASCULAR RESPONSE TO COLD CHALLENGE

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Introduction: While inadequate sleep (length of sleep) has been linked to numerous health outcomes including impairment of cognitive function, increase in negative emotions and cardiovascular mortality, inefficient sleep (quality of sleep) has not been as heavily researched. The purpose of this investigation was to examine the relationship of sleep efficiency to cognitive and cardiovascular performance.
Methods: Adults were recruited for a study investigating exercise withdrawal (n=22, age: 33.9 ± 7.0 years, 55% female, 82% white). An Actiware wristband was used to monitor sleep activity and sleep efficiency. Reaction time during a Stroop test was assessed as the individuals' cognitive performance. In addition, each participant completed a cold pressor test (physical challenge). Cardiovascular measures (systolic and diastolic blood pressure: SBP and DBP), and heart rate) and emotional rating Likert scales were taken at rest, during the two challenge tests, and during the recovery period from each of the tasks.
Results: Decreased sleep efficiency was related to slower reaction time (r=-0.537, p=0.006). Additionally, decreased sleep efficiency was related to higher self-reports of negative emotions (r=-0.410, p=0.042). In order to predict mean reaction time (for correct responses), linear regression was used. The best predictors for reaction time were the combination of sleep efficiency and peak heart response to the challenge tasks (53% of variance explained, p=0.003). In addition, there was a statistically significant relationship between sleep efficiency and the blood pressure recovery measurements from the cold pressor task (SBP: r=0.465, p=0.029 and DBP: r=0.511, p=0.015).
Conclusion: Sleep efficiency was related to cognitive performance (as measured by reaction time). Furthermore, sleep efficiency was related to cardiovascular recovery from a physical challenge, which is a predictor of cardiovascular morbidity and mortality. These results highlight the importance of researching the impact of objective indices of sleep inefficiency on various health outcomes.
Support (If Any): None.

0215

CARDIAC ACTIVITY IN SLOW WAVE SLEEP PREDICTS MEMORY CONSOLIDATION

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Introduction: The autonomic nervous system activity (ANS), as measured by heart rate variability (HRV), shows strong variation during sleep. The classical HRV indices have been correlated with memory improvement in waking and rapid eye movement (REM) sleep, but not in non-REM (NREM) sleep. Our study aimed to use nonlinear HRV analysis to investigate relationship between HRV features and memory-related features in the electroencephalogram (EEG) and to reveal the benefit of NREM ANS activity to memory consolidation.
Methods: HRV dynamics were investigated during a daytime nap in healthy subjects by using Poincare plots of the heart beat-to-beat intervals (RRIs; current RRI versus previous RRI) for wake, Stage 2, slow wave sleep (SWS), and REM. The dispersion of points along the identity line (SD2; describes sympathetic activity) and the perpendicular axis (SD1; describes parasympathetic activity), and their ratio (SD1/SD2; sympathovagal balance) was derived from the Poincare plots. For EEG, delta and sigma powers were extracted. The difference in post- and pre-nap face recognition sensitivity (d') from a face-name-association task was used as measure of declarative memory consolidation.
Results: The SD1/SD2 was significantly different across sleep stages ($p<.05$). The difference in d' (memory change) was significantly correlated with SD1 ($r=.38$, $p<.05$) and SD1/SD2 ($r=.32$, $p<.05$) in SWS. No significant correlations were found between the difference in d' and SD2 in SWS and Stage 2. The EEG/HRV analysis between SD1/SD2 and relative sigma power revealed a significant correlation during SWS

(r=.36, p<.05) and a marginally significant correlation during Stage 2 (r=.28, p=.07). No significant correlations were found with delta power.
Conclusion: Parasympathetic activity in SWS, is positively correlated with sigma activity and better memory consolidation. Taken together with prior findings, ANS activity appears to influence memory consolidation during both NREM and REM sleep. Here, we demonstrate that this relationship may be influenced by changes in sigma power.
Support (If Any): NIH (R01 AG046646); ONR (MURI N000141310672).

0216

COMPARISON OF THE ASSOCIATION OF EXECUTIVE FUNCTION WITH SELF-REPORTED AND OBJECTIVE SLEEP IN HEART FAILURE PATIENTS

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Introduction: Executive dysfunction is common in heart failure patients[1] and associated with poor functional status.[2] Sleep problems, reported by approximate 67% of heart failure patients,[3] may contribute to executive dysfunction.[4,5] Studies have been limited by use of only self-reported sleep measures and objective sleep data are lacking. The aims are to (1) investigate the association between executive function with objective sleep and (2) compare the association between executive function and self-reported and objective sleep in heart failure patients.
Methods: This study analyzed baseline data from a longitudinal intervention study. Data were collected from 170 heart failure patients (age: 60.5 10.9, female: 44.7%, NYHA l/l/III/IV: 9.5%/52.1%/37.3%/1.2%). Executive function was measured by letter fluency test. Higher score indicates better executive function. Self-reported sleep was determined by the converted total score of PROMIS-Sleep Disturbance instruments v.1.0. Higher score indicates more sleep disturbances. Objective sleep by at least 3 nights of waist actigraphy. Descriptive statistics, Pearson's correlation, and hierarchical multiple regression were used to analyze data (covariates: age, gender, education, body mass index, comorbidity, medications, depression, anxiety, fatigue, and ejection fraction).
Results: Better executive function was significantly correlated with more self-reported sleep disturbances (r= 0.19, p=.015). No actigraph sleep variables significantly correlated with executive function. After controlling covariates, the model of self-reported sleep disturbances significantly predicted executive function [n=163, R^2 changes= .016, F(12, 150)= 1.92, p=.036]; however, the variable of sleep disturbances was not a significant predictor (=0.16, p=.103). After controlling covariates, the model of objective sleep was not predictive [n=163, R^2 changes= .002, F(15, 147)= 1.33, p=.190].
Conclusion: Neither self-reported sleep disturbances nor objective sleep were associated with executive dysfunction in this sample. Results need to be confirmed by further evaluation of sleep and use of additional tests of executive function beyond the letter fluency.
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0217

ACTIGRAPHY-DEFINED SLEEP IN RELATION TO LABORATORY MEASURES OF CREATIVITY AND EDUCATIONAL LEARNING

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Introduction: College students often sacrifice sleep in order to maximize study time. However, sleep deprivation is known to have negative effects on cognition, including reduced memory consolidation, impaired creativity, and inability to cope with stress. Therefore, we investigated whether undergraduate students' sleep quantity was associated with their performance on several laboratory measures of creativity and educational learning.
Methods: Forty-one undergraduate students completed both experimental sessions. During session 1, participants completed a virtual microeconomics course along with laboratory based measures of creativity (e.g., Remote Associates Test). Across the following week, participants maintained sleep diaries and wore wristband actigraphy to measure their sleep subjectively and objectively, respectively. During session 2, participants completed creativity measures and a microeconomics test that included problems they were originally trained to perform as well as problems that required integration of learned principles.
Results: Participants who slept for 7 to 9 hours per day (normal sleepers) tended to score higher than participants with short or long sleep on the microeconomics test, both for trained problems (M=10.50 for normal sleepers, M=7.59 for long and short sleepers) and integration problems (M=1.33 for normal sleepers, M=0.82 for long and short sleepers). However, these trends fell short of statistical significance (t=1.44, p=.158, t=.88, p=.385, respectively). Furthermore, normal sleepers showed marginally higher overall Remote Associates Test posttest scores (r=.27, p=.100), particularly on the medium difficult items (r=.29, p=.071). Additionally, participants who objectively slept less reported feeling more stressed before the microeconomics test (r=-.35, p=.030).
Conclusion: The results of this preliminary study indicate that insufficient sleep may impede innovative thinking and coping with stress, abilities that are essential for success in educational settings and beyond. Future research should randomly assign participants to short or normal time-in-bed durations and evaluate creativity and educational outcomes.
Support (If Any):

0218

OPTOGENETIC MANIPULATION OF PARVALBUMIN CONTAINING GABAERGIC NEURONS IN THE THALAMIC RETICULAR NUCLEUS ALTERS DECLARATIVE AND NON-DECLARATIVE MEMORIES IN MICE

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Introduction: Schizophrenia (Sz) patients exhibit sleep and sleep spindle abnormalities along with cognitive impairments. However, a causal link between spindles and cognitive deficits in Sz has not yet been shown. Cortical parvalbumin (PV) containing GABAergic neurons have reduced activity in Sz. Thalamic reticular nucleus (TRN) neurons involved in spindle generation are also GABAergic and most contain PV. Thus, reduced activity of TRN PV neurons may account for spindle abnormalities and associated cognitive deficits. Here we tested whether optogenetic inhibition of TRN PV neurons during sleep following learning alters memory performance in three tasks: novel object recognition (NOR) and object place recognition (OPR) tasks to measure declarative memory; and the rotarod motor learning task to measure non-declarative/procedural memory.
Methods: AAV-CAG-FLEX-ArchT-GFP was bilaterally injected into the TRN of PV-Cre mice. Inhibition of TRN PV neurons was performed via laser illumination (532 nm, 1-min on, 4-min off) during the 4-hr retention interval of NOR and OPR; the time period between the acquisition and recall phases of the tasks. Separately, we trained mice in the rotarod motor task in which laser (or sham-laser) was applied for the first 7hrs after Day-1 training. Motor skill was tested again on Day-2 to assess animal's performance improvement. EEG/EMG recordings were performed during the retention intervals of all tasks.

Results: Recognition memory was significantly impaired following inhibition of TRN PV neurons during the memory retention interval (NOR: N=10, p<0.01, OPR: N=10, p<0.01). Procedural memory, computed as percent improvement from Day-1 to Day-2 of the rotarod task, was also impaired in the TRN inhibition group (N=7) compared to control (N=5, p<0.05). However, correlations between spindle density and behavioral performance were inconsistent among tasks.
Conclusion: These findings demonstrate that optical inhibition of TRN PV neurons following learning affects memory performance. Further investigation of the precise physiological mechanisms that cause behavioral impairments is necessary.
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0219

ACOUSTIC STIMULATION INCREASES SLOPE, AMPLITUDE AND TIME IN BETWEEN SLOW WAVES IN OLDER ADULLTS

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Introduction: Acoustic stimulation during sleep has been shown to increase slow-wave activity (SWA) in young adults but has not been examined in older adults. The aim of this study was to examine the ability of acoustic stimulation to increase SWA parameters in adults ≥50 years old.
Methods: Seven adults (age 66.85 ± 10 years, 1 male) completed one night of acoustic stimulation and one night of sham stimulation. During sleep, an adaptive phase-locked loop (PLL) algorithm was used to lock on to endogenous slow waves measured in midline frontopolar electroencephalographic recordings in real time. Acoustic stimuli were delivered when the PLL system predicted the positive upstate of the slow wave. Stimuli consisted of pulses of pink noise lasting 50 ms with an inter-tone interval of approximately 1 s, depending on the individual's slow oscillations. Tones occurred in blocks of 5 pulses ("ON blocks") followed by a refractory period of equal length ("OFF blocks"). Frequency-amplitude methods were used to calculate amplitude, slopes and time in between slow waves negative peaks.
Results: The amplitude, slope and time in between slow waves had lognormal distributions. The mean of the distribution of the logs of the amplitudes, slopes, and time in between slow waves was 8.1, 5 and 6 percent higher during the stimulation night (p<0.001) compared to the sham night.Spindles were also distributed lognormaly and the mean of the logs during the stimulation night was higher by 5 % relative to sham (p<0.001).
Conclusion: Acoustic stimulation during sleep can enhance SWA and spindle amplitude and has the potential to improve sleep quality in middle-age and older adults.
Support (If Any): Funding: Dixon Translational Research Grant, NIH T32 NS047987, National Science Foundation GFRP DGE-1324585, NIA P01AG11412.

0220

SLEEP OR WAKE BENEFIT WORKING MEMORY IN OLDER ADULTS?

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Introduction: Aging is associated with decreases in cognitive ability (e.g, working memory (WM)), supporting neural structures (Sowell et al., 2004), and sleep (Wolkove st al., 2007); however, the relationship between these factors is not clear. Insufficient sleep prior to testing may impair WM in young adults (Gradisar et al., 2008), but it is not clear whether sleep after testing may benefit WM. Here, we investigate the role of a nap, quiet wake (QW) and active wake (AW) on changes in WM performance in older adults.
Methods: 38 healthy older adults (15 females, 70.8 ± 6 years old) were asked to solve simple math problems while holding a variable-length list of letters in their working memory before (Session 1) and after (Session 2) a nap intervention: 50-minute polysomnographically-recorded nap (n=23), 60-min QW (n=7) or 60-min AW (n=8). Proportional correct performance measure was calculated, and one-way ANOVA and independent-samples t-tests compared group performance, as well as paired t-tests to evaluate within-group changes in performance. Bivariate correlations examined association between sleep variables and performance.
Results: We found a significant main effect of nap condition (p=.05). Post-hoc comparisons revealed no differences in Session 1 (all p>.09). However, at Session 2, QW performed significantly better compared to both nap (p=.04) and AW (p=.02). Additionally, compared to the other groups, QW and AW WM performance did not deteriorate during the day (QW: p=.4; nap: p=.02 and AW: p=.8). Stage 1 sleep percentage negatively predicted Session 2 performance in the nap group (r=-.4, p=.04).
Conclusion: We show that older adults benefit from a period of quiet wake or active wake in maintenance of WM across the day. Moreover, napping and active wake showed worse WM performance compared with QW. Given the prior literature demonstrating scant benefits of sleep for memory consolidation in older adults (Scullin, 2013), our data suggest that older adults do not use sleep to maintain executive functioning across the day either.
Support (If Any): None.

0221

EXAMINING THE COMPETITION OF SALIENCE CUES FOR DOMINANCE IN MEMORY OVER A NAP VERSUS WAKE

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Introduction: Selectively remembering emotional information is biologically adaptive, but how this type of salience ranks in importance to other salience cues, such as a task direction to remember or forget specific items, remains unclear. Furthermore, sleep selectively consolidates that which is the most important to remember, but it is unknown how sleep, and what particular aspects of sleep physiology, will prioritize multiple cues of future relevance.
Methods: Participants viewed both negative and neutral scenes, with presentation of each scene followed by a direction to either REMEMBER or FORGET that item. Half of the emotional and neutral items were to-be-remembered, the other half to-be-forgotten. Following baseline testing on half the encoded material, subjects either obtained a 90-min nap or remained awake. Memory for the remaining images was tested 7 hours later, holding constant the time of training and testing between groups.
Results: Across groups, we found a greater preservation of memory for negative compared to neutral scenes and for the to-be-remembered items compared to the to-be-forgotten items (both p<0.001). Interestingly, the task cue to remember was valued more than emotional salience, forming a hierarchy of memory with negative-remember items best remembered, followed by neutral-remember, negative-forget, and neutral-forget. Comparing the groups, we found a trending 3-way interaction at retest (p=0.09). For neutral

items, similar patterns of memory are seen between wake and nap groups, with cued to-be-remembered items better remembered than forget items and with the nap benefitting both types better than remaining awake. However, for negative items, the nap selectively benefitted the to-be-remembered items at the expense of memory for the to-be-forgotten items, with a greater decay of the negative-forget items with sleep compared to wake. Interestingly, memory for the negative-forget scenes was negatively correlated with the percentage of the time spent in rapid eye movement (REM) sleep in the nap group (p=0.02), indicating the more REM sleep they obtained, the more negative-forget items they forgot.
Conclusion: Taken together, these findings indicate that the interaction of salience cues results in preferential consolidation of negative-remember items during sleep, particularly REM sleep, resulting in a memory tradeoff.
Support (If Any): NIA NRSA F32AG047807.

0222

A NAP HAS NO EFFECT ON THE TRANSITIVE INFERENCE TASK

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Introduction: In the Transitive Inference (TI) task, subjects are given premise pairs of the form A > B, B > C, etc., and intuit the relationships between items not previously seen together (i.e. A?C). Previous studies have reported that in subjects trained to below-ceiling levels on the premise pairs, the passage of time affects performance on the TI task, and that sleep specifically boosts performance on 2º pairs-pairs of items linked by 2 intermediate items (A?D).
Methods: Healthy subjects (18–30 yrs) were trained on the premise pairs of a six-item hierarchy of abstract visual stimuli. During learning subjects guessed, with feedback, which item to choose out of a pair, until they reached 70% accuracy. Later they were tested on pairs of items not seen together during training. In Experiment 1, subjects were tested only once, after 3 hours, or twice, after 20 minutes and 3 hours. In Experiment 2, all subjects were tested at both 20 minutes and 3 hours; some subjects napped between tests.
Results: In Experiment 1, there was no evidence that testing at 20 minutes affected performance at 3 hours, justifying the repeated measures approach of Experiment 2. In Experiment 2, performance at 3 hours did not differ significantly between subjects who did or did not nap. On average, there were no changes in performance on this task over the course of 3 hours, with or without sleep. In contrast to previous work, many subjects had high levels of performance after only 20 minutes, especially on 2º pairs.
Conclusion: In contrast to how previous work on the effect of delay and sleep on the TI task has been done, changes in performance should be measured within-subject. Previously reported differences between performance at 20 minutes and later, or between performance after sleep and after wake, may have been due to cohort differences. Alternatively time and sleep dependent changes may take longer than 3 hr to develop.
Support (If Any): MH48832, TR000170.

0223

COMBINED ACUTE EFFECTS OF SHORT TERM EXERCISE AND SLEEP ON DECLARATIVE MEMORY IN YOUNG, SEDENTARY ADULTS: A PILOT STUDY

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Introduction: Research has provided evidence for the beneficial role of exercise in enhancing cognition and improving sleep. Sleep has been linked to memory processing and enhanced performance. Little is known about the effects of moderating factors. We aim to test the idea that a nap and a single aerobic exercise session may have synergistic, complementary effects on long-term memory in young sedentary adults.
Methods: Participants were screened based on a history of having a low-to-moderate level of physical activity. Participants underwent medical and psychological evaluations, sleep screening, 10-day sleep diary and actigraphy. The study involved a between-subject design with three groups (N=5/group): 1) exercise+nap (ExNap), nap only (NoExNap), exercise only (ExNoNap). During the experimental procedure, participants were provided with a lunch after undergoing 40min of moderate-intensity cycling, followed by a study session (13h30), and a 60min nap (14h00). At the test session (17h00), the participants completed a recognition task whereby 45 of the previously studied photos were intermixed with 45 "foils". The participant's task was to indicate the previously presented photos by pressing a key on a computer. Polysomnography was used to monitor sleep. A visual analog scale for vigilance was administered prior to the memory testing. The outcome variables were accuracy, reaction times (RT) and sleep metrics (%N3, %N2, TST).
Results: We have preliminary data in 15 healthy, normal weight young adults (Mage23±3.11SD yrs). We interpreted our results based on effect size, Cohen's d calculations. A comparison between the groups showed that the ExNap group was more accurate than the NoExNap group (M±SD 93.8%±2.9 vs. 91.3%±8.7, respectively), d=.38. Furthermore, the NoExNap and the ExNap group were more accurate than the ExNoNap group (89.6%±6.6), d=.23 and d=.83, respectively. Pearson correlations revealed no significant associations between performance on the memory task and groups, or between RTs and sleep variables.
Conclusion: These preliminary data, obtained in a small sample, support our hypothesis and suggest that a single moderate-intensity aerobic exercise session and a daytime nap may improve memory performance more than a nap or exercise alone in young adults with a sedentary lifestyle.
Support (If Any): American Sleep Medicine Foundation FPA 2016.

0224

SLEEP SELECTIVELY ENHANCES ASSOCIATIVE ASPECTS OF EMOTIONAL MEMORIES

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Introduction: Sleep promotes the retention of episodic memories, but depends on items' perceived relevance. Typically, emotional material benefits more from a period of sleep than neutral information.

However, it is unclear which aspects of emotional memory are preferentially consolidated. Here, we test whether selective consolidation effects differ for item recognition and associative memory.
Methods: Forty-five healthy volunteers encoded neutral and negative stimuli presented visually to either the left or right visual field, with separate groups encoding in the morning (n=16) and evening (n=29). Immediately after encoding, and after a 12h interval containing either sleep or wake, individuals were shown items that were presented before as well as new items. Crucially, items were now presented centrally. Subjects judged each item in two ways. First, to measure item recognition, subjects provided an old/new rating. Second, to measure associative memory aspects, they indicated the side where they believed the item was originally presented. We analyzed behavioral data by performing several 2 (GROUP: sleep/wake) x 2 (VALENCE: emotional/neutral) x 2 (TIME: immediate/delayed) ANOVAs. In addition, we recorded EEG in the sleep group throughout the entire protocol to search for neural correlates of sleep-dependent memory effects.
Results: Source memory for correctly recognized old items was selectively enhanced for emotional items over a period of sleep vs. wake. This was expressed as a significant 3-way interaction between all factors (P=0.004). Follow-up tests demonstrated that while associative memory performance decreased across time for emotional (P=0.015) and neutral items (P=0.10) in the wake group, and for neutral items in the sleep group (P=0.001), source memory improved significantly for emotional items across sleep (P=0.035). In contrast, changes in recognition memory over time did not depend on whether subjects slept or not, either for emotional or neutral items. EEG oscillatory correlates underlying behavioral consolidation effects will be presented.
Conclusion: These results of selective strengthening of associative links for emotional items during sleep are consistent with theoretical accounts of sleep's role, recoding labile, hippocampus-dependent, relational memories to a more stable neocortical format.
Support (If Any): Grants by NWO to RC, NIH to RS, and The Harvard Clinical and Translational Science Center.

0225

SLEEP BENEFITS MEMORY FOR SEMANTIC CATEGORY STRUCTURE WHILE PRESERVING INDIVIDUAL EXEMPLARS

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Introduction: While sleep is known to influence diverse aspects of learning and memory, its role in learning semantic category structure remains unclear. We investigated how sleep affects learning of novel object properties that are either shared among category exemplars or are unique to an exemplar.
Methods: Participants learned about 15 objects ("satellites") organized into three categories. Each satellite had five shared and two unique features. During learning participants guessed, with feedback, a missing part of one satellite on each trial. Exposure frequency was manipulated so that (1) shared and unique properties were equally well learned and (2) a given category appeared with high, moderate, or low frequency. After reaching a criterion of 66% correct, participants were tested immediately and again later on their memory for unique and shared properties. In Experiment 1, a full night of sleep or a day of wake elapsed between test sessions. In Experiment 2, participants either stayed awake or took a polysomnographically-recorded nap between tests. Naps either contained non-rapid eye movement (NREM) sleep only or NREM and REM sleep.
Results: In Experiment 1, memory for shared properties improved and memory for unique properties was preserved over a night of sleep, while memory for both feature types declined in the wake group. In Experiment 2, memory for shared properties improved across a nap, but only for lower-frequency items. This increase was observed in the NREM group, and it also correlated with time spent in REM sleep.
Conclusion: Our results suggest that sleep can improve memory for the shared structure of object categories. For short sleep periods, this effect was only observed for more weakly learned (lower-frequency) items, perhaps indicating a prioritization of memories that are most in need of help. We found evidence for the involvement of both NREM and REM sleep stages in this processing.
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0226

SLOW WAVE SLEEP ORCHESTRATES INPUT-SPECIFIC STRENGTHENING AND GLOBAL DOWNSCALING OF SYNAPSES IN THE HUMAN CORTEX

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Introduction: Preclincial work suggests that sleep promotes the consolidation of synaptic long-term potentiation (LTP) of task-specific synapses (associative plasticity) and downscaling of overall synaptic strength (homeostatic plasticity).
Methods: Here we use transcranial magnetic stimulation (TMS) and electroencephalography (EEG) as non-invasive indices of LTP-like plasticity and overall synaptic strength in humans before and after brief periods of daytime sleep and wakefulness (repeated measures sleep laboratory study, 14 healthy participants, 5 females, 9 males, 18–30 years).
Results: We demonstrate indices of increased LTP-like plasticity (paired associative stimulation induced change in motor-evoked potential) and decreased overall synaptic strength (EEG theta activity) after sleep compared to wakefulness. The increase in LTP-like plasticity was positively correlated with EEG slow wave activity (1–4 Hz) over the respective motorcortical area (M1).
Conclusion: Our study supports the notion that slow wave sleep orchestrates associative and homeostatic synaptic plasticity, believed to be the neural basis for adaptive behavior, in humans.
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0227

PROSPECTIVE MEMORY PERFORMANCE NEGATIVELY CORRELATES WITH SLOW-WAVE SLEEP

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Introduction: Prospective memory (PM), or the ability to plan and spontaneously remember to execute activities in the future, is a vital, everyday life skill. Recent evidence demonstrates that sleep enhances

PM, particularly in the context of a semantic categorization task (Scullin and McDaniel, 2010). The goal of the present study was to determine the generalizability of sleep's benefit on PM and its relationship to sleep stages.
Methods: Participants were divided into wake (n=30) and sleep (n=30) groups. Wake participants arrived at 9am and completed a battery of cognitive tests including three ongoing tasks: living/nonliving decision, lexical decision, and semantic categorization. After the final task, a PM instruction for the next session was given (i.e., hit "q" whenever "table" or "horse" appears), followed by a distractor task. Wake participants were dismissed for 12hr of wakefulness before a second session that included another round of the ongoing tasks and a PM test for the critical words. Sleep participants completed the same experimental design, but arrived at 9pm and had a 12-hour delay that included a night of polysomnograph-recorded sleep.
Results: Results showed no main effect of task type, indicating that performance was similar across all tasks. Importantly, the sleep group performed significantly better on overall PM performance than the wake group [t(58)=2.0, p=0.05]. Within the sleep group there was a negative correlation between PM performance and percentage of SWS [r(30)=-0.39, p=0.03], such that individuals with higher percentages of SWS during the night had worse PM performance.
Conclusion: These results suggest that sleep protects the ability to successfully perform future actions across multiple contexts and is not limited to testing modality. Further, we found a negative association between PM performance and SWS, which is interesting in light of recent evidence suggesting that SWS impairs gist memory (Pardilla-Delgado et al., 2016). We suggest that given the generalizable (i.e. not based on individual experiences) nature of a PM instruction, prospective memory and gist memory may have overlapping sleep consolidation networks, such that while a night of sleep benefits PM, the detail-focused episodic memory benefit of SWS reduces time spent consolidating prospection-based memory.
Support (If Any):

0228

DELAYED NAPPING BENEFITS DECLARATIVE MEMORY

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Introduction: Declarative memories are subject to forgetting over time purportedly due to task-specific interference and general mental fatigue from waking. Here, we examined the effect of reduced waking-related mental fatigue by varying the duration of post-learning wake prior to a period of sleep. We hypothesized that reduced interference in the short delay (between learning and sleep) condition would benefit memory more so than a longer delay (Mednick et al., 2011).
Methods: 113 young, healthy adults encoded 48 word paired-associates immediately followed by a cued recall test. Subjects were assigned to one of four consolidation conditions: active wake (AW, n=23, high interference), quiet wake (QW, n=30, low interference), non-rapid eye movement nap (NREM, n=30, no interference), or REM nap (REM, n=30, no interference). Naps and QW sessions were delayed (4hrs post-encoding, n=15/group) or not delayed (10min post-encoding, n=15/group). Recall in all groups was retested after an 8hr retention interval. We regressed out immediate recall from delayed recall and used regression residuals to estimate performance change on the task.
Results: Overall, subjects who slept outperformed those who remained awake (p=.03). There were no differences between QW and nap groups in either time condition. However, compared to 8hrs of AW, there was a trending memory benefit for both the NREM and REM naps in the delay condition (both ps=.06).
Conclusion: Compared to wake, we found that sleep provided the most memory benefits, but these effects were most pronounced in the delay condition. In other words, waiting four hours after learning to sleep provided a greater benefit to memory than sleep immediately following learning. These findings suggest that a period of wake processing prior to sleep may be important for facilitating consolidation.
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0229

ELECTROPHYSIOLOGICAL MARKERS OF SUCCESSFUL DREAM RECALL

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Introduction: Although dreaming is experienced by most people on a nightly basis, its mechanism still remains unclear. Recent studies have suggested that successful dream recall relies on mechanisms similar to those that support memory encoding during wakefulness. For example, participants with higher frontal theta activity (associated with successful encoding during wakefulness) prior to morning awakening were more likely to recall dreaming from REM sleep (Marzano et al., 2011). The current study aimed to identify electrophysiological (EEG) markers of dreaming experience in a within-subjects design, in which the EEG preceding awakenings from which a dream was recalled is compared to EEG preceding failure of recall in the same participants.
Methods: Participants (N=40) slept in the laboratory and were awakened to report their mental experience during the sleep onset period, REM sleep, and NREM sleep. Reports were coded as to whether they contained any recalled mental content, and if so, whether the experience contained imagery or only thought. Linear mixed models were used to assess how the spectral profile of pre-awakening EEG varied across these categories of recall.
Results: At sleep onset, reports containing mental imagery were associated with broadly increased absolute power in the slow oscillation (<1Hz), delta (1-4Hz), and theta (4-7Hz) frequency bands, along with a focal increase in relative beta (13-35Hz) power over right central electrodes. Thought reports were associated with decreased absolute power in the slow oscillation and theta bands. During NREM sleep, dream imagery was associated with relatively decreased slow oscillation power and increased power at higher frequencies, including theta, alpha and beta. No EEG correlates of dream recall were identified during REM.
Conclusion: Our observations are consistent with the view that global levels of EEG synchronization are the most relevant EEG predictors of dreaming. In the first minutes of sleep, emergence of dream imagery is associated with the increasingly synchronized oscillations that occur as participants move into the sleep state. Later in the night, NREM dreaming is maximal during relatively low-amplitude, high-frequency periods of N2, with recall falling off as EEG synchronization increases.
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0230

SLEEP'S ROLE IN CURIOSITY DRIVEN MEMORY ENHANCEMENT

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Introduction: Sleep's role in memory processing goes beyond rote strengthening of what was learned in a day, as it also seems to facilitate the selective consolidation of salient information. How exactly

the brain determines which information is important to remember is unclear, though cues such as emotion, reward, depth of encoding, and future relevance have been shown to mediate this effect. Here, we examined the role of sleep in the preferential strengthening of memories learned in the presence of curiosity.

Methods: Participants viewed a series of trivia questions, and for each question they were asked to rate how curious they were about the answer. The answers to these questions were then presented, with a face appearing along with each learned answer. Memory for both answers and faces was then tested either immediately or after a 12-hour delay containing sleep or wakefulness.

Results: The current results show a significant main effect of curiosity on both answer and face remembrance, such that answers to high-curiosity questions were recalled better (M=43.52%, SE=3.50%) than those of low-curiosity questions (M=32.76%, SE=2.90%), t(28)=-4.81, p<.001, and the faces associated with high-curiosity questions were recognized better (M=33.17%, SE=3.36%) than those associated with low-curiosity questions (M=27.95%, SE=3.79%), t(25)=-2.47, p<.05. Although there was no significant interaction between sleep and curiosity for answer recall, the interaction between sleep and curiosity predicted memory for incidentally learned faces, F(1, 14)=4.41, p=.054. This indicates that the brain state associated with curiosity, likely characterized by higher dopamine production, may facilitate the selective consolidation of certain memories during sleep. Main effects of circadian rhythm were not found in the immediate test groups, but an interaction between time of day and curiosity was found for facial recognition such that memory for high-curiosity faces received a boost in the morning, F(1, 8)=5.55, p<.05, an effect requiring more investigation.

Conclusion: Though these results are preliminary, the current data suggest that the neuromodulators and processes associated with curiosity may be one means by which the brain selects information for sleep-dependent processing.

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0231

THE ASSOCIATION OF SLEEP PATTERNS WITH RISK-RELATED DECISION-MAKING AND PLANNING

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Introduction: While experimental sleep restriction data showed altered frontal lobe activation and risk-taking tendency among youths, we investigated if naturalistic sleep patterns were also related to youth's executive functions, including planning and risk-taking.

Methods: A convenient sample of college students (N=194) completed a sleep diary and wore an actigraph-watch for 5 days to measure their average and variability (standard deviation, SD) of total-sleep-time and mid-sleep-time. Sleep restriction referred to less than 6 hours of sleep with reference to the National Sleep Foundation. Participants also completed the Pittsburgh Sleep Quality Index (PSQI) and Composite Scale of Morningness (CSM). On the 6th day, they completed the Tower of London and Risky-gain Task at 1-2pm as measures of their planning and risk-taking, respectively.

Results: The sample had a mean total-sleep-time of 7.1h (SD=1.1h) on sleep diary and 7.4h (SD=1.0h) on actigraphy, PSQI of 6.4 (SD=2.4) and CSM of 29.2 (SD=5.6). Correlational analyses showed that selection of risky choices following punishment trials was related to variability of mid-sleep-time (actigraphy, r=.160, p=.038, and sleep diary, r=.202, p=.033), apart from higher PSQI, p=.157, p=.032, and lower CSM (eveningness), r=-.173, p=.019. Number of steps in completing the Tower of London task was correlated with lower alertness after wake-up in the morning (CSM subscale), r=-.172, p=.017. Total-sleep-time and its variability were not correlated with risk-taking or planning. Independent t-test showed youths with or without habitual sleep restriction did not differ on measures of risk-taking or planning.

Conclusion: Contrary to experimental data on sleep restriction, here we showed that planning and risk-taking were correlated with sleep timing variability, sleep quality and chronotype, but not habitual total sleep duration or its variability. While decreasing sleep duration is a general phenomenon among youths, sleep education should also promote regularity of sleep timing to optimize youth's cognitive functioning.

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0232

REM SLEEP STABILIZES VISUAL PERCEPTUAL LEARNING WHICH WAS RENDERED FRAGILE BY NREM SLEEP

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Introduction: A growing body of evidence suggests that sleep spindle activity and slow-wave activity during NREM sleep play roles in enhancing visual perceptual learning (VPL). However, to successfully consolidate already enhanced VPL, a stabilization process of VPL needs to occur after the enhancement. Otherwise, VPL should be left fragile and vulnerable to interference by training of another task. That REM sleep succeeds NREM sleep during which VPL is enhanced raises the question regarding whether REM sleep plays a role in stabilization. To address this question, we tested whether VPL is still resilient to interference and therefore is stabilized if REM sleep does not occur after training.

Methods: We used a two-block training paradigm using the texture discrimination task, a standard VPL task. Earlier studies have shown that learning of the first training with a stimulus is interfered by the second training with a similar but different stimulus unless the time-interval between the two trainings was longer than 60 min. Here, we separated two trainings by a 120-min interval, during which subjects either slept (sleep group, n=11) or stayed awake (control-wake group, n=10). Performance was measured before and after the first training, before the interval, and after the second training.

Results: In the control-wake group, consistently with the previous findings, the first learning was not interfered by the second, which showed stabilization of the first learning during wakefulness occurred. In the sleep group, the first learning was significantly interfered by the second training with subjects who showed only NREM sleep, whereas no such interference occurred with subjects who showed REM sleep after NREM sleep. The degree of the resilience of the first learning measured after the second training was significantly correlated with the strength of theta activity (5–7 Hz) from the visual areas retinotopically corresponding to the trained visual field during REM sleep, but not with the strength of slow-wave activity, sleep spindle activity, or the duration of slow-wave sleep during NREM sleep.

Conclusion: These results suggest that theta activity in the visual areas during REM sleep is necessary for consolidation of VPL during sleep after training.

Support (If Any):

0233

EXECUTIVE SKILL OF VOLITION IS CONNECTED TO PURSUIT OF GOALS IN NON-LUCID PROBLEM-SOLVING DREAMS

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Introduction: In the psychology of waking consciousness, specifically in the executive skills repertoire, Meisner (2011) defined volition as a "central and essential component of human psychic functioning" (p. 1123). Dijksterhuis and Aarts (2010) considered it to be "a central organizing principle" (p. 468) that motivates individuals toward the pursuit of explicitly known or covert goals. In the psychology of dreaming consciousness, Fosse and Domhoff (2007) noticed that studies of non-lucid dreaming are marked by a "noteworthy absence of contributions from core processes of executive thought" (p. 50). The aggregate of executive function already has been mapped out; it consists of eight types of executive though processes: (a) analytical, (b) decision-making, (c) defense mechanisms, (d) evaluative, (e) goal-oriented/goal-directed, (f) interpretative, (g) motivational, and (h) self-determinative (Kozmová, 2012). Volition, however, is deemed non-existing (e.g., Fosse & Domhoff, 2007; Hobson, 2009; Voss, Holzmann, Tuin, & Hobson, 2009) for reasons of deactivated dorsolateral prefrontal cortex considered to be a neural correlate of executive skills (e.g., Braun et al., 1997; Maquet et al., 1996).
Methods: In the present study, the author hypothesized that volition, similarly to waking life, will be related to dreamers' goals. The sample consisted of 73 illustrative problem-solving dreams with executive processes and overt or covert goals (Kozmová, 2012) analyzed using the method of grounded theory (Glaser & Straus, 1967) with question, *What does the dreamer pursue, want, desire, need, or aim to accomplish?*
Results: The emerged scope of volition reaching toward goals consists of (a) self- and other-preservation, (b) psychological and emotional fulfillment, (c) comfortableness with one's own decision, (d) pursuit of satisfactory school or work performance, (e) reaching a destination, (f) sexual satisfaction, and (f) aggressive discharge.
Conclusion: The results invite reconciling evidence of an active executive cognitive system during non-lucid dreaming with theories about disfacilitation of neural correlates needed for nocturnal executive skills.
Support (If Any): Selected references: Kozmová, M. (2012). Dreamers as agents making strategizing efforts exemplify core aggregate of executive function in non-lucid dreaming. *International Journal of Dream Research, 5*(1), 47–67. doi: http://dx.doi.org/10.11588/ijodr.2012.1.9159

0234

LOSING MEMORIES WITH TARGETED MEMORY REACTIVATION

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Introduction: Targeted memory reactivation during sleep is a powerful tool to influence the mind. Current literature demonstrates memory strengthening following targeted memory reactivation (TMR) using sounds or odors (see Oudiette & Paller, 2013 for review). Here we investigate whether TMR-forget can successfully induce episodic memory loss.
Methods: Eighteen participants were administered two learning tasks before sleeping. First, participants were trained on a forget cue where they viewed 46 words, half of which were followed by the cue. Then participants learned 28 novel object-location pairs that were paired with their associated sounds. From these objects, five were randomly chosen for reactivation and five others for controls. That night, during the first period of SWS, we reactivated the five objects with the forget tone 20 times each. Seven days later, we tested participants' memories of the objects, their locations, and the words using free-recall and recognition.
Results: Seven days later, participants recalled fewer reactivated than control objects ($t(1,17)=3.682$ $p = .002$, Cohen's $d = 1.23$). Reactivated objects that were not recalled were also less likely to be correctly located than those that were recalled ($t(1,15) = -2.132$ $p = .05$, Cohen's $d = .764$) and had lower confidence ratings ($t(1,15) = -5.558$ $p > .001$, Cohen's $d = 1.983$). No stage of sleep (N1, N2, N3, or REM) correlated with later forgetting ($r's \geq -.177$, $p's \geq .383$). N1, N2, and REM did not correlate with control retention ($r's \geq .072$, $p's \geq .494$), however we found a trending correlation for N3 ($r = .465$, $p = .07$).
Conclusion: We demonstrate that TMR-forget can successfully induce episodic memory loss for objects one week later. Participants are less likely to recall the reactivated objects as well as less likely to correctly spatially locate those they successfully forgot. It will be important for future studies to determine whether TMR-forget can induce loss of emotional memories, which will lead the way for novel therapeutic interventions for disorders such as PTSD or specific phobias.
Support (If Any): Not applicable.

0235

FREQUENCY-DEPENDENT MODULATION OF SLEEP SPINDLES BY SLOW OSCILLATIONS AND ITS RELATION TO DECLARATIVE MEMORY IN HUMANS

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Introduction: One of the main hypothesized functions of sleep is its involvement in memory consolidation through hippocampal-neocortical replay and homeostatic synaptic downscaling. Mounting evidence implies that slow oscillations (SOs) and spindles together play a key role in these phenomena. Here, we examined the relation between spindle activity and SOs and its impact on memory performance.
Methods: Subjects (n=32–36 depending on sleep stage examined) learned face-name associations in the morning, followed by an immediate test and a delayed test after a nap. Memory performance was measured as the difference in d' between sessions. For both Stage 2 (S2) and slow wave sleep (SWS), SOs were automatically detected and two measures of phase-amplitude coupling were computed within the cut-outs around the SOs: Mean Vector Length (MVL) and a modified version of Modulation Index (MMI). The phase-providing frequency was that of SOs (0.5–1.5 Hz), along with two amplitude-providing frequencies, corresponding to slow and fast spindles (9–12 Hz and 13–16 Hz, respectively).
Results: In S2, there was a significant positive correlation between d' difference and both MVL and MMI. However, for MVL this held only for the fast spindle band and frontal electrodes, while for MMI this also held for slow band (central electrodes). In contrast, in SWS there were no significant relationships, although fast spindle activity exhibited a trend towards positive correlation.
Conclusion: In conclusion, our results suggest that the coordination of slow oscillations and spindles aid memory consolidation. Interestingly, and contrary to some reports, it was the fast spindle frequency that mainly exhibited this beneficial property. Future studies should examine whether causally manipulating the coupling of SOs

and spindles can change memory outcomes, which would be intriguing as a potential mechanism of replay and a novel treatment for memory impairment.

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0236

DIRECT ELECTRICAL STIMULATION TO THE HUMAN AMYGDALA ENHANCES RECOGNITION MEMORY FOLLOWING SLEEP

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Introduction: Emotional events are often better remembered than neutral events, and this benefit depends on the amygdala. We have previously demonstrated that brief basolateral amygdala electrical stimulation enhances memory in rodents. This study examined whether human amygdala stimulation immediately following the presentation of neutral object photographs enhanced later recognition memory following a night of sleep.

Methods: We recruited 14 epilepsy patients undergoing intracranial EEG (iEEG) with depth electrode contacts placed in basolateral amygdala and sub-regions of the hippocampus. During continuous iEEG, each participant was presented a series of photographs of neutral objects, half of which were followed immediately by a unilateral stimulation to the amygdala (8 trains of 50-Hz pulses for 1-second at 0.5 mA after image offset). No epileptiform activity was elicited by the stimulation. Participants reported no awareness of the stimulation.

Results: Recognition memory and subjective confidence for half the photographs was tested immediately after the study session and for the other half of the photographs after a night of sleep. On the recognition memory test administered the following day, participants recognized neutral objects initially followed by amygdala stimulation more accurately than control objects. The result was similar when only high-confidence judgments were included. On the immediate recognition memory test without intervening sleep, participants performed similarly for both object conditions. We are also currently investigating how duration and quality of intervening sleep related to subsequent memory performance and network oscillatory activity.

Conclusion: Similar to the prior rodent studies, the current results indicate that direct electrical stimulation to the human amygdala can enhance item-specific memory for neutral stimuli in the absence of awareness of the stimulation, and following a night of sleep, reflecting a key role of the amygdala in prioritizing experiences for long-term storage in declarative memory. Amygdala stimulation likely engages amygdala-hippocampus connections that normally serve to prioritize memory for emotional events and may provide a therapeutic route for patients with memory deficits

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0237

IMPACT OF DAYTIME BLUE-ENRICHED LIGHT EXPOSURE ON COGNITION DURING THE WORKDAY

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Introduction: Exposure to bright versus dim light at night increases alertness and cognition and decreases sleepiness, whereas exposure to bright light during the daytime has shown mixed effects on cognition. Most previous studies have compared bright light versus dim light rather than versus typical room light. Furthermore, few studies have examined effects of white light enriched by specific color spectrums. Because the non-visual system in mammals is most sensitive to blue light, we examined effects of daytime bright indoor light alone and combined with intermittent blue-enriched white light on cognitive performance compared to performance during exposure to typical room light.

Methods: Fifteen healthy adults [7 females, 23.3 ± 3.4yr (mean±SD)] were studied in a three day in-laboratory protocol. Following one week of 8h per night sleep opportunities at home, participants were exposed to three light conditions (randomized order, one each day): continuous typical room white light (2,700K, ~100 lux angle of gaze), continuous bright white light (2,700K, ~750 lux), and bright white light alternating every hour with blue-enriched white light (17,000K, ~750 lux). Performance and subjective alertness, sleepiness and mood ratings were assessed during typical work hours (1.5–9.5 hours awake) with Psychomotor Vigilance Task (PVT), Stroop Color Word task, Conjunction Visual Search task, Mathematical Addition task, Karolinska Sleepiness Scale and visual analog scales.

Results: Compared to room light, Stroop correct reaction times to neutral stimuli were improved on the day of exposure to intermittent blue-enriched light; conversely, Conjunction cognitive throughput when targets were absent and relaxed mood were reduced. On the day participants were exposed to intermittent blue-enriched light, there were significantly fewer PVT lapses in attention ($p<0.05$) when the blue-enriched light was on. Compared to room light, Mathematical number correct responses were significantly lower on the day of exposure to continuous bright white light. No significant differences were observed for subjective alertness, sleepiness, eye strain, eye discomfort, or headache across conditions.

Conclusion: Intermittent bright blue-enriched white light exposure had mixed effects on daytime performance when compared to typical room light. Additional research is needed to determine optimal light conditions to promote daytime cognitive function.

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0238

EFFECTS OF SIMULATED EARLY MORNING SHIFTWORK ON COGNITION

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Introduction: Modern society requires 24h availability of goods and services, often provided by those working non-traditional hours;

~20% of the US workforce. Early morning shiftworkers are the largest population of shiftworkers in the US and relatively little research has examined the influence of such work hours on cognition. We therefore tested the impact of simulated early morning shiftwork on mathematical addition performance and subjective ratings of alertness, sleepiness and mood.

Methods: 18 participants (9 female) aged 23.2±3.8y (±SD) completed a 16-day protocol. Each subject completed two overnight in-laboratory visits in a randomized, counterbalanced order, separated by one week. Prior to each study visit, subjects maintained habitual, self-selected 8h sleep schedules for one week. One visit served as control where subjects were scheduled to sleep 8h at their habitual time. The other visit simulated an early morning shift where subjects were scheduled to sleep ~1h prior to habitual bed time and to wake up~2.5h prior to habitual wake time. After waking, cognition was initially tested for effects of sleep inertia and thereafter cognition was assessed every ~40 minutes for 4h.

Results: Subjects attempted and correctly answered more two-digit number addition questions in the simulated early morning shiftwork condition compared to performance at habitual time during sleep inertia (0-2h awake) and after sleep inertia had dissipated (2-4h awake) (both $p<0.05$). In contrast, subjects reported increased ratings of subjective sleepiness on the Karolinska Sleepiness Scale and decreased ratings of alertness, clear-headedness, competence, motivation, sharpness, and quick-wittedness during the early morning shiftwork condition (all $p<0.05$).

Conclusion: Contrary to our hypothesis, cognitive function was better during simulated early morning shiftwork versus that seen after awakening at habitual wake time, despite worse subjective ratings. Better performance in the early morning shift work condition could be related to the circadian timing of performance as, from a circadian perspective, forced desynchronony protocols indicate performance is worst near and shortly after habitual wake time.

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0239

THE INFLUENCE OF ANCESTRY ON SLEEP AND PERFORMANCE

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Introduction: Racial differences exist in sleep duration and circadian timing, however it is unknown whether these differences extend to cognitive performance. The current study investigated the role of ancestry on sleep and performance before and after a 9h advance of the sleep/wake episode.

Methods: Twenty African-Americans (9F; 32.1±7.5yr) and 17 European-Americans (8F; 29.7±5.7yr) completed the study. Participants were scheduled to four baseline days each with 8h time in bed based on their habitual sleep schedule such that sleep and circadian rhythms were aligned. The sleep-wake schedule was then advanced 9h earlier (misaligned) for three days. Total sleep time (TST) was assessed with actigraphy. The Automated Neuropsychological Assessment Metrics (ANAM) test battery was administered every 3h each day starting 2h after waking. Tests included a simple reaction time task (SRT) and Stanford sleepiness scale (SSS). Mixed model ANOVAs assessed the effects of ancestry (African-American or European-American) and condition (aligned or misaligned) on sleep and performance.

Results: TST was reduced on misaligned days compared to baseline ($F=18.67$, $p<0.001$) and African-Americans slept less compared to European-Americans ($F=8.58$, $p<0.01$), especially on the first two misaligned days when the difference was 47 and 59 minutes respectively ($F=6.67$, $p<0.01$). Compared to baseline, misalignment increased SSS ratings ($F=72.69$, $p<0.001$), but did not affect the number of lapses ($F=0.02$, $p=0.90$) or median reaction time (RT) ($F=0.02$, $p=0.88$) on the SRT. While there was no effect of ancestry on SSS ($F=0.22$, $p=0.64$), there was a trend for lapses ($F=3.55$, $p=0.07$) and median RT ($F=2.80$, $p=0.10$) to be higher for African-Americans. On misaligned days, African-Americans performed worse than European-Americans at times corresponding to the end of baseline sleep (lapses, $F=7.16$, $p<0.05$; median RT, $F=5.16$, $p<0.05$).

Conclusion: Racial disparities in sleep may be more prominent when the sleep episode is shifted, and there may be racial differences in the circadian regulation of performance. Results have implications for the sleep and performance of individuals undertaking shiftwork or transmeridan travel.

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0240

VALIDATION OF A TOUCHSCREEN PSYCHOMOTOR VIGILANCE TASK FOR ANDROID DEVICES

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Introduction: The Psychomotor Vigilance Task (PVT) is a gold-standard, widely used, and highly sensitive tool to quantify effects of sleep loss. Current portable versions are either costly, not validated, or based on out-of-date platforms. Our goal was to develop a low-cost, widely accessible version of the PVT that runs on touchscreen devices. This study evaluated a new application (PVT-Touch), compared to the industry-standard PVT-192.

Methods: Subjects included N=44 healthy adults without symptoms of sleep disorders. They were administered the PVT-Touch and the standard PVT-192. Order of administration was block-randomized to ensure balanced presentation. Tests were 10 minutes each and administered in sequence. Mean and median reaction time (RT) and performance lapses (RT>500ms) were assessed and correlations were computed, with 95% confidence intervals. Regression analyses determined appropriate transforms that generated comparable scores. Following transforms, paired t-tests evaluated differences.

Results: Despite differences in input style and device hardware, PVT-Touch and PVT-192 values correlated highly for mean RT ($r=0.83$; 95%CI[0.71,0.91]; $p<0.0001$), median RT ($r=0.82$; 95%CI[0.70,0.90]; $p<0.0001$), and lapses ($r=0.83$; 95%CI[0.71;0.91]; $p<0.0001$). Perhaps due to input differences, though, the PVT-touch systematically produced longer reaction times, resulting in more lapses. To adjust for this difference, a correction factor (determined by regression analyses) of 0.75 was applied to PVT-Touch values. This resulted in no differences between groups, with t-test p values of 0.999 for mean and 0.953 for median. For lapses, a correction factor of 0.5 was applied, resulting in a t-test p-value of 0.862.

Conclusion: PVT-Touch responses correlated very highly to the PVT-192, though mean and median RT were higher and lapses more frequent. These differences are likely touchscreen-specific. Because values were highly correlated, transformations allowed for direct comparisons. The PVT-Touch has potential to be an easy to use, portable, scalable, inexpensive assessment of sleep loss in the natural environment.

Support (If Any):

0241

2B-ALERT APP AND WEB: TOOLS FOR MEASURING, PREDICTING, AND OPTIMIZING NEUROBEHAVIORAL PERFORMANCE AT INDIVIDUAL AND GROUP-AVERAGE LEVELS

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Introduction: To date, no validated, computer-based tools exist to measure, predict, and optimize neurobehavioral performance due to sleep loss at both individual and group-average levels, while also accounting for the effects of caffeine. We addressed this gap by developing and validating a predictive mathematical model of performance [the unified model of performance (UMP)], and instantiating it into two tools: *1*) *2B-Alert* App, a smartphone application for real-time, individualized performance prediction and *2*) *2B-Alert* Web, a Web-based software for designing sleep/wake and caffeine schedules to optimize group-average performance.
Methods: We developed and validated the UMP on psychomotor vigilance task (PVT) performance data from 14 different studies (in laboratory and field conditions), encompassing >500 subjects and including a wide range of sleep/wake schedules and caffeine doses. We then developed and validated an automated method to customize the UMP to an individual's sleep-loss phenotype based on the individual's PVT measurements. Finally, we embedded these capabilities into a smartphone app (Android and iPhone) and a Web tool, which allow users to enter sleep/wake schedules and caffeine consumption (doses and times), and obtain individual-specific or group-average performance predictions.
Results: The UMP predicted group-average PVT performance across 26 different sleep/wake schedules (from partial to total sleep loss) and 6 different caffeine doses (ranging from repeated 200 mg doses to single 600 mg dose) with errors ranging from 6% to 36%. Accounting for the effects of caffeine in the model improved prediction accuracy by up to 70%. Individualized UMP models improved prediction accuracy by up to 50% compared to a group-average model. The Web tool is freely available at: <https://2b-alert-web.bhsai.org>, and the *2B-Alert* App is expected to be available by summer of 2017.
Conclusion: The *2B-Alert* App and Web provide practical means for personal fatigue management and for optimizing work/rest schedules.
Support (If Any): Disclaimer: The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U.S. Army or of the U.S. Department of Defense. This abstract has been approved for public release with unlimited distribution.

0242

THE EFFECT OF SLEEP ON EMOTIONAL REACTIVITY AND NEGATIVE MEMORY IN OLDER ADULTS

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Introduction: Evidence suggests that in older adults, positive emotional memories are prioritized in order to enhance emotional well-being. Previous studies have demonstrated that sleep enhances negative emotional memories and preserves aspects of emotional reactivity associated with negative memories in young adults. Given that older adults prioritize positive memories, sleep may not preserve memory and reactivity for negative memories in this age group. Thus, the objective of this study is to investigate the influence of sleep on negative memories and emotional reactivity in older adults.
Methods: Healthy older (55–80 yrs) adults viewed a mixture of negative and neutral pictures. During a three-hour delay, participants either napped (Nap group) or participated in restful wake activities (Wake group). Afterwards, participants underwent a picture recognition task. Emotional reactivity associated with picture viewing was measured during both sessions using valence and arousal scales, skin conductance response, heart rate deceleration, and corrugator supercilii electromyography.
Results: Contrary to what was observed in young adults using this procedure (presented in Jones et al. abstract), preliminary data in older adults suggest no benefit of sleep on negative memories (Nap: M=0.772, SD=0.164; Wake: M=0.868, SD=0.078) and no preservation of valence ratings in the nap group compared to the wake group (Nap: M=0.147, SD=0.087; Wake: M=0.261, SD=0.354). However, there is evidence for the preservation of skin conductance response (Nap: M=0.020, SD=0.231; Wake: M=-0.127, SD=0.192) and heart rate deceleration response (Nap: M=3.167, SD=9.879; Wake: M=-4.087, SD=8.633) in older adults.
Conclusion: These initial results suggest that some but not all aspects of emotional reactivity associated with negative memories may be preserved by sleep in older adults. Sleep-dependent consolidation of negative memory contents may decline with age.
Support (If Any): This work was funded by NIH R01 AG040133 (PI: Spencer).

0243

CORTICOTROPIN RELEASING FACTOR IN THE AMYGDALA REGULATES INDIVIDUAL DIFFERENCES IN REM RESPONSES TO STRESS

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Introduction: Fear conditioning associated with inescapable shock training (ST) and fearful context re-exposure (CTX) alone can produce significant fear indicated by increased freezing, a stress response, and alterations in subsequent REM sleep. These alterations may vary amongst animals and are mediated by the basolateral nucleus of the amygdala (BLA). Here we assessed the effect of the CRF receptor antagonist, antalarmin (ANT), on fear-conditioned changes in sleep in REM vulnerable (Vul) and REM resilient (Res) rats.
Methods: Rats were surgically implanted with electrodes for recording EEG and EMG for recording sleep and with bilateral guide cannulae directed at BLA. Sleep was recorded for baseline, after ST (20 footshocks, 0.8mA, 0.5s duration, 60s interstimulus interval), and after CTX. The rats received microinjections of ANT (4.82mM, 0.5µL) or vehicle alone immediately after ST. The rats were separated into 4 groups: Veh-vulnerable (Veh-Vul; n=10), Veh-resilient (Veh-Res; n=13), ANT-vulnerable (ANT-Vul; n=10), and ANT-resilient (ANT-Res; n=8) based on whether, compared to baseline, the rats showed a decrease or no decrease in REM during the first 4 h following ST. Sleep was compared across groups for baseline, ST and CTX.
Results: ANT in BLA did not prevent post-ST reductions in REM; however, it attenuated the reduction in REM on the CTX day in the ANT-Vul group. The Veh-Vul animals showed reduced REM on both ST and CTX days whereas the Veh-Res and ANT-Res groups showed similar levels of REM for baseline and the ST and CTX days. NREM did not significantly differ across groups.
Conclusion: Individual differences in REM responses to stress are regulated by BLA and involve the CRF system. These differences in REM may be important in mediating adaptive and non-adaptive outcomes of stress.
Support (If Any): MH64827.

0244

A GOOD NIGHT SLEEP ENHANCES LIFE SATISFACTION: THE ROLE OF THE POSITIVITY OF RECALLED EXPERIENCES

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Introduction: Humans are highly social beings. The most heavily researched happiness-promoting activity has therefore been on socialization. Despite the benefits of social activities, however, humans spend more than one third of their time sleeping, fundamentally alone. In this research, we focused on sleep, testing the effect of sleep quality on life satisfaction as well as its underlying mechanism. Based on previous findings on the role of sleep in consolidation and recall of emotional memories (positive contents were more affected by sleep deprivation compared to negative contents), it is hypothesized that good sleep would promote happiness by recalling everyday episodes in a positively biased manner.

Methods: Data was collected from 109 undergraduates (female = 31). To test the causal link between sleep quality and happiness, participants completed surveys at two time points: before bed time (T1; 9–12 pm) and the next morning (T2; 9–12 am). At Time 1, baseline level of happiness (the Satisfaction with Life Scale; SWLS) was assessed. At Time 2, last night's sleep quality and current life satisfaction were assessed. In addition, at both Times 1 and 2, participants were asked to recall three memorable experiences of the day and those of the prior day, respectively. The positivity ratings of each recalled experience were made and averaged.

Results: The PROCESS method was used to examine the indirect effect of sleep quality on life satisfaction through the positivity of recalled experiences. Results revealed that, controlling baseline variables, last night's good sleep portends today's happiness. Moreover, this relationship was partially mediated by the degree of positivity in the retrieved episodes (effect size = .07, SE = .029, CI_{95}= [0.02, 0.16], $Z = 2.47$, $p < .05$).

Conclusion: We found that good sleep can lead to greater happiness via positively biased recall of daily experiences. This study sheds new light on the vital, nonsocial function of sleep on happiness, which has been underappreciated.

Support (If Any): This study was supported by POSTECH (Pohang University of Science & Technology), Korea.

0245

CLOSED-LOOP TACS DURING SWS BOOSTS SLOW-WAVE AND DELTA POWER AND POST-SLEEP MEMORY FOR THREAT DETECTION ON NOVEL STIMULI

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Introduction: Few studies have shown transcranial alternating current stimulation (tACS) applied in open loop during slow-wave sleep (SWS) could improve declarative memory performance following sleep. The present study investigates the mechanisms by which closed-loop tACS can enhance sleep consolidation more robustly.

Methods: Participants (n=7) underwent a within-subjects counterbalanced protocol involving baseline, training, and post-training tests (immediate and morning). Similar to prior work in our lab, participants viewed static images, half of which contained a target signaling a potential threat. Subjects made a response (target present or absent), received feedback via a short video during training, and then were tested for two image types: repeated (identical from training to test) and generalized (same scene from training to test, but novel spatial viewpoint). During sleep after training, participants received 1.5 mA of closed-loop tACS (adapted to ongoing slow-wave oscillations) to F3 and F4 with returns on mastoids, or sham stimulation on different nights. Normalized spectral power changes in sleep EEG across stimulation events were correlated with performance changes over the night.

Results: We observed not only a robust performance improvement but also a significant post-stimulation increase in power of slow-wave (0.5–1.5 Hz), delta (1.2–3 Hz), spindle (11–16 Hz), and gamma (30–50 Hz) bands relative to pre-stimulation baseline (ps<0.002). Further, we identified a cluster in the delta band at 3–4 s post stimulation that significantly correlated with the overnight change in performance for generalized images (p=0.0160). Performance for repeated images did not change overnight due to ceiling effects.

Conclusion: Our results suggest that closed-loop tACS during sleep increases slow-wave and delta activity, which then triggers spindle and gamma band activity. These mechanisms promote memory consolidation wherein performance becomes less tied to a specific event and instead more generalized to the goals of the task.

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0246

STRESS PRIOR TO ENCODING AFFECTS RESTING STATE FUNCTIONAL CONNECTIVITY AND EMOTIONAL MEMORY RETRIEVAL FOLLOWING SLEEP

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Introduction: Previous work has illustrated that sleep and stress enhance long-term emotional memory. Although memory for emotionally arousing items is strengthened following stress exposure, it is unclear how consolidation-related neural processes are affected. The purpose of this project was to examine whether a psychosocial stressor administered before encoding would influence subsequent emotional memory retrieval following a night of sleep through changes in the functional coupling of the ventral medial prefrontal cortex (vmPFC) and the amygdala.

Methods: Participants underwent either the Trier Social Stress Test or a control task before encoding a series of negative, positive and neutral scenes while we collected functional magnetic resonance imaging (fMRI) data. Overnight sleep was recorded using polysomnography. The following day, participants returned to the MRI to complete an incidental recognition task. Change in functional connectivity was examined by comparing the resting state fMRI scans following the stress manipulation and shortly before the recognition task.

Results: Resting state fMRI data collected shortly before the recognition task revealed that greater functional coupling between the amygdala and the vmPFC post-sleep was associated with negative memory enhancement (negative d' minus neutral d') in participants who underwent the psychosocial stressor, $\beta = .51$, $p = .02$ ($n = 18$). Furthermore,

negative memory enhancement was associated with a greater increase in coupling between the amygdala and vmPFC from the encoding to retrieval sessions, $\beta = .46$, $p = .05$.
Conclusion: The participants in the stress condition who remembered more negative scenes compared to neutral scenes showed greater functional coupling between the amygdala and the vmPFC post-sleep. These preliminary results suggest that stress prior to encoding affects consolidation-related brain networks important for emotional memory function.
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0247

SLEEP PRESERVES EMOTIONAL REACTIVITY FOR NEGATIVE MEMORIES

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Introduction: Sleep consolidates memory for emotional events. Whether it likewise preserves or, to the contrary, depotentiates emotional responses associated with such events is unclear, as there is evidence to support both cases. Conflicting findings may be partially due to differences in the way emotional reactivity is measured. Thus, the goal of the current project is to investigate the influence of sleep on emotional reactivity using multiple simultaneous measures.
Methods: Young adults (18–30 years) viewed 45 negative and 45 neutral pictures before a period containing either a nap measured with polysomnography (n=33) or wake (n=25). Following the nap or wake period, they viewed the same pictures intermixed with novel ones and indicated whether they remembered each picture. Emotional response to each picture was measured at both time points with valence and arousal ratings, skin conductance response, heart rate deceleration, and corrugator supercilii electromyography (corrugator EMG).
Results: Across the sessions, both valence ratings ($t=2.043$, $p=0.046$) and skin conductance response ($t=-4.052$, $p<0.001$) were preserved for negative pictures in the nap group relative to the wake group. Arousal ratings, heart rate deceleration, and corrugator EMG response declined non-significantly more in the wake group than the nap group. Participants in the nap group remembered non-significantly more pictures than those in the wake group (M+/-SD: 85.25+/-10.14% vs. 80.83+/-10.56%). Polysomnography data will be analyzed to investigate the relationship between specific features of sleep and change in reactivity measures.
Conclusion: These data suggest that sleep consolidates reactivity associated with emotional experiences whether it is measured with subjective rating scales or objective physiological responses.
Support (If Any): This work was funded by NIH R01 AG040133 (PI: Spencer).

0248

STUDYING SLEEP STAGE SPECIFICITY OF EMOTIONAL MEMORY CONSOLIDATION USING TARGETED MEMORY REACTIVATION

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Introduction: A growing body of evidence indicate that sleep plays a role in emotional processing, including consolidation of emotionally salient memories. However, the roles of different sleep stages in emotional memory consolidation are not clear. Recent studies have shown that memory reactivation using external cues during specific sleep stages can enhance sleep-dependent memory consolidation. In this study, we aimed to investigate the sleep stage specificity for emotional memory consolidation by using a sleep-dependent spatial task and targeted memory reactivation (TMR).
Methods: Participants were healthy adults between the ages of 18–30. During the computerized task, pictures with aversive content appeared in different locations while an associated sound played in the background. After a learning period, participants were tested for their memory of picture locations prior to (T1) and after (T2) a daytime nap. During nap, a subset of the sounds was replayed during slow wave sleep (SWS) or rapid eye movement (REM) sleep. Change in error in locating the pictures from T1 to T2 were compared between the reactivated (REA) and non-reactivated (non-REA) stimuli within and between SWS and REM conditions.
Results: Results are preliminary, as we continue to recruit participants in both groups. In SWS (n=7), there was significantly smaller error at T2 in non-REA ($t=5.545$, $p=0.01$), and a strong trend towards significantly smaller increase in error (T2-T1) in the same group ($t=2.363$, $p=0.056$). In REM (n=10), there was significantly smaller error at T2 ($t=2.476$, $p=0.035$), and a smaller numerical (T2-T1; $t=2.653$, $p=0.026$) and percentage ((T2-T1)/T1; $t=2.779$, $p=0.021$) increase in error in non-REA.
Conclusion: We observed a different pattern compared to the majority of previous TMR studies which used neutral stimuli and reported improvement in memory for reactivated stimuli or no effects. Our results suggest that reactivation of emotional memories and neutral memories may have contrasting effects on sleep-dependent memory consolidation.
Support (If Any): N/A.

0249

CHRONIC SLEEP RESTRICTION INCREASES ERRORS IN A LINE ORIENTATION TASK

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Introduction: Chronic sleep restriction (CSR) results in reliable deficits in cognitive functioning. However, whether CSR affects visuo-motor performance is unknown. This study examined performance on a motor rotation task throughout five nights of CSR.
Methods: Five healthy males (20–35 years of age) completed an 11-day laboratory protocol, including 4 baseline days following 10 hours sleep/night, 5 days following sleep restricted to 5 hours sleep/night (CSR), and 2 recovery days following 10 hours sleep/night. Approximately every two hours during wake time, participants completed a battery of cognitive tests (Joggle Research©) including the Line Orientation Task (LOT). During this task, participants were presented with two lines on a touchscreen tablet and were instructed to incrementally rotate the blue line until it was parallel to the black line. Outcomes of interest for this task included number of correct responses (CORR) and rotation error (RE). To preclude practice effects, only days 4–10 were included for analysis.
Results: Preliminary results showed performance on both LOT measures changed significantly throughout the 7 days examined [CORR: $F(6, 24) = 2.92$, $p = .028$; RE: $F(6, 24) = 3.09$, $p = .022$]. Pairwise comparisons revealed that on the 3rd day of CSR, CORR significantly declined (mean±SE, 12.25 ± 0.85) compared to baseline (13.21 ± 0.96) performance ($p = .033$). RE followed a similar trend, increasing on the 3rd day of CSR (0.57 ± 0.06) compared to baseline (0.52 ± 0.06) in marginally significant findings ($p = .086$). During recovery, performance on CORR (14.73 ± 1.17) and RE (0.44 ± 0.08) significantly improved compared to the 5th and last day of CSR (CORR: 12.50 ± 1.27, $p = .020$; RE: 0.58 ± 0.08, $p = .009$).

Conclusion: Performance on the LOT decreased on the 3rd day of CSR compared to baseline, deviating from previous findings of unchanged LOT performance after sleep deprivation. Limitations include practice effects and a small sample size.
Support (If Any): This study was funded by grant UL1TR000127 from the Clinical and Translational Science Institute at the Pennsylvania State University (Anne-Marie Chang PI).

0250

INTERACTIONS BETWEEN SLEEP DEPRIVATION, MOTOR LEARNING AND S6 KINASE SIGNALING

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Introduction: We have previously shown that acute sleep disruption (SD) impairs offline gains in motor performance in mice on a rotarod motor task. The goals of the current study are to understand the necessity of S6 kinase signaling in these offline motor learning gains, to characterize the effects of acute SD on S6 kinase signaling, and test the possibility that SD-associated changes in S6 kinase signaling serve as a mechanism by which SD impairs motor learning.
Methods: Mice completed 10 consecutive rotarod trials per day with a 3 minute inter-trial interval. Rod acceleration was from 4 to 40 RPM over 5 minutes, and latency to fall was measured. During acute SD experiments, SD was achieved using an automated sensory stimulus every 10 seconds for 10 hours between ZT 2 and 12. S6 kinase signaling was blocked prior to motor learning with systemic administration of either rapamycin or PF-470867. S6 kinase signaling was augmented either prior to or during SD using systemic administration of the AMPK inhibitor Compound C. Brains were harvested and prepared for Western blotting 30, 60, or 120 minutes after rotarod learning, or after 10 hours of SD, using the ratio of phosphorylated to total ribosomal protein S6 (RpS6) as a readout of S6 kinase activity.
Results: Rotarod learning resulted in transient increases in brain RpS6 phosphorylation at 30–60 minutes. The offline gains in rotarod learning across days were impaired by S6 kinase inhibition with either rapamycin or PF-4708671 without affecting the learning curve across trials within one day. Acute SD of 10 hours impaired offline gains in rotarod performance and decreased RpS6 phosphorylation. Attempted rescue of S6 kinase signaling with Compound C during SD did not prevent SD-associated impairments in offline gains in motor learning.
Conclusion: Acute SD impairs both S6 kinase signaling and offline gains in rotarod performance. Because S6 kinase signaling appears to be necessary for offline gains in motor learning, a SD-associated decrease in S6 kinase signaling represents a mechanism contributing to such impairments. However, augmentation of S6 kinase signaling does not appear sufficient to minimize SD-associated impairment in motor learning.
Support (If Any):

0251

THE EFFECT OF SLOW WAVE SLEEP DEPRIVATION ON ERROR MONITORING

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Introduction: Our previous study showed error monitoring was impaired after a night of experimental sleep fragmentation which reduces the amount of both slow wave sleep (SWS) and rapid-eye-movement sleep (REMS). This study investigates whether a night of SWS deprivation (SWD) affects error monitoring.
Methods: Ten participants (5 males; 20–24 years old) underwent 3 sleep conditions with a between-participant counterbalanced sequence: SWD, yoked control (YC) and baseline (B). Auditory stimuli were given in SWS at the SWD night but, at the YC night, were given at the time and for a total amount compatible to those at the SWD night except that they were particularly limited in SWS. In the B condition, participants maintained a normal sleep night at home. In each morning following the 3 sleep nights, the participants performed an arrow version flanker task and simultaneously underwent multiple-channel electroencephalogram recordings.
Results: SWS was reduced (5.08 ± 0.03% vs. 17.4 ± 0.07% in YC, $p < 0.001$) but stage N2 sleep percent was increased (59.39 ± 0.04% vs. 45.55 ± 0.06% in YC, $p < 0.001$) at the SWD night. The REMS percent ($p = 0.84$) and arousal index ($p = 0.85$) were compatible between the SWD and YC conditions. The peak-to-peak amplitude of the error-related negativity (ERN) at Pz was reduced in the SWD condition (2.95 ± 3.17μV vs. 4.68 ± 3.93μV in YC, $p = 0.04$; vs. 4.99 ± 4.02μV in B, $p = 0.02$). The P300 amplitude at CPz was also reduced in the SWD condition (11.40 ± 3.95μV vs. 13.54 ± 3.70μV in B, $p = 0.02$).
Conclusion: A night of SWD caused reduced ERN and P300 amplitudes, which represent the weakening of error detection and attention resources, respectively.
Support (If Any): Ministry of Science and Technology Grant 101-2410-H-194-058-MY3 and 105-2811-H-194-005.

0252

EXPERIMENTAL CUMULATIVE SLEEP RESTRICTION IMPAIRS WORKING MEMORY BUT NOT DECISION MAKING

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Introduction: Eighteen percent of young adults are sleep deprived. Sleep deprivation leads to significant neurobehavioral impairments and compromises job and academic performance and driving safety. Data is scarce and contradictory regarding the impact of cumulative sleep deprivation on neurobehavioural functoning (NBF). The objective of this study was to assess the impact of cumulative sleep restriction on the NBF of young adults.
Methods: Participants: Sixty-five healthy participants (ages 18–34). Design: A double-blind, placebo controlled, randomized trial. Participants were randomized into experimental and placebo conditions. Each participant completed a period of baseline protocol and an experimental period. The experimental period lasted 6 nights and had 2 conditions: 1) sleep restriction condition -participants were asked to restrict their sleep by one hour per night 2) placebo condition- participants were asked to use a lamp which had no clinical effects for 30 minutes during day time. NBF was assessed at baseline (Day 1) and following sleep manipulation (Day 12).Measures: Sleep duration was assessed using actigraphy, an accelerometer that measures sleep objectively based on movement. NBF was measured using the Cambridge Neuropsychological Test Automated Battery Spatial Span task and the Cambridge Gambling Task for working memory and decision-making, respectively.
Results: Poorer performance on spatial span task was found in the experimental condition compared to the placebo condition, controlling for baseline spatial span length, sex, age, sleep efficiency

during experimental week, baseline sleep duration, and chronotype, ($F_{(1,49)}$=5.18, $p < 0.05$). No significant effects for sleep restriction were found on decision making measures when comparing the experimental condition to the placebo condition.

Conclusion: Young adults' performance on spatial working memory task deteriorated following cumulative sleep deprivation whereas their performance on decision making task was not affected. The present study indicates that sleep deprivation has a differential impact on the NBF of young adults.

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0253

SIMULATED SURGICAL SKILL AND DECLARATIVE MEMORY RETENTION FOLLOWING THE OB/GYN CLERKSHIP IN 3RD YEAR MEDICAL STUDENTS

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Introduction: This study examined the impact of a rigorous third year clerkship (rotation) affects simulated surgical skill and declarative memory retention in medical students. In this study the OB/GYN clerkship was targeted because it is one of the more difficult clerkships, with increased student responsibilities usually occurring toward the end of the clerkship (weeks 5 and 6). We assessed declarative memory retention and virtual surgical skill using the a laparoscopic simulation device (LapSim) immediately following the completion of the OB/GYN clerkship (Rotation group) or a 2-week interval between rotations (Rested group).

Methods: Twenty-six 3rd year medical students (24.6 ± 0.9yo; 12 males) completed the study. Orientation and acclimation to the tasks occurred at least 2 weeks prior to their Test day (post-Rotation (n=14) or post-Rest (n=12)). On the morning of the Test day students learned a declarative memory task (picture pairs) and trained on two LapSim skills (Clip Applying and vessel Cutting). Students returned approximately 10hrs later to retest on the same tasks. Sleep and wake activity data were collected via actigraphy the week preceding the Test day.

Results: On the morning of testing, subjective measures of alertness were similar (p values> 0.25), as were PVT reaction times (p=0.49). Despite sleeping, on average, ~30min more per night, students in the Rested condition, overall, did not perform better than students in the Rotation condition on the VPA task (p=0.81) or on core measures of simulated laparoscopic surgical skills (p values for the six tasks > 0.41).

Conclusion: Following the cumulative effects of a rigorous 3rd year obstetrics rotation, abilities important in the practice of medicine (declarative memory recall and simulated surgical skills) did not suffer when compared to students who rested the two weeks prior to testing. This finding may suggest that medical students have the capacity to tap into a deep cognitive reserve under challenging conditions. However, further analysis of waking activity patterns/activity logs prior to testing need to be conducted to better understand these performance similarities.

Support (If Any):

0254

INSOMNIA-RELATED SLEEP DISRUPTION IMPAIRS SLEEP-DEPENDENT MEMORY CONSOLIDATION IN THE RAT

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Introduction: Insomnia involves disruption of sleep initiation, maintenance, and/or overall quality, and may interfere with cognition. We evaluated here rodent insomnia models predicted to produce sleep disruption and interfere with sleep dependent memory consolidation (SDMC), assessed as performance on a spatial reference memory version of the Morris Water Maze (MWM).

Methods: Rats were trained to remember platform location in MWM (Acquisition), and then exposed to 6 hrs of: 1) baseline (BL, undisturbed); 2) dirty cage change-induced insomnia (animal placed into a cage dirtied by another rat); or 3) double dirty cage change-induced insomnia (DDCI, animal placed into a cage dirtied by another rat, and then another three hours later). The animal's memory for platform location was then immediately evaluated in a probe trial.

Results: Time spent in Wake, NREM, and REM sleep was significantly different between treatments. Post-hoc pair wise comparison between BL and DDCI revealed an increase in Wake and decrease in REM sleep. NREM episode bout number and duration significantly differed between treatments, and post-hoc comparison between BL and DDCI revealed an increase in NREM bout number and decrease in bout duration, indicating sleep fragmentation. Significance differences were noted for measures of water maze performance during the probe trial (total time in target quadrant and latency to target quadrant). A difference between treatments in total distance swam was not evident, indicating that motivation and swim speed did not confound performance measures.

Conclusion: The DDCI model particularly fragmented sleep and attenuated memory. Of utmost important is the development of hypnotics that improve the sleep profile of the insomniac but do not impair cognition, including sleep-dependent memory processing. This insomnia model uniquely mimics acute insomnia, and may provide an animal paradigm to screen hypnotic treatments and evaluate effects on cognition.

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0255

EFFECT OF ACUTE SLEEP DEPRIVATION ON SELECTIVE MEMORY FOR EMOTIONAL SCENES: AN EXPERIMENTAL STUDY

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Introduction: Prior research suggests that sleep preferentially encodes the central, negative aspects of scenes compared to neutral aspects. Previous studies, however, have only used periods of daytime wakefulness as the comparison group, and therefore, it is unknown whether the effect of sleep on selective memory for emotional scenes

is attributable to sleep or the intervening nocturnal period (i.e., a circadian effect).

Methods: Participants included 39 young adults between the ages of 18 - 29. The protocol included spending two nights in the laboratory. After an adaptation night, participants were randomized into either a sleep deprivation condition (29 consecutive hours awake; n = 20) or a sleep condition (8-hour sleep opportunity; n = 19). The encoding portion of the memory scenes task occurred prior to the experimental manipulation, whereas, the recognition portion occurred during the subsequent morning. We conducted a 2 (condition: sleep, deprivation) x 2 (valence: negative, neutral) x 2 (scene component: object, background) mixed ANOVA on overall recognition.

Results: There was a main effect of condition and scene component, and a significant two-way interaction between valence and scene component. The three-way interaction was not significant. Results revealed that negative objects were better remembered compared to both neutral objects and background images, but that this was true across both experimental conditions.

Conclusion: The current study replicated the emotional memory trade-off observed in previous studies. Specifically, participants who experienced an intervening period of sleep between encoding and recognition trials were better able to remember negative components of scenes, relative to neutral components. The emotional memory trade-off, however, was not specific to participants in the sleep condition. Similar recognition rates for negative components were observed among acutely sleep-deprived participants. While specific explanations for these results are unknown, these findings may be related to circadian effects and/or the impact of acute stress (i.e., sleep deprivation) on selective memory consolidation.

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0256

IMPROVEMENT IN COGNITION DURING THE WAKE MAINTENANCE ZONE FOLLOWING SLEEP LOSS IS DEPENDENT ON COGNITIVE DOMAIN

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Introduction: The wake-promoting signal from the circadian system enhances alertness in the early evening when the homeostatic signal for sleep is increasing. This 'wake maintenance zone' (WMZ), which precedes the onset of evening melatonin secretion, is associated with improved vigilant attention even under conditions of elevated sleep pressure, such as 40 hours of sleep deprivation (SD). The impact of the WMZ on different cognitive domains during SD is not well established, and forms the basis of this study.

Methods: Twenty-three healthy volunteers (18 males; mean age=25.4±5.7y) underwent 40 hours of SD under constant routine conditions. The Psychomotor Vigilance Test (PVT) and Karolinska Sleepiness Scale (KSS) were completed bi-hourly. An additional test battery assessing the cognitive domains of processing speed, visual learning, visual attention, and working memory was administered at 3h, 13h, 27h, and 37h after habitual wake time. Melatonin onset timing confirmed that tests administered at 13h and 37h occurred during the WMZ. Paired t-tests compared performance during SD with performance at a circadian matched control, during the morning (3h versus 27h post-wake) and early evening/WMZ (13h versus 37h).

Results: As expected, PVT mean reaction time and number of lapses significantly increased at 27h and 37h, relative to control. This effect was also observed for processing speed. In contrast, measures of visual attention, visual learning, and working memory significantly deteriorated after 27h of SD (relative to 3hr post-wake), yet no effect of SD was observed at 37h (relative to 13h post wake).

Conclusion: Vigilant attention and processing speed deteriorated with SD, with no improvement observed during the WMZ. In contrast, visual attention, visual learning, and working memory were also adversely impacted by SD (27h awake), but preserved in the WMZ despite increased homeostatic sleep pressure (37h awake). These data highlight the need to examine a variety of cognitive domains when examining the impact of sleep and circadian factors on performance.

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0257

EFFECTS OF ACUTE SLEEP DEPRIVATION IN RATS: SEXUALLY DIMORPHIC INCREASE IN HIPPOCAMPAL KYNURENIC ACID AND IMPAIRED CONTEXTUAL MEMORY

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Introduction: While restful periods at night have been associated with memory consolidation, prolonged periods of poor sleep quality result in neurocognitive dysfunction. Our current experiments were designed to test the hypothesis that kynurenic acid (KYNA), an astrocyte-derived metabolite of the kynurenine pathway (KP) of tryptophan degradation, is elevated in the brain after sleep disturbances. KYNA is an antagonist of α7 nicotinic acetylcholine (α7nACh) and NMDA receptors, and elevations in KYNA negatively impact learning and memory.

Methods: We investigated the effect of sleep deprivation (SD) on KP metabolism in both male and female adult Wistar rats. Animals were sleep deprived by gentle handling for 6h from Zeitgeber time (ZT) 0 to ZT6, where ZT 0 is the start of the light-phase. KP metabolites were analyzed in the brain and plasma immediately after SD. In separate adult animals, we tested contextual memory using the passive avoidance paradigm (PAP). Animals were sleep deprived from ZT0 to ZT6 and underwent PAP training at ZT3. Twenty-four hours after training, animals were tested in the retention trial.

Results: In the hippocampus, a region that mediates learning and memory, KYNA levels were 1.4-fold elevated in male rats after SD, but not changed after SD in female rats. In the serum, no significant changes in KYNA or its bioprecursor kynurenine were observed in either sex. In male rats, SD induced significant PAP deficits, evidenced as decreased avoidance latency during the retention trial. Conversely, in female animals, the avoidance latency was not significantly reduced after SD. To test our hypothesis that KYNA elevations mediate memory impairments after SD, we have used a KYNA synthesis inhibitor, BFF-816, that targets the enzyme kynurenine aminotransferase (KAT) II and prevents *de novo* KYNA production. In male rats, BFF-816 treatment (30mg/kg, p.o. at ZT0 and Z3) attenuated SD-induced contextual memory impairments.

Conclusion: Collectively, our results demonstrate a striking sexual dimorphism in the elevation of hippocampal KYNA and contextual memory retention after an acute period of SD. Additionally, we introduce KAT II inhibition as an efficacious strategy to combat cognitive disruption after SD.
Support (If Any): NIH K12 HD43489.

0258

EFFECTS OF SLEEP DEPRIVATION ON COMPONENT PROCESSES OF WORKING MEMORY IN YOUNGER AND OLDER ADULTS

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Introduction: Working memory (WM) has been described as a process comprised of multiple components, including: attention, capacity for rehearsal of information, and encoding to and retrieval of information from episodic memory. Impairments can have significant impacts on higher order cognitive processes and many everyday functional abilities. As both WM and sleep have been shown to decline throughout aging, further investigation is needed into the impact of sleep changes on WM across the life span. Here, we aimed to better understand effects of sleep deprivation on component processes of WM, comparing younger (YA) and older adults (OA) across both verbal and spatial modalities.
Methods: 31 YA (19–38 years) and 33 OA (59–82 years) were studied twice, in counterbalanced order, approximately two weeks apart: once after a regular night's sleep (well-rested condition) and once after 32 hours of total sleep deprivation (TSD condition). Participants completed matched versions of a verbal and spatial WM task each time. Test order was counterbalanced across subjects.
Results: Performance on the WM task showed YA significantly outperformed OA on attention and capacity component processes, for both verbal and spatial modes of WM. Following TSD, YA showed a significantly larger drop in the attention component of verbal WM, and in the capacity component of spatial WM, compared to OA. A main effect of condition was observed for the verbal capacity parameter.
Conclusion: Differences were observed in the performance of YA and OA on component processes of WM following TSD. In both studies, YA showed impairments in WM attention and rehearsal span, but not episodic memory. Our older adults experienced verbal rehearsal span deficits following TSD. They did not, however, show attention deficits nor episodic memory deficits. In the spatial task, OA did not show any statistically significant changes in spatial WM parameters following TSD, though they had overall lower attention parameter scores than YA. Understanding the profile of changes in WM components can inform prevention and intervention in operational settings. In the context of aging, it could provide a basis for development of compensatory strategies or interventions, and differentiation of clinical and healthy populations.
Support (If Any):

0259

SLEEP DEPRIVATION EFFECTS ON THE DIGIT SYMBOL SUBSTITUTION TEST: GENERAL COGNITIVE SLOWING OR WAKE STATE INSTABILITY?

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Introduction: Sleep deprivation (SD) causes wake state instability, which amplifies variability in reaction times (RTs), skews the RT distribution, and increases the frequency of lapsing on the Psychomotor Vigilance Test (PVT). SD also causes various other effects on a range of cognitive performance tasks. Any shared underlying mechanisms for these effects have been difficult to demonstrate due to heterogeneity of task characteristics and outcome measures. Here we used a computerized Digit Symbol Substitution Test (DSST), which involves matching symbols to digits based on a 9-number key. Cognitive throughput (number of correct responses) on the DSST is used as a measure of cognitive processing speed, in both aging and sleep research. SD reduces cognitive throughput on the DSST, suggesting that SD slows cognitive processing speed. We investigated whether RT distributions on the DSST reflect general cognitive slowing, or rather wake state instability.
Methods: N=56 healthy adults (ages 22–37, 29 females) completed a 4-day/3-night in-laboratory study, randomized with a 2:1 ratio to a total SD (TSD) condition or a well-rested control condition. The TSD condition (n=37) had 10h sleep opportunities (22:00-08:00) on the first and last nights, with 38h TSD between; the control condition (n=19) had 10h sleep opportunities each of the three nights. A 10min, computer-paced PVT and a 4min, subject-paced DSST were administered twice before TSD, twice during TSD, and once following recovery. Lapses were defined as RTs≥2000ms on the DSST and RTs≥500ms on the PVT.
Results: TSD reduced cognitive throughput on the DSST ($p<0.001$). TSD reduced mean response speed (1/RT) on the DSST ($p<0.001$) and PVT ($p<0.001$). However, TSD also increased the number of lapses on the DSST ($p<0.001$) and PVT ($p<0.001$). Furthermore, TSD skewed the RT distribution for both tasks.
Conclusion: A hallmark effect of SD on the PVT is wake state instability. Despite considerable differences in task characteristics, we observed the same phenomenon on the DSST. It thus appears that reduced cognitive throughput on the DSST during SD reflects wake state instability.
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0260

IMPACT OF SLEEP RESTRICTION AND RECOVERY ON MOTIVATION DURING REPEATED COGNITIVE PERFORMANCE TESTING

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Introduction: Both motivation and sleep deprivation affect cognitive performance. Especially during long-lasting studies with repeated cognitive performance tasks there is concern that subjects will lose motivation over time. Results may be confounded due to changes in motivation.
Methods: In an ongoing study, 29 healthy volunteers performed 55 cognitive performance tasks at three-hourly intervals in a 12-day inpatient study. After two baseline nights with 8 h time in bed (TIB) the intervention group (N=20; mean age 26 ± 4 years, 9 females) underwent chronic sleep restriction for 5 nights (5 h TIB) with a following recovery night of 8 h TIB. The control group (N=9; mean age 25 ± 5 years, 3 females) had the opportunity to sleep 8 hours every night. Participants completed the Karolinska Sleepiness Scale (KSS) and a questionnaire about their motivation (from 1=very little/not motivated to 5=very motivated) at 6 p.m. on all days.

Results: Wilcoxon signed-rank tests showed a significant decrease in motivation (p=.0439) and a significant increase in subjective sleepiness (p=.0184) from baseline (motivation: 2.8±0.6 (SD), sleepiness: 3.2±1.2) to the last day of chronic sleep restriction (motivation: 2.2±0.5, sleepiness: 5.1±1.8) for the experimental group. Motivation remained low after recovery sleep (2.2±0.8; p=.0198). Sleepiness and motivation scores showed a significant Spearman correlation (r=-0.43, p<0.001).
Conclusion: Chronic sleep restriction for five days leads to an increase in sleepiness and a decrease in motivation. One night of recovery is insufficient to reverse the motivation loss, contrasting with the beneficial effect on sleepiness. During chronic sleep restriction conditions subjective motivation seems to decrease as a function of subjective sleepiness.
Support (If Any):

0261

MOOD MEDIATES THE RELATIONSHIP BETWEEN GLUCOSE AND PERFORMANCE DURING SLEEP LOSS

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Introduction: Sleep loss disrupts how the body utilizes glucose, and glucose bioavailability influences attention and cognitive self-control. Recent results from our lab demonstrated that 15 grams of glucose in solution sustained psychomotor vigilance during 40 hours of continuous wakefulness. The time course of this effect, relative performance sustainment for seven hours, went beyond expectations for direct neuronal nutrition. Mood, glucose, and performance are also mechanistically tied in various literatures. Therefore, we tested a mediation model of supplemental glucose on performance during sleep loss via self-reported mood.
Methods: 20 college students stayed awake for 40 hours. Cognitive performance and mood were quantified while rested, then every three hours across the sleep deprivation period. Participants received 15 grams of glucose solution or an equivalent sucralose placebo at hours 18 and 36. Participant mood and cognitive function were analyzed by group across time using a bootstrapping mediation model.
Results: As observed in previous results, participants in the sucralose condition committed an average of 2.83 more lapses than the glucose condition 7 hours post-dose, 22 hours into continuous wakefulness (path C, $p < .05$). However, sucralose participants also reported 10.17 more subjective fatigue units than glucose participants at the same time point (path A), while their subjective fatigue score predicted their lapse rate (path B). When paths A and B are added to the original path C, the effect disappears (path C' = .99), indicating a near complete mediation of that effect by subjective fatigue, $z = 2.26$, $p < .05$, $K^2=.40$.
Conclusion: Strategic glucose supplementation can temporarily sustain performance during total sleep deprivation within certain parameters. Specifically, performance sustainment is achieved via prevention of negative mood development (subjective fatigue). Glucose prevents the development of negative mood, which optimizes conditions for positive motivation. Positive motivation provides a small but measurable boost in performance as quantified by continuous engagement with the psychomotor vigilance task. Additional analyses to understand the magnitude and reach of this effect are underway.
Support (If Any): This work was completed as part of contract N62645-14-P-2046 under direction of the Naval Medical Research Unit - Dayton.

0262

THE ABILITY TO SELF-MONITOR PERFORMANCE DURING 60 HOURS OF TOTAL SLEEP DEPRIVATION AND FOLLOWING TWO NIGHTS RECOVERY

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Introduction: The adverse cognitive consequences of total sleep deprivation (TSD) are well documented. The ability to accurately assess one's current performance is critical in an operational context as it could have protective effects in reducing the negative consequences of sleep deprivation. However, few studies have investigated the ability of an individual to accurately self-monitor performance under conditions of sleep deprivation or following recovery. Therefore, the present study aimed to investigate whether self-monitoring of performance is altered during 60 hours of TSD, following two nights of recovery sleep, and by task difficulty and/or subjective sleepiness.
Methods: Forty healthy adults (18 females, aged 19–39 years) underwent a five day protocol, with a well-rested day, 66 hours of TSD (last test session at 60 hours), and two nights of 8-hour recovery sleep. An arithmetic task with three difficulty levels assessed working memory. The psychomotor vigilance task (PVT) assessed sustained attention. Arithmetic accuracy and PVT median reaction time measured objective performance. Subjective performance was measured with self-reported accuracy and self-assessed speed (relative to baseline). Objective-subjective differences assessed self-monitoring ability.
Results: Performance on both tasks declined during TSD and improved following recovery. During TSD, participants overestimated their cognitive deficits on both tasks, self-reporting performance as worse than actually observed. Following recovery, participants overestimated the extent of performance improvement, but only on the PVT. Task difficulty influenced self-monitoring ability, with greater overestimation of performance deficits as task difficulty increased. Subjective sleepiness predicted subjective ratings of performance at several time points, but only for the PVT.
Conclusion: Individuals have some ability to track cognitive performance, though the accuracy of self-monitoring is influenced by TSD and recovery. Findings suggest development of self-monitoring strategies for operational contexts may serve as a strategy for reducing the consequences of sleep-related impairments. Strategies should assess both subjective perceptions of performance and subjective sleepiness.
Support (If Any): The US Department of the Army award DAMD17-02-1-0201.

0263

IMPACT OF THE 5-HTTLPR POLYMORPHISM ON NEURAL RESPONSES TO IMPLICIT THREAT AND FEAR LEARNING AND MEMORY AFTER SLEEP DEPRIVATION

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Introduction: The short (s) allele variant of the serotonin transporter polymorphism 5-HTTLPR, compared to the long (l) allele variant, has been associated with heightened stress reactivity. We explored the moderating impact of this polymorphism on neural correlates of

implicit threat detection and fear-associated learning and memory following total and partial sleep deprivation in healthy young adults.
Methods: 134 participants spent 3 night in the laboratory after being genotyped for 5-HTTLPR. After a baseline night, participants were randomized to total sleep deprivation (SD, n = 35), sleep restriction (SR or half the normal sleep time, n=40), or normal sleep (NS, n = 43). The following morning, the participants completed a fear conditioning and extinction protocol. Fear extinction recall was tested in the evening. Neural responses to implicit threat cues were assessed in the evening before and after randomization. BOLD signals in the amygdala and ventromedial prefrontal cortex (vmPFC) were compared between s/s, s/l, and l/l carriers. ROI analyses were conducted using SPM8 and SPSS.
Results: No significant Sleep Group X Genotype interaction was found for fear conditioning, extinction, or extinction recall for the amygdala or vmPFC. For the threat task, a main effect of Genotype was detected for the right amygdala ($F(2,129) = 3.24$, $p < 0.05$) at baseline, where the s/l group showed lower BOLD activation in response to threatening vs. neutral cues than the l/l and s/s groups. Following the sleep manipulation, the three genotypes no longer differed.
Conclusion: The 5-HTTLPR polymorphism does not moderate neural fear-related responses. Heterozygotes (s/l carriers) showed the greatest BOLD reactivity to threat cues in the right amygdala at baseline, but this effect was absent following the sleep manipulation. Sleep loss may override the impact of genotype on neural reactivity to salient cues.
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0264

EFFECT OF ACUTE SLEEP DEPRIVATION ON COGNITIVE PERFORMANCE AND FEAR EXTINCTION RECALL

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Introduction: Sleep loss has been associated with numerous poor health outcomes, including post-traumatic stress disorder (PTSD) and traumatic brain injury (TBI). Both PTSD and sleep loss lead to cognitive deficits. This study explored the relationship between sleep loss, fear extinction recall and cognitive performance.
Methods: Ninety-one healthy participants completed three consecutive nights in the sleep laboratory. After one baseline night, they were randomized to a night of normal sleep (NS, n =47) or total sleep deprivation (SD, n = 44). The following morning, all participants completed fear conditioning tasks, fear extinction tasks, and the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) battery. Fear extinction recall was tested in the early evening on the same day. Neural correlates of fear extinction recall were assessed using fMRI blood-oxygen level-dependent (BOLD) responses in regions of interest (ROIs).
Results: The SD group demonstrated higher BOLD activity in the amygdala, the dorsal ACC, the hippocampus, and the thalamus as compared to the NS group during early fear extinction recall. The SD group reported more subjective cognitive symptoms than the NS group (effect size = 0.73, $p < 0.001$), but showed no significant differences in the objective cognitive measures. BOLD activity in the dorsal ACC and the hippocampus during FER were positively correlated with subjective cognitive symptoms. However, subjective cognitive symptoms did not moderate the relationship between sleep loss and BOLD activity during FER.
Conclusion: The ImPACT battery did not reveal objective cognitive changes following sleep loss. Subjective cognitive symptoms correlated with changes in neural activity during FER, but did not independently contribute to BOLD changes when accounting for sleep group. Neurocognitive measures sensitive to sleep loss are required to further probe the extent to which cognitive functions can impact FER following sleep loss.
Support (If Any): This work was supported by the Department of Defense Congressionally Directed Medical Research Program Military Operational Medicine Research Program (MOMRP; Log#11293006). The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the US Army or of the US Department of Defense.

0265

WOMEN AND MEN ARE DIFFERENTIALLY AFFECTED BY SLEEP LOSS WITH RESPECT TO COGNITIVE PERFORMANCE AND HUNGER REGULATION

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Introduction: Recent studies have suggested that cognitive performance and hunger regulation in humans are differentially altered in men and women following restricted or misaligned sleep. Whether these sex differences extend to a night of total sleep loss - a typical scenario for many shift workers - has not yet been investigated.
Methods: The present crossover study involved 13 women and 12 men (matched for age, body-mass index, chronotype score, and daytime sleepiness). One night of total sleep loss was compared to one night with an 8-hour sleep opportunity, with respect to morning cognitive performance (procedural and spatial memory processing, as well as working memory performance) and hunger regulation (measured by plasma concentrations of the hunger hormone ghrelin and subjective hunger scores). The results were analyzed separately for the sexes in order to evaluate if the response to acute sleep loss is different in women and men.
Results: Following one night of total sleep loss, female participants showed deficits in working memory and procedural memory processing. In contrast, sleep loss did not alter spatial memory processing or hunger regulation in women. In men, acute sleep loss impaired processing of both spatial and procedural memories, whereas working memory performance remained unaltered. Moreover, circulating concentrations of ghrelin and hunger were elevated in men following acute sleep loss.
Conclusion: The results of the present study highlight the importance of investigating possible sex differences when studying functions of sleep and health consequences of sleep loss in humans.
Support (If Any): This study was supported by AFA Försäkring; Novo Nordisk Foundation; the Swedish Brain Foundation; and the Swedish Research Council. The funders did not have any role in study design or interpretation of the results; nor in the writing process.

0266

EFFECTS OF FATIGUE ON OFFICER PERFORMANCE IN DEADLY FORCE SIMULATIONS

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Introduction: Law enforcement officers are expected to function under fatigued conditions as a result of job strains and shift requirements. While in a fatigued condition, officers may be required to use

deadly force. It is critical to assess officer performance in deadly force simulations to gain a better understanding of the effects of fatigue on deadly force judgement and decision making. The purpose of this study was to assess the effects of fatigue and shift work on a series of performance measures in simulated deadly force scenarios.
Methods: Participants were experienced patrol officers recruited from a medium-sized law enforcement agency in the Inland Northwest (N=80). Subjects participated in two to four separate sessions in the lab, at least one directly following the last patrol shift of the work week (fatigued condition) and at least one at the same time of day after a three day rest period (control condition). Each five hour session included six deadly force scenarios and variety of cognitive tasks as well as multiple driving simulations.
Results: Mixed effects analysis of variance found fatigued officers to outperform rested officers F (1, 1124) = 6.53, p = 0.01. Follow up Pearson chi-square analysis and nonlinear mixed effect regression analysis showed fatigued officers to perform significantly better on several distinct measures of performance. These performance items were primarily associated with measures of the officers' immersion and engagement within the simulated deadly force scenario.
Conclusion: Fatigue appears to lower the suspension of disbelief barrier seen within simulation-based training. This would explain why our fatigued law enforcement officers outperformed rested officers on the measures of performance which are associated with immersion and engagement with the simulated scenario. A more complete understanding of the physiological differences of these officers within the simulation would provide a clearer picture of participant engagement and immersion.
Support (If Any):

0267
SLEEP DISORDERED BREATHING AND LOW SCHOOL PERFORMANCE
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Introduction: The SEALION (Sleep Education and Learning in Our Neighbourhood) study aimed to estimate the prevalence of sleep-disordered breathing (SDB) in a large community sample of New Zealand (NZ) 6 to 10-year-old children and investigate whether children with SDB are more at risk for not progressing adequately within the NZ curriculum.
Methods: Parents/caregivers of 6 to 10 year-old children were recruited through NZ primary schools and parent-targeted Facebook advertisements. 1621 NZ parents/caregivers completed the on-line survey covering items including: the extent and severity of SDB symptoms (SDB scale of the Pediatric Sleep Questionnaire); and children's academic performance based on teacher feedback relative to National Standards (well below/below/at/above) across domains of reading, writing, and mathematics.
Results: Preliminary analysis (n=1621) shows the prevalence of children "at risk" of SDB as rated by their parents was 19.0% (95% CI = 17.1 - 21.0%). The proportion of children "at risk" of SDB who were achieving below the National Standards was 26.3% for reading, 32.8% for writing, and 29.2% for maths. Of the children "not at risk" of SDB, 13.5% were achieving below National Standards for reading, 18.6% for writing, and 13.5% for math, according to parent report. For those children at risk of SDB, the odds ratio of being below the National Standards compared to those not at risk was 1.9 for reading, 1.8 for writing, and 2.2 for math, after adjustment for ethnicity, gender, age, and mother's education (all $P < 0.01$).
Conclusion: These preliminary findings suggest that more NZ children with, than without, SDB may be performing below National Standards for academic performance. Equipping teachers and parents to be able to identify children at risk of sleep problems could facilitate early screening and referral for possible diagnosis and treatment to benefit the children's long term health and potentially academic development.
Support (If Any): Freemasons of New Zealand Fellowship in Paediatrics, The Grand Lodge of New Zealand.

0268
ROLE OF INTERMITTENT HYPOXIA AND SLEEP FRADMENTATION FROM OSA DURING SLOW WAVE SLEEP ON SPATIAL MEMORY
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Introduction: Slow wave sleep (SWS) is thought to benefit spatial memory consolidation. This study investigates whether disrupting SWS via sleep-stage specific OSA affects spatial memory consolidation and how sleep fragmentation and intermittent hypoxia differentially impact this effect.
Methods: We recruited 5 subjects with severe OSA who are well treated and compliant with CPAP. Individual subjects spent 3 different nights in the lab and performed timed trials before and after sleep on unique but equally difficult 3D spatial mazes. The 3 conditions included: 1) consolidated sleep with treated OSA 2) CPAP withdrawn exclusively in SWS (SWS-OSA) and 3) CPAP withdrawn exclusively in SWS with simultaneous addition of supplemental oxygen (SWS-OSA+O2).
Results: CPAP withdrawal in SWS both decreased %SWS (21% +/- 11% during consolidated sleep vs. 13% +/- 7% with SWS-OSA), and fragmented remaining SWS (SWS apnea hypopnea index with 3% oxygen desaturation or arousal (AHI3A) = 0.5/hour +/- 1 during consolidated sleep vs. 36/hour +/- 12 with SWS-OSA). During SWS-OSA+O2, SWS was also reduced (11% +/ 8%) and respiratory events continued (AHI3A 31/hour +/- 20), however indices of oxygen desaturation were minimized (%time below 90% in SWS = 4.3% +/- 1.7% during SWS-OSA vs 0.5% +/- 0.9% during SWS-OSA+O2; average oxygen saturation during respiratory event = 88.7% +/- 3.3% during SWS-OSA vs. 94% +/- 1.4% during SWS-OSA+O2). During consolidated sleep, median completion time improved from 180 sec pre-sleep (range 86 to 248 sec) to 111 sec post-sleep (range 87 to 412 sec) (38%). During SWS-OSA median completion time improved from 138 sec pre-sleep (range 116 to 272 sec) to 133 sec post-sleep (range 73 to 453 sec) (4%) and during SWS-OSA+O2 median completion time improved from 172 sec pre-sleep (range 61 to 339 sec) to 161 sec post-sleep (range 51 to 306 sec) (6%).
Conclusion: CPAP withdrawal during SWS in subjects with severe OSA reduces and fragments SWS. The addition of supplemental oxygen during CPAP withdrawal minimizes the associated intermittent hypoxia. Early evidence suggests a greater benefit of consolidated sleep on overnight change in spatial navigation performance than sleep with SWS disruption either with or without intermittent hypoxia.
Support (If Any):

0269
INSOMNIA, SHORT SLEEP DURATION, AND FAILED TEST PERFORMANCE IN A MILITARY ACADEMIC SETTING
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Introduction: College age students often obtain poor sleep and experience adverse physical and mental health outcomes as a result, which

may, in turn, impact their academic performance. However, little is known about the relationships between sleep, well-being, and performance of soldiers in academic training settings. The goal of this study was to characterize the typical sleep pattern in soldiers undergoing intensive language training and to assess the relationship between sleep and failed tests.

Methods: 729 soldiers in a military academic training environment were asked to participate in a study on sleep, academic performance, mental health and well-being. Cross-sectional anonymous survey data were analyzed using a subset consisting of 607 soldiers. Participants completed study measures that included the Insomnia Severity Index (ISI), the Patient Health Questionnaire (PHQ-9), the Generalized Anxiety Disorder 7 Item Scale (GAD-7), the PTSD Checklist for DSM-V (PCL-5), and additional questions regarding demographics, sleep quantity, and academic performance (as measured by failed tests). Logistic regression was used to evaluate the relationship between insufficient sleep, insomnia, mental health outcomes, and failed tests, adjusting for age, rank and gender.

Results: No relationship was found between mental health outcomes and failed tests. However, risk factors that were associated with failing a test included insomnia (OR = 1.63, 95%CI = 1.07–2.49) and insufficient sleep (OR = 0.51, 95%CI = 0.29–0.90). 80.9% of soldiers reported obtaining insufficient sleep (6 hours or less per night). Additionally, 38.2% of this sample screened positive for moderate to severe insomnia.

Conclusion: Insomnia and insufficient sleep were significantly and independently associated with a higher likelihood of failing at least one academic test in this military population. Assessing and treating insomnia within the academic training environment, emphasizing good sleep habits, and creating greater opportunity for sleep may lead to improved academic outcomes.

Support (If Any): This study was funded as part of the US Army's Military Operational Medicine Research Program.

0270

ON THE INCONSISTENCY OF SLEEP EFFECTS ON DECLARATIVE AND PROCEDURAL MEMORY CONSOLIDATION - AN EEG STUDY ACROSS MULTIPLE SLEEP LABORATORY NIGHTS

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Introduction: Numerous studies indicate memory consolidation during sleep and postulate that memories are less susceptible to interference after sleep. Griessenberger et al. (2013), moreover, found that susceptibility to interference is pronounced in insomniacs in the declarative memory domain only as compared to the procedural domain. However, it is still unclear how stable these findings are in the long term. In an extensive study across multiple nights we investigated the temporal stability of declarative and procedural memory as well as susceptibility to interference.

Methods: We tested insomnia patients (IN, n=16) and patients, who merely misperceive their sleep quality (misperception insomniacs, MP, n=9), but show sleep efficiency comparable to healthy controls. Each participant completed 9 nights with full polysomnography (PSG) including 4 nights with a declarative memory task (word-pair association) and 4 nights following a procedural memory task (finger-tapping). Following an encoding session, participants were tested during a retrieval session the following morning (RET1). Thereafter an interfering sequence or list of words was learned and participants were tested again on the initially learned material immediately (RET2) and after further six days (RET3).

Results: INs and MPs differed regarding their sleep architecture yet there were no differences between the two groups regarding performance on the procedural task. In the word-pair task, INs and MPs differed regarding their performance (RET2, RET3) and MPs always performed better than INs. Interestingly, a comparison of the RET2 results across the four visits to the lab revealed a general increase of performance across visits in both groups. Besides this, INs were more susceptible to interference than MPs and both groups became less susceptible to interference with each visit to the lab. Most interestingly, however, neither sleep architecture nor sleep spindles did vary systematically with overnight memory changes (in either task) when considering all two times 4 learning nights per subject.

Conclusion: The results therefore question the robustness of sleep-dependent memory consolidation findings in the literature and await similar studies in healthy individuals.

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0271

SEVERE OBSTRUCTIVE SLEEP APNOEA IS ASSOCIATED WITH SELECTIVE ATROPHY OF NEURONAL LAYERS IN THE HIPPOCAMPUS AND REDUCED MYELINATION

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Introduction: Obstructive sleep apnoea (OSA) is often associated with memory impairments. Since memory is processed in the hippocampus, the present study investigated the relationship between OSA severity, cell layer thickness and myelination in specific hippocampal regions.
Methods: Autopsy hippocampal tissue was obtained from 33 Icelandic patients previously diagnosed with mild-to-severe OSA (oxygen desaturation index (ODI): 1.9 - 92.2 events/hr). The formalin-fixed tissue, embedded in paraffin, was sectioned at 20 microns. Sections were stained with cresyl violet to show general histology, and immunohistochemistry for myelin basic protein (MBP) to show the extent of myelination. The thickness of each cell layer and intensity of MBP staining was measured in the entorhinal cortex, CA1 region and dentate gyrus.
Results: As ODI increased there was a corresponding decrease in the cross-sectional area of the molecular layer of the hilus in the dentate gyrus (r=-0.378, p=0.03), a decrease in the thickness of layer 1 (r=-0.505, p=0.009) and layer 3 of entorhinal cortex (r=-0.395, p=0.046) and layer 2 of CA1 (r=-0.388, p=0.028). Trends towards decreased thickness were found for layer 2 of entorhinal cortex (r=-0.378, p=0.057), and layer 1 (r=-0.329, p=0.066) and layer 3 of CA1 (r=-0.318, p=0.076). Increased OSA severity was also associated with less MBP staining in layer 5 (r=-0.468, p=0.018) and layer 6 of entorhinal cortex (r=-0.627, p=0.001), and in layer 1 (r=-0.440, p=0.013) and 2 of CA1 (r=-0.461, p=0.009), with a trend in layer 4 of entorhinal cortex (r=-0.385, p=0.057). No changes in MBP were observed in the dentate gyrus.
Conclusion: Brain tissue from patients with severe OSA had fewer myelinated axons in the deep layers of the entorhinal cortex, which originate mainly from CA1. In turn, neuronal layers 1–3 of entorhinal cortex, which project back to CA1 and to the dentate gyrus, were thinner. These target regions also had thinner neuronal layers. Taken together, these data indicate that severe OSA affects the 'trisynaptic circuit' that underpins memory consolidation, and these degenerative changes may contribute to the memory deficits that are reported. It is notable that these regions also undergo atrophy in early Alzheimer's disease.
Support (If Any):

0272

CHRONIC SHORT SLEEP INITIATES AN AMYLOID CASCADE IN LOCUS COERULEUS NEURONS AND TAU-DEPENDENT NEURODEGENERATION

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Introduction: Sleep loss, highly prevalent in modern societies, can increase extracellular cortical amyloid; yet whether insufficient sleep can influence the temporal progression or development of spontaneous Alzheimer's disease is not known. Locus coeruleus neurons (LCn) are activated persistently across waking and are an early site for pathogenic tau changes. We hypothesized that chronic short sleep (CSS) increases LCn A-beta42 that in turn increases tau phosphorylation (p-tau), and that the increased p-tau is critical for CSS-induced LCn degeneration.
Methods: Here in wild type adult mice, we examined A-beta42 and tau responses to CSS within LCn. To assess the role of amyloid peptides, we supplied a beta secretase inhibitor across CSS. To examine the role of tau in CSS LCn loss, we examined CSS responses in tau deficient mice. CSS responses in LCn were related to early Alzheimer's changes in the newer knock-in Alzheimer's mouse models.
Results: CSS in young adult mice triggers persistent increases in LCn A-beta42 and tau phosphorylation, microglial activation, synaptic pruning and spatial learning and memory impairment, remarkably akin to early findings in the novel amyloid precursor protein knock-in (APPKI) mice, prior to the development of cortical amyloid plaque. Mice genetically or pharmacologically lacking the ability to produce A-beta peptides confer resistance to CSS-induced tau phosphorylation, microglial activation and synapse loss, while mice deficient in tau do not lose LCn with CSS.
Conclusion: Here we provide compelling evidence that CSS in healthy young adult mice initiates A-beta-dependent persistent changes in tau, synapse loss, and glial activation, associated with tau-dependent neurodegeneration of LCn and neurobehavioral impairments all consistent with early AD.
Support (If Any): NIH grants HL123331, HL 124576 and AG054104 to SCV and National Natural Science Foundation of China (No. 81100991).

0273

BASELINE EXCESSIVE DAYTIME SLEEPINESS ASSOCIATED WITH AN INCREASE IN BRAIN METABOLISM IN NON-DEMENTED ELDERLY: A LONGITUDINAL FDG-PET STUDY

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Introduction: Excessive daytime sleepiness (EDS) increases with aging, and may be associated with cognitive decline in the elderly. As Alzheimer's Disease dementia (AD) has been linked to metabolic changes particularly in areas involved with the default mode network (DMN), we investigated whether EDS is associated with metabolic changes in those regions.
Methods: From the population-based sample of Mayo Clinic Study of Aging, we identified 277 non-demented individuals aged 70 and older who had at least two serial FDG-PET scans and completed sleep questionnaires. EDS was defined as Epworth Sleepiness Scale score ≥10. Multiple linear regression models were fit in 7 AD-vulnerable regions also part of the DMN (orbitofrontal, prefrontal, anterior cingulate, cingulate-precuneus, medial temporal, lateral temporal, and parietal) to explore whether baseline EDS predicted variability in regional brain metabolism as measured by annualized change in FDG-PET signal using two scans. We controlled for baseline age, sex, APOE4, education, cardiovascular comorbidities (obesity, hypertension, hyperlipidemia, diabetes), reduced sleep duration, sleep-disorder breathing symptoms (snoring and/or witnessed apneas), depression, and baseline FDG-PET signal.
Results: Age, male sex, and APOE4 were associated with significant metabolic reductions in multiple regions. On the other hand, EDS was associated with a longitudinal increase in FDG-PET signal in all regions, especially in the prefrontal (0.024, 95% CI: 0.008–0.041, p=0.003), cingulate/precuneus (0.022, 95% CI: 0.004–0.039,

p=0.014), and orbitofrontal (0.021, 95% CI: 0.009–0.034, p=0.001) areas. A post-hoc analysis showed similar trends throughout the brain.
Conclusion: Baseline EDS was associated with a longitudinal increase in FDG-PET signal. This hypermetabolism may represent a compensatory mechanism in response to efficiency loss in the setting of overloaded synaptic activity. This hypothesis is consistent with previous findings suggesting increased blood flow at the end of the waking day when compared to blood flow after a night of sleep. However, the increase predicted by EDS does not imply an overall increase in brain metabolism, because the magnitude of the reduction predicted by baseline age is higher than the increase in FDG-PET signal predicted by EDS in all regions.
Support (If Any): NIH.

0274

NON-VISUAL EFFECT OF LIGHT ON COGNITIVE BRAIN FUNCTION: AGE AND IMPACT OF LENS YELLOWING

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Introduction: Light, particularly blue light, increases alertness, performance and cognitive brain responses, but age-related decrease in the effects of light has been reported. The extent to which these age-related modifications are caused by changes at the level of the eye (because of senile miosis and lens yellowing) or the brain is unclear.
Methods: We conducted a neuroimaging protocol including 14 younger (20-30y), 12 older (60-80y) and 12 matched older healthy individuals with intraocular lens replacement after cataract surgery (IOL subjects), i.e. they differed from the healthy older group only in terms lens light absorption. Subjects completed two functional magnetic resonance imaging (fMRI) acquisitions while performing a working memory 2-back task (2b) and a simple letter detection "0-back" task (0b), once under blue monochromatic light (B) (480nm, 3x1013ph/cm2/s) and once under orange monochromatic light (O) (620nm, 3x1013ph/cm2/s). Each fMRI session was conterbalned and also included blocks of n-back task in darkness, as well as blocks of light alone (B, O).
Results: First, all blue blocks were contrast against blocks completed in darkness [(2bB+0bB+B)-(2bD+0bD)]. Results revealed common group effects with greater brain activations in lateral geniculate nucleus, lingual, calcarine sulcus and median occipital gyrus under blue light exposure (P corrected < 0.05). As a second step, in order to estimate non-visual impact of light, we computed the effect of blue versus orange light on cognitive brain responses [(2bB-0bB)-(2bO-0bO)]. Results revealed a main effect of group (P corrected < 0.05) with group differences in various regions including the cingulate cortex, median prefrontal cortex and hippocampus. Young subjects showed greater brain sensitivity to light as compared to IOL and older individuals. No significant differences were found between IOL and older with their natural endogenous lens.
Conclusion: Our results confirm that the aging brain is still sensitive to blue light. However, both older groups showed reduced non-visual effects of light on cognitive brain responses as compared to the young. These results suggest that cerebral modifications, not the lens, underlie age-related reduced non-visual impact of light on cognitive brain responses.
Support (If Any): CIHR.

0275

AGE EFFECTS ON REM SLEEP AND PROSPECTIVE MEMORY CONSOLIDATION

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Introduction: Prospective memory refers to memory for executing future intentions (e.g., taking medication with breakfast). In college-aged adults, sleep benefits consolidation of prospective memories, but it is unclear whether changes in sleep architecture with increasing age compromises prospective memory consolidation. Investigating age-related changes in prospective memory *consolidation* is particularly interesting because previous research has shown no age-related changes in prospective memory *encoding* or *retrieval*.
Methods: Sixty-one community dwelling adults ages 18 to 85 completed all phases of this three-night experiment in a controlled, polysomnography-recorded laboratory environment. Following a baseline adaptation night, participants completed experimental nights in which they performed computerized tasks and encoded a laboratory-based prospective memory task or a control task (i.e., all computerized tasks without the prospective component; order counterbalanced). For the prospective memory task, participants were instructed to remember to press a specific key (e.g., Q) if they saw a target stimulus (e.g., the word "table") amidst any of the computerized tasks they would later perform. All participants then verbally explained these instructions to the experimenter to confirm encoding. The next morning participants performed several computerized tasks and we measured the proportion of times participants pressed the specified key in response to the target stimuli.
Results: The young adults showed significantly greater prospective memory consolidation (M = 63% correct responses) than the older adults (M = 41% correct responses), p=.03. Prospective memory consolidation was not associated with slow-wave sleep duration, r=.05, but it was with REM sleep duration, r = .42, p<.001. Mediation analyses demonstrated that the effect of age on prospective memory consolidation was explained by variability in REM sleep duration, and independent of total sleep time.
Conclusion: Previous research on memory consolidation has focused on slow-wave sleep, but these findings identify a key role for REM sleep in the consolidation of future intentions. Future research should investigate whether augmenting REM sleep in older adults improves prospective memory functioning.
Support (If Any): Sleep Research Society Early Career Development Award.

0276

SLEEP ENHANCEMENT ASSOCIATED WITH REDUCED ALPHA-SYNUCLEIN ACCUMULATION IN THE BRAIN CORTEX OF VESICULAR MONOAMINE TRANSPORTER 2 DEFICIENT MICE SUFFERING FROM INCREASED AROUSAL

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Introduction: Parkinson's disease (PD) is the second most common neurodegenerative disease in the general population. The hallmark of the disease is a staggering loss of dopaminergic neurons in *substantia nigra pars compacta* and intracellular deposits of aggregated α-synuclein. The disease manifests with motor and non-motor symptoms,

including bradykinesia, tremor, rigidity and sleep-wake disturbances (SWD). SWDs are one of the most frequent non-motor symptoms of PD, often preceding the onset of other symptoms and, despite growing interest in studying SWD in the context of PD, there is a lack of appropriate murine models. Some lines of evidence recently suggested that sleep deficits correlate with increased burden in neurodegenerative disease and that sleep might alleviate disease severity by increasing clearance of metabolites and proteins from interstitial space, which could prove beneficial in diseases with protein accumulation/aggregation as primary pathology.

Methods: We performed EEG/EMG recordings in vesicular monoamine transporter 2 (VMAT2) deficient mice at age of 5 months. Afterwards, at age of 14 months we investigated whether sleep modulation by means of pharmacological sleep induction and chronic REM sleep restriction had an effect on alpha-synuclein accumulation in the brain of VMAT2 deficient mice and behavioral symptoms.

Results: EEG/EMG recordings in VMAT2 deficient mice (n=6) and wild type (WT) littermates (n=7) at age of 5 months shows that VMAT2 deficient animals present SWD and EEG changes similar to those seen in PD, namely: increased arousal, decreased time spent in non-rapid eye movement (NREM) and rapid eye movement (REM) sleep and lower sleep efficiency. Furthermore, our results suggest that alpha-synuclein burden was reduced in the sleep-induced (SI) group as compared to the untreated (Ctrl) group. However, we found sleep modulation not associated with improved motor ability, which probably indicates hypodopaminergia as the primary cause of the phenotype as opposed to synucleopathy.

Conclusion: Overall, our results suggest that VMAT2 deficient mice present increased arousal and reduced sleep efficiency and that reversing such sleep traits by pharmacological sleep enhancement may have an alleviating effect on the alpha-synuclein pathology present in this murine PD model.

Support (If Any): none.

0277

ROPINIROLE AMELIORATES INSOMNIA IN A PROGRESSIVE MOUSE MODEL OF PARKINSON'S DISEASE

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Introduction: Insomnia is one of the common sleep problems in Parkinson's disease (PD). However, pathological mechanisms involved are unknown. MitoPark mice have a selective ablation of midbrain DA neurons by impaired respiratory chain function in DAT-expressing cells and have been validated to show the progressive development of key PD features. We therefore evaluated longitudinal changes in sleep and drug response.

Methods: Adult male mice (n=9 each genotype) underwent surgery for EEG/EMG electrodes and E-mitters. Baseline was recorded at 10 (absent from motor symptoms), 15 (mild), 20 (moderate), and 25 (severe) weeks of age. Sleep deprivation was performed for 6 hours after baseline. Three doses of ropinirole, a dopamine D2-like receptor agonist, were intraperitoneally administered before the light off at 13, 17, 21, and 25 week olds.

Results: MitoPark mice showed an age-dependent decline of up to 40% in locomotion following a new environment, while there was no difference between control and MitoPark mice in spontaneous locomotion through 24 hours on baseline in all ages examined. MitoPark mice had normal amounts, and natural diurnal distributions, of wakefulness and sleep in the baseline by 20 weeks. Once motor symptoms severely exacerbated at 25 weeks, sleep fragmentation and a decrease in NREM sleep amount occurred during light period. There was no difference in the occurrence of REM without atonia at 25 weeks. MitoPark mice age-dependently showed more enhanced increases in locomotion at middle and high doses than controls for 3 hours after injection. Accordingly, wakefulness dose-dependently increased in all ages of both genotypes during dark period. Importantly, ropinirole showed opposite effects on sleep in a dose-dependent manner during following light period. Ropinirole increased wakefulness in control mice, while decreased in MitoPark mice at advanced stages.

Conclusion: Insomnia with fragmented sleep at the severe stage of motor symptoms may correlate to insomnia in human subjects. Since sleep problems observed in PD patients could be intermingled with both a function of disease and its treatment, age- and dose-dependent changes in response to ropinirole could be fundamental to understand mechanisms of movement and sleep problems in PD.

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0278

HYPOCRETIN AS A MEDIATOR OF POST-TRAUMATIC BRAIN INJURY SLEEP DISTURBANCE

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Introduction: Disorders of sleep and wakefulness occur in the majority of individuals who have experienced traumatic brain injury (TBI), with increased sleep need and excessive daytime sleepiness often reported. Behavioral and pharmacological therapies have limited efficacy, in part, because the etiology of post-TBI sleep disturbances is not well understood. The hypocretinergic system is essential for the maintenance of wakefulness and is perturbed in human TBI patients and in animal models of TBI. However, previous studies examining the role of hypocretin in responses to TBI have all been correlational. We hypothesized that post-TBI sleep disturbances in hypocretin-null (KO) mice would be less severe than in wild type mice subjected to TBI.

Methods: Adult male C57BL/6 and hypocretin KO mice were implanted with EEG recording electrodes and baseline recordings were obtained. After baseline recordings, animals were subjected to a controlled cortical impact (CCI) or sham surgery. EEG recordings were obtained from the same animals at 3, 7, 15, and 30 days post-surgery. Since hypocretin plays an important role in regulating neuroinflammation, especially microglial response, brains were examined with immunohistochemistry for microglial activation.

Results: Similar to previous studies, wild type mice exhibited a decrease in wakefulness during the dark period at chronic time points in response to TBI. Hypocretin KO mice exhibited less time in wakefulness and shorter bouts of wakefulness during the dark period compared to wild type mice. At chronic time points, post-TBI sleep-wake disturbance was attenuated in hypocretin KO mice compared to wild type mice.

Conclusion: Hypocretin is a mediator of post-TBI changes in sleep-wake behavior. Thus, hypocretin may be a therapeutic target for treatment of chronic sleep-wake disturbances that occur after TBI.

Support (If Any): Department of Anesthesiology & Pain Medicine, University of Washington, Seattle WA.

0279

SLEEP AND BEHAVIORAL PHENOTYPE OF A COMBINED MOUSE MODEL OF TBI AND PTSD

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Introduction: Traumatic brain injury (TBI) and post-traumatic stress disorder (PTSD) are commonly comorbid, especially in the Veteran population. We have recently shown sleep-wake disturbances in rodent

models of TBI. PTSD is also associated with significant sleep-wake and behavioral disturbances. Little is known about the phenomenology and pathophysiology underlying the combined disorder (TBI+PTSD). We created a novel mouse model of TBI+PTSD, and analyzed sleep staging, behavior, and neural activation patterns.

Methods: Mice were randomized to one of four conditions: Naïve, TBI (using controlled-cortical impact), PTSD (using Single Prolonged Stress, or SPS), or TBI+PTSD. The first cohort of mice (n=8–9/group) was instrumented with EEG/EMG for chronic sleep-wake recordings and then underwent fear extinction and digital gait assessment testing. The second cohort of mice (n=20/group) underwent prepulse inhibition (PPI) testing, followed by brain immunohistochemistry for c-Fos neural activation patterns after exposure to a novel environment compared to a sleep condition.

Results: Baseline sleep staging did not differ between groups. When placed into a novel environment, both PTSD and TBI+PTSD mice in showed a shorter latency to fall asleep (p=0.035) and more sleep-wake transitions (p=0.066) compared to naïve mice. Both PTSD and TBI+PTSD mice showed less exploration during the fear extinction task (p<0.001). Mice in the TBI, PTSD, and TBI+PTSD groups showed decreased tau propulsion (a gait metric affected by muscle strength) in Digigait testing compared to controls (p=0.015). Mice in the TBI+PTSD group showed decreased startle response in PPI (p=0.031) compared to controls.

Conclusion: Similar to what we have observed with in-lab polysomnography studies in Veteran subjects with TBI and PTSD, the mouse model of combined TBI+PTSD shows only subtle differences in objective baseline sleep staging. However, trauma-exposed mice showed profound behavioral deficits, including inability to maintain wakefulness in a novel environment, inability to extinguish fearful memories, and enhanced PPI. Ongoing studies will examine patterns of neural activation across sleep and stress circuits, and relationships between EEG and behavior.

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0280

A RECIPROCAL RELATIONSHIP BETWEEN SLEEP AND ALZHEIMER'S DISEASE?

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Introduction: Sleep-wake cycling is a vital brain function associated with cognition and synaptic plasticity. An intriguing relationship between sleep and Alzheimer's disease (AD) emerged after an observation that sleep-deprived rodents accumulated β-amyloid (Aβ). In parallel, another study demonstrated that mice lacking the gene encoding wake-promoting orexin neuropeptides (OX-A, OX-B) not only exhibited characteristic hypersomnolence, but also developed half as many Aβ plaques. While not universally observed by research groups, there is also a report showing elevated CSF OX-A in patients with moderate to severe AD. While the exact relationship between sleep and AD remains to be deciphered, the association between OX-A and Aβ warrants further study.

Methods: To assess whether humans with insomnia accumulate greater levels of (a) OX-A and (b) Aβ oligomers (AβO) (a neurotoxic species implicated in the pathology of AD), CSF from insomniacs (N=3) and good sleepers (N=3) was mined for OX-A and AβO, using MSD and Singulex ELISA platforms, respectively. CSF levels of other neurotransmitters and metabolites, including acetylcholine, *tele*-methylhistamine, dopamine, 3,4-dihydroxyphenyl-acetic acid, homovanillic acid, glutamate and gamma-aminobytyric acid were measured using LC/MS-MS. In a parallel study, the (a) OX-A and (b) AβO levels in the CSF of aged African Green Monkeys (AGM), known to develop Aβ plaques with aging, were compared to young AGM using abovementioned methodologies.

Results: Preliminary data indicated a trend towards elevated OX-A and AβO in subjects with insomnia vs. those with good sleep. Furthermore, we also observed a tendency towards elevation of *tele*-methylhistamine in poor sleepers. Finally, we demonstrate a significant (p=0.0001) increase of baseline CSF oligomers in aged vs. young monkeys, with a parallel, albeit not significant trend for CSF OX-A levels.

Conclusion: The reciprocal relationship between sleep and AD remains incompletely understood. The current pilot study strengthens the link between OX-A, Aβ and AD and supports further studies to validate these observations.

Support (If Any): None.

0281

FRONTAL B-AMYLOID BURDEN AND SLEEP DURATION IN AGING

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Introduction: Recent studies suggest relationships between sleep disturbances and early signs of Alzheimer's disease pathology (Spira, 2013). The aim of this study was to examine relationships between objectively measured sleep and β-amyloid (Aβ) burden in aging subjects.

Methods: 59 elderly (79.7 years; 44% female) without dementia, sleep disorders and medications were included. Actigraphy was used to measure sleep duration and fragmentation over 7–8 nights. Participants underwent MRI anatomic scans and [18F]-Flutemetamol PET-CT scans. First, PET scans were spatially normalized into the MNI space and included in whole brain multiple regression analyses. Secondly, MRI scans were segmented using FreeSurfer v5.3 to provide several regions of interest (ROIs) including frontal area, anterior and posterior cingulate cortex, precuneus and hippocampus. Regional distribution volume ratios were calculated for each ROI and included in multivariate regression models. Both analyses were conducted to explore relationships between Aβ burden (outcome) and each sleep parameter (predictor) corrected for age, gender and time between actigraphy and PET scans.

Results: In the voxel wise analysis, short sleep duration was associated with Aβ burden in frontal area including left inferior frontal gyrus (trend for the right part), left middle and superior frontal gyrus, bilateral precentral, left insula and bilateral anterior cingulate cortex (p<0.05, FDRc corrected). Sub-threshold results were observed between short sleep duration and Aβ burden in hippocampal regions. These last results were confirmed by the ROI analysis (F=2.763, p<0.05 for left hippocampus and a trend was observed for the right part F=2.375, p=0.06). In contrast, no significant association was observed with sleep fragmentation in either analysis.

Conclusion: In elderly, sleep duration but not sleep quality was associated with Aβ burden in frontal and hippocampal regions. Level of

Aβ in brain interstitial fluid has been shown to decrease during sleep in mice (Kang, 2009), suggesting that short sleep duration may cause or exacerbate Aβ accumulation.

Support (If Any): GE Healthcare provided the [^{18}F]-Flutemetamol for PET imaging.

0282

WHITE MATTER DAMAGE AND AXONAL DEGENERATION ARE RELATED TO HYPOXIA IN UNTREATED OBSTRUCTIVE SLEEP APNEA

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Introduction: Mid-life is a critical period for brain health, when vascular risk factors and white matter injury are associated with cognitive impairment, and predict future dementia. Obstructive sleep apnea (OSA) is prevalent in midlife and is characterized by repetitive hypoxic episodes, which may damage brain white matter. Yet few studies have investigated this relationship using objective measures of OSA and white matter health. Therefore we examined white matter lesions and axonal and synaptic degeneration in untreated OSA.

Methods: 49 cognitively normal, late middle-aged adults (23 female, age 60.4 +/-5.1 years) were recruited from the Wisconsin Alzheimer's Disease Research Center. Participants had no previous diagnosis or treatment of sleep disordered breathing. Cerebrospinal fluid was collected via lumbar puncture and assayed for markers of axonal degeneration (Neurofilament Light, NFL) and synaptic dysfunction (neurogranin). Volume of white matter hyperintensities (WMH) was quantified by T2 MRI. Sleep architecture and sleep disordered breathing were assessed with polysomnography. Secondary analyses examined CSF biomarkers of Alzheimer's disease pathology (amyloid-beta 42, 40 and tau). Multiple regression was used to test the relationships between CSF markers or WMH and Apnea-Hypopnea Index (AHI) or oxygen saturation (SpO2), controlling for age, time between sleep and CSF or MRI assessments, CSF assay batch and intracranial volume where applicable. CSF markers and white matter hyperintensities were also compared between groups with OSA (AHI>15, n=6) and controls (AHI<5, n=22) with t-tests.

Results: Compared to controls, untreated OSA patients had elevated NFL (t=2.2, p=.04) and greater volume of white matter hyperintensities (t=2.2, p=.04). Lower mean SpO2 was associated with greater NFL (b=-7.3, p=.01) and greater WMH (b=-8.5, p=.005). Neither NFL or WMH were significantly associated with AHI. Neurogranin, amyloid and tau did not differ by OSA group, AHI or SpO2.

Conclusion: In midlife, untreated OSA and hypoxia are associated with white matter lesions and axonal degeneration. OSA treatment could be a useful strategy to ameliorate cognitive decline mediated by white matter injury.

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0283

SUBJECTIVE COGNITIVE COMPLAINT IN LATE MIDDLE-AGED AND OLDER INDIVIDUALS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Subjective cognitive complaint (SCC) increases the risk of mild cognitive impairment (MCI) and dementia. Obstructive sleep apnea (OSA) has recently been identified as a risk factor of MCI and dementia in the elderly. However, the ability of SCC to predict cognitive dysfunction and cognitive decline over time among individual with OSA need to be investigated. Objectives: To clarify weather OSA is a risk factor of SCC and investigate how SCC is associated with objective cognitive decline in older individuals presenting OSA.

Methods: One hundred eleven subjects (age: 55–85; apnea-hypopnea index: 0.25–84.74) were included at baseline and 62 subjects were followed 1.5-years after. All subjects underwent an overnight polysomnography at the baseline. At both visits, SCC was evaluated using standardized questionnaires and a single question asked by clinician during the neuropsychological assessment. Logistic regressions on SCC and MCI measures with demographic (age, education), clinical (mood, sleep quality, vascular index, ApoE4) and respiratory variables were performed. Moreover, (2X2) ANOVA with two independent variables (OSA group: OSA+/OSA- X Cognitive status: MCI+/MCI-) were performed on SCC questionnaires.

Results: Variables related to OSA, namely apnea-hypopnea index, hypoxemia and sleep fragmentation, did not increase the risk of SCC or MCI. In fact, higher scores on mood and sleep quality questionnaires increased the risk of SCC [OR 2.13 and 11.65], while higher education decreased the risk of MCI [OR 0.78 and 0.71] at the baseline and follow-up. Significant OSA group X Cognitive status interactions were found for SCC questionnaires. Interestingly, OSA+/MCI+ participants reported significantly fewer SCC compared to OSA+/MCI-. An opposite relation was found in healthy controls: OSA-/MCI+ had more SCC than OSA-/MCI-.

Conclusion: Although OSA does not predict SCC and cognitive decline in our sample, there is a disconnection between SCC and the objective presence of MCI in OSA that is not observed in control subjects. More specifically, older individuals with OSA are less aware of their cognitive deficits compared to individuals without OSA. Our results stress the importance of an objective neuropsychological evaluation of older patients with OSA.

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0284

FUNCTIONAL CONNECTIVITY DURING REM SLEEP IN HEALTHY AGING

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Introduction: Aging is associated with modifications in waking electroencephalographic (EEG) coherence, a measure of cerebral

functional connectivity. EEG coherence in the alpha frequency band was reported to be lower in rapid eye movement (REM) sleep than during wakefulness in young individuals. The aim of this study was to compare EEG functional connectivity in REM sleep and in wakefulness in a group of elders with normal cognition.
Methods: Thirty-two subjects without cognitive impairment (10 F; mean age 63.7 ± 6.6 years) underwent a neuropsychological evaluation, a night of polysomnography and a resting state EEG recording with 14 EEG electrodes. Imaginary coherence analyses were performed on manually selected artefact-free sections in both REM sleep and resting wakefulness. Four frequency bands (delta, theta, alpha and beta) were analysed. REM sleep and wakefulness (Fisher transform) were assessed with a Welch's t-stat. Non-parametric test on the max-stat and a permutation resampling allowed to account for multiple comparisons (between pairs of electrodes) in a false discovery rate like thresholding ($p<0.01$).
Results: A global decrease of imaginary coherence was found for the alpha band in REM sleep compared to wakefulness. For delta and theta bands, imaginary interhemispheric coherence was lower in frontal areas (between F3-F4-F7-F8) but imaginary intrahemispheric coherence (between F3-C3-T5 and F4-C4-P4) was higher in REM sleep compared to wakefulness.
Conclusion: REM sleep and wakefulness show robust differences in functional connectivity in elderly individuals with normal cognition. Future analyses will determine how these differences in coherence are associated to cognitive status in aging.
Support (If Any): Canadian Institutes of Health Research

0285

CHARACTERIZATION OF SLEEP NEED DISSIPATION USING EEG BASED SLOW-WAVE ACTIVITY ANALYSIS IN TWO AGE GROUPS

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Introduction: In the two-process model of sleep regulation, slow-wave activity (SWA, EEG power in the 0.5–4 Hz band) is a direct indicator of sleep need. SWA builds up during NREM sleep, declines before the onset of REM sleep, remains low during REM and the level of increase in successive NREM episodes gets progressively lower. The sleep regulation model of Borbely et al, 1999, states that the rate of decrease in sleep need $S(t)$ is proportional to SWA, i.e. $dS(t)/dt = -\gamma SWA(t)$ where γ is the *decay rate*. The sleep need after T minutes of sleep is: $S(T)=S_0-\gamma CSWA(T)$, where S_0 is the sleep need at sleep-onset and $CSWA(T)$ is the integral of SWA from sleep onset to time T. The goal in this research is to assess the effect of age on the dynamics of sleep need dissipation.
Methods: Sleep EEG and EOG data were collected from 25 subjects (10M and 15F; 37.1 ± 6.5 years old) for 3 nights at home. The data was manually scored into sleep stages according to AASM rules. SWA was calculated for each 6-second *epoch* of NREM sleep. In this model, sleep need dissipation is completely determined by S_0 and γ. To estimate these, two boundary conditions were used: 1) the final value of $S(t)$ is 0, and 2) $S(t^*)$ coincides with $SWA(t^*)$ at time t^* where SWA is maximum in the first sleep cycle.
Results: Two age groups were defined using as threshold the median age (38) of subjects in the study. S_0 did not significantly differ between groups while γ was significantly different (γ group1=2.82 and γ group2=2.12; p=0.006). These results suggest that the efficiency of sleep need dissipation significantly decreases in the older group by 25%.
Conclusion: The rate of sleep need dissipation is proportional to slow wave activity. The proportionality coefficient γ (decay rate) can be estimated using a differential model. It was found that γ is significantly lower, by 25%, in the age group 38 to 47 as compared to the age group 22 to 38. The initial sleep need did not differ between groups.
Support (If Any):

0286

IS TRANSCRANIAL ALTERNATING CURRENT STIMULATION (TACS) AN EFFECTIVE TOOL TO ENTRAIN SPINDLES DURING SLEEP IN OLDER INDIVIDUALS?

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Introduction: NREM sleep markers like sleep spindles are crucial for brain plasticity and their density, amplitude and duration decrease in aging. Few studies were able to entrain NREM sleep oscillations using transcranial alternating stimulation (TACS) and to enhance sleep-dependent memory consolidation. This pilot study aimed to induce sleep spindles using TACS in older individuals.
Methods: Eighteen older (60-75yo; mean: 64yo) healthy participants came to the laboratory for polysomnographic recording of two counterbalanced naps with and without TACS (STIM and SHAM). Fourteen participants completed the study, as four participants were excluded because of insufficient sleep in at least one of the naps. In the STIM condition, one-sec bursts of TACS oscillating at 14Hz with a random delay between 4 and 10 sec., were applied bilaterally on central (C3, C4) locations for four minutes. Each stimulation periods were followed by two minutes without stimulation to allow the scoring of the EEG. Intensity of the stimulation was adjusted just below each individual sensation threshold (min.: 0,04mA; max.: 1mA). Parameters for the SHAM condition were exactly the same, except that TACS was turned on only one second at the beginning of the nap. The participants were blind to the conditions. After selecting EEG signals free of TACS artefacts, spindles were automatically detected on F3 and Cz. Differences in spindle characteristics between the two conditions (TACS, SHAM) were computed using paired T-tests.
Results: In comparison with SHAM stimulation, TACS increased spindle density (p=0,053) in Cz derivation only. No significant effect was found for spindle duration, frequency and amplitude in Cz. No significant effect was observed in F3 derivation.
Conclusion: TACS was able to locally enhance spindle density during a nap in a small sample of older participants. Whether this enhancement in sleep spindle density is linked to improved sleep-depend consolidation still needs to be evaluated.
Support (If Any): This study was supported by the Canadian Institute of Health Research (CIHR) and the Natural Sciences and Engineering Research Council of Canada (NSERC).

0287

HABITUAL SLEEP DURATION, DEPRESSION SYMPTOMS, AND NEUROPSYCHOLOGICAL PERFORMANCE IN MIDDLE-AGED AND OLDER ADULTS: FINDINGS FROM A KOREAN COMMUNITY SAMPLE

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Introduction: While sleep duration has been linked to cardiovascular risk and mortality rate, there is a lack of consistent finding on the association between sleep duration and cognitive and mental health outcomes in the general population. The current study used a large-scale, community-based sample of middle-aged and older adults to examine the association between habitual sleep duration and depression and neuropsychological performance in the aging population.
Methods: A total of 1,528 (mean age=60.4, 52% female) participants from the Korean Genome and Epidemiology Study (KoGES) were categorized into short sleep (<6 h), intermediate sleep (7-<8 h), and long sleep duration (≥8 h) based a self-reported sleep duration over the past month. Neuropsychological performance was measured with a test battery that contained memory (Logical Memory and Visual Reproduction), verbal fluency (Controlled Oral Word Association Test), and attention/executive function (Trail Making Test, Digit Symbol, and Stroop). Depression was measured with the Beck's Depression Inventory (BDI).
Results: Results from multivariate analyses of covariance indicated that there was a significant difference in Logical Memory and Visual Reproduction across the sleep duration groups after adjusting for age, sex and education. Delayed Recall on Logical Memory and Immediate and Delayed Recall on Visual Memory were significantly lower in short or long sleep, compared to intermediate sleep, after additional adjustment of medical and lifestyle factors, daytime sleepiness, and use of sleep medications (Logical Memory $F=3.93$, $p=0.02$, Visual Reproductions Immediate $F=3.67$, $p=0.02$ and Delayed $F=5.40$, $p=0.005$). The BDI was also independently associated with sleep duration groups, with short sleep exhibiting the highest level of BDI scores ($F=5.18$, $p=0.006$).
Conclusion: The current findings indicate that short or long sleep duration are negatively associated with cognitive performance in middle-aged and older adults. Short sleep was also associated with higher depression score. These results support previous findings that demonstrated an inverted U-shaped association between sleep duration and cognitive performance and highlight the importance of maintaining a balanced sleep quantity.
Support (If Any): This study was supported by grants from the Korean Centers for Disease Control and Prevention and the Korean Ministry for Health and Welfare (Grant 2011-E7---E71004-0 & 2012-E71005-00).

0288

RELATIONSHIP BETWEEN METACOGNITIVE BELIEFS AND SLEEP QUALITY IN OLDER ADULTS

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Introduction: Numerous structural and physiological changes influence the quality of sleep in aging. Sleep is also influenced by the individual's perceived quality of sleep, the dysfunctional beliefs, and the metacognitive beliefs about sleep as well as the nighttime thought management strategies. The aim of this study was to describe the relationship between dysfunctional beliefs, metacognitive beliefs about sleep, thoughts control strategies, and quality of sleep in elderly people.
Methods: Fifty Italian healthy older adults (33 females) aged between 56 and 86 (M=70.40; SD=7.43) participated in the study. During 7 consecutive days, they completed different questionnaires on the quality of sleep (Pittsburgh Sleep Quality Index), dysfunctional beliefs (Dysfunctional Beliefs and Attitudes about Sleep), metacognitive beliefs (Metacognition Questionnaire Insomnia) about sleep, and thoughts control strategies related to sleep (Thought Control Questionnaire Insomnia-revised). Furthermore, during the 7 days, they also wore an actigraphic device (Actiwatch-64) to record objectives measure of sleep, such as sleep onset latency.
Results: The results showed that the age per se did not influence the quality of sleep. Also, dysfunctional beliefs were not significantly associated with reported quality of sleep. In contrast, metacognitive beliefs were positively related to worse sleep quality and with the frequency of thoughts control strategies (such as aggressive suppression, reappraisal, social avoidance, and worries). The strategies of cognitive and behavioral distraction were found to be negatively associated with a worse sleep quality. Lastly, sleep onset latency, measured through the actigraphic device, was not related to metacognitive beliefs and nighttime strategies.
Conclusion: Overall the present findings highlight the role of cognitive aspects, in particular, the metacognitive beliefs, on the perceived quality of sleep in older adults. In this view, addressing these metacognitive beliefs may be a suitable intervention for improving sleep quality in older adults.
Support (If Any): N/A.

0289

CARDIOVASCULAR AUTONOMIC DYSFUNCTION IN PATIENTS WITH INSOMNIA AND OBJECTIVE SHORT SLEEP DURATION

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Introduction: Objective sleep duration has been proposed as a biological marker of insomnia severity. Based on this conceptualization, two phenotypes have emerged. Insomnia with near-normal sleep duration (NNSD) appears to be related to increased psychological symptoms. Conversely, insomnia with short sleep duration (SSD) is associated with an increased risk of future cardiovascular morbidity. Reduced heart rate variability (HRV) has also been implicated in the pathophysiology of cardiac conditions; however, there is little data on whether this physiological marker of cardiovascular function differs based on sleep duration in chronic insomnia patients.
Methods: Participants were 189 adults (Mage = 49.8 years, SD = 11.8; 63.5% female) who met diagnostic criteria for insomnia. Objective sleep duration was based on total sleep time averaged across two consecutive nights of polysomnography (PSG). The sample was divided into two groups based on sleep duration - shorter (n = 48) or longer (n = 141) than 6 hours. Electrocardiogram data (2-min epochs) derived from PSG were edited and analyzed to obtain HRV during N2, N3, and rapid-eye movement (REM) sleep. HRV measures included high frequency (HF), an index of parasympathetic activation, and the ratio of low to high frequency (LF/HF ratio), an index of sympathovagal balance.
Results: Compared to insomnia patients with NNSD, those with SSD had significantly reduced HF-HRV during N2 (45.2 *vs.* 40.8, $p<.001$) and REM sleep (34.1 *vs.* 32.2, $p=.007$). Additionally, insomnia patients with SSD had significantly greater LF/HF ratio during N2 (1.12 *vs.* 1.06, $p=.002$) and REM sleep (1.26 *vs.* 1.21, $p=.009$) compared to insomnia patients with NNSD. No significant differences in N3 were found between phenotypes.
Conclusion: Overall, insomnia patients with objective SSD showed significantly dampened parasympathetic activation and elevated sympathovagal imbalance relative to their counterparts with NNSD. It is posited that the pathophysiological responses related to short sleep may exacerbate a nocturnal stress response, expediting the progression of cardiovascular morbidity. These findings highlight the importance of treating insomnia, as treatment may reduce risk of cardiovascular disease.
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0290

DIFFERENTIAL RELATIONSHIPS BETWEEN CATEGORICAL VERSUS DIMENSIONAL MEASURES OF INSOMNIA AND REWARD CIRCUITRY FUNCTION

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Introduction: Insomnia is a prominent risk factor for affective disorders, but the functional neural mechanisms underlying this relationship remain poorly understood. As affective disorders are characterized by functional abnormalities within neural circuitry supporting reward processing, it is possible that altered reward processing may link insomnia and affective disorders. This study examined insomnia - defined as both a categorical and dimensional construct - as a predictor of reward-related brain activation.
Methods: 56 young adults (Age 24.4±2.9yr; 28 Female) were recruited across a range of sleep disturbance using the PROMIS-Sleep Disturbance scale (PSD). Participants completed clinical interviews, rating scales, sleep diary, actigraphy, and the Monetary Incentive Delay fMRI task. This fMRI task involves anticipation and receipt of monetary gains and losses of varying magnitude. DSM-5 insomnia (N=13) was diagnosed via clinical interview. Dimensional insomnia measures included a self-report scale of insomnia severity [PSD], sleep diary-derived minutes spent awake after sleep onset [WASOs], and actigraphy-derived WASO [WASOa]. Mean BOLD activation during gain anticipation (versus no gain) was extracted from 3 bilateral anatomical regions of interest (ROIs) previously associated with reward function: nucleus accumbens[NAcc], anterior insula[AIns] and mesial prefrontal cortex[mPFC]. For each ROI, BOLD response was assessed as a function of insomnia diagnosis, PSD, WASOs, and WASOa (adjusting for age and sex).
Results: Greater WASOa was related to greater mPFC activation (B=0.29,p=0.033). Insomnia diagnosis was associated with reduced NAcc activation at the trend level (B=-0.23,p=0.079). PSD and WASOd were not related to activation within the NAcc, AIns, or mPFC.
Conclusion: Insomnia is associated with reward-related activations in brain regions implicated in affective disorders, though these relationships differ based on how insomnia is quantified. Using additional task-based and resting-state fMRI data collected in this study sample, future analyses will further characterize insomnia-related functional abnormalities in neural circuits supporting positive and negative affect.
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0291

ASSOCIATION BETWEEN STRESS-INDUCED AROUSAL AND NOCTURNAL SLEEP

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Introduction: Stress and hyperarousal contribute to insomnia. Elevated sleep reactivity, characterized by increased sensitivity in physiological stress response and sleep system, might also constitute a vulnerability to hyperarousal and future insomnia. The present study examined acute stress-induced arousal and its impact on sleep.
Methods: Participants (26.7±5.3 years; 66.7% female) were adults with insomnia (INS; $n=10$) and good sleepers ($n=20$). Based on the Ford Insomnia Response to Stress Test (FIRST=20), good sleepers were further sub-divided into high vulnerability (HV; $n=10$) and low vulnerability (LV; $n=10$) to insomnia groups. Participants underwent two nights of polysomnography. On the stress condition night, the Trier Social Stress Test (TSST) was administered. Physiological arousal variables included salivary cortisol, heart rate (HR), heart rate variability (HF, LF/HF ratio), and blood pressure. Subjective arousal was assessed with the Pre-Sleep Arousal Scale.
Results: Cortisol, HR, and systolic blood pressure were significantly elevated in response to the TSST in all groups (all $ps<.05$). The INS group had greater total cortisol secretion ($p<.05$) and increased cortisol reactivity ($p<.05$) compared to the LV group across the test period. The INS group also reported greater pre-sleep cognitive arousal ($p<.01$) and had elevated cortisol secretion at bedtime ($p<.05$) than the LV group. No significant differences on these measures were observed between the HV and INS groups. Further, cortisol stress response ($r=.41$, $p=.030$) and elevated LF/HF ratio ($r=.39$, $p=.039$) were each significantly associated with longer nocturnal awakenings. Increased blood

pressure was associated with longer sleep onset latency (*ravg*=.43, *p*< .05) and reduced sleep efficiency (*ravg*=- .41, *p*< .05).
Conclusion: Overall, participants with insomnia showed greater acute cortisol response and (subjective and physiological) bedtime hyperarousal than the LV group but not compared to the HV group. Elevated stress-induced arousal is associated with increased sleep disruptions. These findings support the hyperarousal conceptualization of insomnia and suggest that increased stress reactivity and hyperarousal might represent a trait-like vulnerability in certain good sleepers. More research is warranted to validate and expand our preliminary findings.
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0292

STRESS AND STRESS-RELATED SYMPTOMS AMONG TAIWANESE PRIMARY FAMILY CAREGIVERS IN INTENSIVE CARE UNITS

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Introduction: Primary family caregivers (PFCs) in the intensive care unit (ICU) experience stress and stress-related symptoms (e.g., sleep disturbances and fatigue), which could affect their health and care quality of their care recipients. The vulnerability of PFCs could become a risk factor to develop posttraumatic stress disorder (PTSD). This study aimed to: 1) explore the associations between ICU hospitalization event stress and stress-related symptoms (i.e., sleep disturbances, fatigue); 2) identify the predictors for sleep disturbance and fatigue among PFCs.
Methods: *Lazarus and Folkman's* Stress-Coping theory was used to guide for this descriptive correlational study. A total of 72 PFCs, from a teaching hospital in Taiwan, completed a battery of questionnaires within the first two weeks while their care recipient was cared in the ICU, to measure their event stress perception, sleep disturbance, and fatigue severity. Social support and demographic data were also obtained as confounding variables.
Results: The mean age of the PFCs was 49.2 (SD=10.9) and the majority of them were female (62.5%), and patient's child (68.1%). These PFCs perceived high stress level (M= 33.2, SD=16.9) as indexed by Impact of Event Scale-revised, indicating high risk of PTSD. They also reported clinically significant poor sleep quality (M= 3.5, SD=1.6) and fatigue severity (M= 3.7, SD=2.6). On average, they had 6 sources of social support, and usually came from family members (58.4%). Those PFCs who perceived higher stress also reported more sleep disturbances (*r*= .59, *p*< .05) and severe fatigue (*r*= .54, *p*< .05). Female, younger age, higher self-ratedcare recipient's disease severity, lower social support and higher stress perception accounted for sleep disturbance and fatigue 36.2% and 30.1%, respectively. Perceived event stress is the only significant predictor for fatigue while age along with perceived event stress are the significant predictors for sleep disturbance.
Conclusion: The PFCs experienced high stress, poor sleep quality and severe fatigue and these warrant further stress-coping interventions to reduce stress-related symptoms. Social supports buffer stress in Western society; however, it was not in this study, which call for further research, particularly in the area of cultural variance.
Support (If Any):

0293

SAVORING IS UNIQUELY AND INVERSELY ASSOCIATED WITH SLEEP DISTURBANCE AND SLEEP-RELATED IMPAIRMENT

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Introduction: Rumination and other negatively-valenced forms of repetitive thought have been identified as having the potential to impede sleep. Positive forms of repetitive thought, such as mindfulness, have received growing attention in the sleep literature, yet there remains a relative lack of research examining how other forms of positive thought relate to sleep. Savoring is a form of positive repetitive thought characterized by attendance to positive affective experiences. Though previously proposed as a potential sleep-promoting behavior, savoring has not been extensively examined as a correlate of sleep outcomes. Acknowledging the close link between sleep and cognitive and emotional experiences, the present study aimed to explore the associations of rumination and savoring (i.e., negative and positive thought forms) with subjective sleep outcomes.
Methods: Participants were 216 adults aged 20 to 80 years old (M=44.9 years, SD=15.6 years). Study materials were completed online at a single time point. Trait rumination was measured using the Ruminative Thought Style Questionnaire. Savoring was measured using the Savoring Beliefs Inventory. Sleep outcomes were assessed using the respective 8-item NIH PROMIS measures of sleep disturbance and sleep-related impairment.
Results: Multiple hierarchical regression was used to test study aims. Age, sex, and self-rated health were covariates. Whereas higher trait rumination was associated with greater sleep disturbance (β=2.5, p<.001) and sleep-related impairment (β=2.8, p<.001), higher savoring beliefs were associated with less sleep disturbance (β=-1.3, p=.01) and sleep-related impairment (β=-1.6, p=.001).
Conclusion: The present findings corroborate existing literature associating ruminative tendencies with poorer sleep outcomes and provide new support for the unique association of savoring with positive sleep outcomes in an age-diverse, adult sample. Future work discerning the causal and temporal associations of savoring and sleep is warranted, and may provide insight into the utility of incorporating savoring practices into sleep interventions.
Support (If Any): This research was supported in part by a grant to the first author from the American Psychological Association.

0294

RESILIENCE, EMOTION AND AROUSAL REGULATION IN INSOMNIA DISORDER

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Introduction: According to the diathesis-stress model of insomnia, a vulnerability to developing it may lead to insomnia in response to stress. Recently, there has been a paradigm shift in the understanding of resilience in context of stress- risk-vulnerability dimension. Resilience is a psychobiological factor which determines individual's capacity to adapt successfully to stressful events. Lower level of resilience increases vulnerability for developing mental disorders. Beacuse emotion and arousal regulation is a key factor in insomnia the aim was to explore the level of resiliency in subjects with insomnia and its relationship with emotion and arousal regulation.

Methods: The study consisted of 48 subjects with Insomnia disorder according to the DSM-5 and 35 good sleepers. Insomnia Severity Index (ISI), Resilience Scale for Adults (RSA), Difficulties in Emotion Regulation Scale (DERS), Pre-sleep Arousal Scale (PSAS) were administered while controlling for anxiety and depressive symptoms. Differences in means between groups were assessed using t-test or Mann-Whitney U/Wilcoxon test. Univariate/ multivariate regression analyses and mediation analyses were performed.
Results: Subjects with Insomnia (F 24, mean age 49±2.1) presented higher ISI, RSA, DERS and PSAS scores than good sleepers (F 22, mean age 47.2±1.2) (ISI: 15.7±5.8 vs 5.1±0.6, p<.01; RSA 96.2±9.5 vs 45±15, p<.01; DERS: 83.1±3.3 vs 24.1±12.1, p<.01; PSAS Cognitive 23.3±11 vs 10±0.6, p<.01, PSAS Somatic 16.1±7 vs 10.2±1.2, p<.01). After controlling for anxiety/depressive symptoms, low level of resiliency correlated to DERS Impulse control difficulties (B=0.5, p=0.008) DERS Limited emotion regulation strategies (B=0.35, p=0.008) and PSAS Cognitive (B=0.42, p=0.003). Impulse control difficulties mediated the relationship between low level of resilience and cognitive hyperarousal-PSAS Cognitive (Z=2.03, SE=0.08, p=0.04).
Conclusion: *Subjects with insomnia show low level of resilience that is considered* a mechanism of successful adaptation to stressors. In insomnia, low level of resilience is related to emotional deregulation and to cognitive hyperarousal. In particular, impulse control difficulties may mediate the relationship between lack of resilience and cognitive hyperarousal in subjects with insomnia. If resilience helps to minimize the extent of pathogenesis in developmental process an early identification of vulnerable candidates should be useful for preventing insomnia development and mainteinance.
Support (If Any): no support.

0295

RECURRENT INSOMNIA-"BIPOLAR SLEEP" OR MIRROR IMAGE OF THE KLEINE-LEVIN SYNDROME?

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Introduction: Patients with untreated bipolar disorder show simultaneous cycling of mood and sleep across a range of time scales (insomnia with hypomania or mania, hypersomnia with depression). A unique pattern of recurrent insomnia is described, where sleep cycles but mood does not. These patients have no hypersomnia or hyperphagia which characterize the Kleine-Levin syndrome (KLS).
Methods: Polysomnography, actigraphy, sleep logs and clinical data was collected from 7 patients with recurrent insomnia. Demographic information, sleep and mood patterns, duration of sleep cycling, polysomnographic metrics, comorbid conditions, and therapeutic response to lithium response were recorded. All patients are currently actively followed in the sleep clinic at the Beth Israel Deaconess Medical Center, Boston, MA, USA.
Results: Seven patients (age range: 32–69; gender: 78% males) were identified with recurrent insomnia. Sleep durations fluctuated from 2 to 20 hours; 4/7 patients never cross the threshold to hypersomnia. The first identified patient cycled from no sleep for 3–4 nights to 4–5 hours sleep for 4–5 nights, for over 20 years, which normalized with 150 mg lithium. A diagnosis of remote bipolar disorder (1/7) and depression (3/7) was noted. Eighty five percent had sleep disordered breathing (AHI range 3.7–221.89; RDI range 18–262.64), but treated with positive airway pressure. Sleep duration cycling ranged from 0 to 20 hours with total mean sleep time of 12.5 hours. Sleep staging showed mean N1 of 12.14%, N2 of 61.61%, N3 of 12.8 and REM sleep ranging from 1.8–23.3%. No patients showed cyclic mood changes during the period of recurrent insomnia or when switching to relative hypersomnia. Five patients were started on lithium (dose range 150mg-450mg) and has shown marked improvement in recurrent insomnia.
Conclusion: A relatively unique syndrome of recurrent insomnia is described, with cycling reminiscent of bipolar disorder but with stable mood; there are some similarities to KLS. So far the disorder has proven to be sensitive to low dose lithium, (serum levels between 0.2 to 0.3mg/dl) which is considered sub-therapeutic for bipolar disorder. KLS can respond to lithium. Recurrent insomnia may reside within a spectrum of "cycling" disorders which include bipolar disease and KLS.
Support (If Any): None.

0296

PRE-SLEEP COGNITIVE ACTIVITY IN PATIENTS SUFFERING FROM INSOMNIA DISORDER, MAJOR DEPRESSION WITH INSOMNIA AND GOOD SLEEPERS

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Introduction: Pre- Sleep Cognitive Activity (PSCA) consists of worry, intrusive thoughts and a racing mind before going to sleep; PSCA has been considered as a precipitating/perpetuating factor of insomnia. Considering the comorbidity between insomnia disorder (ID) and major depression (MD), it is important to know if the PSCA operates in a similar way when both conditions are present and if it is related to the practice of sleep hygiene (SH). Therefore the aim of this study was to compare the PSCA among patients with ID, patients with MDI and individuals considered GS. We also explored the association between the SH and the PSCA between the different groups.
Methods: Three groups of participants were selected: 35 individuals with ID, 33 with MDI and 34 considered GS. Diagnosis (or its absence) was established by the Mini International Neuropsychiatric Interview. Subsequently the participants fulfilled the following questionnaires: Insomnia Severity Index, Pittsburgh Sleep Quality Index, the Quick Inventory of Depressive Symptomatology (16-item) (Self Report), Pre-Sleep Arousal Scale (PSAS), and the Sleep Hygiene Practice Scale. Descriptive statistics were used for socio-demographic and clinical characteristics; One- way ANOVA was conducted for comparison between groups and Pearson´s Coefficient Correlation to assess relation between PSAS and SH.
Results: No significant differences were found between the groups in age and gender. Subjects in the MDI group showed higher scores on the cognitive component of the PSAS (47.6±10.9) than those with ID (31.47±8.9) and these in turn had a higher score than the GS (20.73±4.4) (F84.9, gl 2, p= <0.001). The PSCA was significantly correlated with the SH in the whole sample (r=0.65, p= < 0.001). When analyzing the data by group, only subjects with ID and GS showed a correlation between PSCA and SH (r= 0.42, p=0.01; r=0.44 p=0.008).
Conclusion: Individuals with MDI have higher PSCA than those with ID and GS. But only in the last two groups there was a positive relation between PSCA and SH.
Support (If Any): None.

0297

THE EFFECT OF COGNITIVE-BEHAVIORAL THERAPYON INTRINSIC FUNCTIONAL CONNECTIVITY IN PATIENTS WITH PSYCHOPHYSIOLOGICAL INSOMNIA: A RESTING STATE FMRI STUDY

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Introduction: We evaluated the changes of intrinsic resting-state functional connectivity (FC) in response to cognitive behavioral therapy for insomnia (CBTi) in patients with psychophysiological insomnia (PI).
Methods: Thirteen patients with PI (age 51.0±10.2, 10 women) underwent resting-state functional MRI scans both before and after CBTi consisting of 5 sessions without medication for FC analysis with the frontostriatal regions as seed regions by the Harvard-Oxford Atlas. Self-reported sleep scales were evaluated before and after CBT-I, respectively. Sleep parameters were calculated according to sleep diaries recorded by the patients before and after CBTi, respectively. Scores of Beck Depression Inventory were adjusted in all of the analyses.
Results: After CBTi, FC decreased between the prefrontal cortex and occipital cortex, precuneus, motor-somatosensory cortices but increased between the prefrontal cortex and posterior cingulate cortex. After CBTi, FC decreased between the medial frontal regions (anterior cingulate cortex, paracingulate cortex) and motor-somatosensory, lateral occipital cortices but increased between the left orbitofrontal cortex and both left putamen and pallidum. After CBTi, FC decreased between the right thalamus and right superior parietal cortex; left putamen and right superior frontal, left supplementary motor area whereas increased between the left caudate and left supramarginal cortex; the left hippocampus and left frontal pole, left supramarginal, right paracingulate cortices; the left accumbens and the left precentral, right occipital fusiform cortices. After CBTi, changes in measures of sleep parameters by sleep diaries and sleep scale scores significantly correlated with FC change between the frontoparietal cortex and subcortical regions including the striatum, thalamus, hippocampus, accumbens, and insular.
Conclusion: Frontostriatal network have been hypothesized to be a key pathway in the sleep-wake cycle. Current results suggest the frontostriatal network to be involved in the neurobiological mechanisms of CBTi by regulating hyperarousals, emotional and cognitive processing.
Support (If Any): This research was supported by Basic Science Research Program through the National Research Foundation of Korea funded by the Ministry of Education (Study No.: 2013R1A1A2062517, Dr. Yu Jin Lee) and the Brain Research Program through the National Research Foundation of Korea funded by the Ministry of Science, ICT & Future Planning(Study No.: NRF-2016M3C7A1904336, Dr. Seog Ju Kim).

0298

CHANGES OF STROOP TASK-RELATED REGIONAL BRAIN ACTIVITY AFTER COGNITIVE BEHAVIORAL THRAPY FOR INSOMNIA IN PSYCHOPHYSIOLOGICAL INSOMNIA

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Introduction: Psychophysiological insomnia (PI) patients have an excessive preoccupation with sleep and attentional bias towards sleep, which results in conditioning to pair sleep-related information and autonomic arousal/emotional distress. However, there have been limited researches on cognitive attentional processes in the patients with PI. In the present study, we compared task-related regional brain activity between PI patients and good sleepers (GS) and between before and after cognitive behavioral therapy for insomnia (CBTi), during the traditional Color-Word Stroop Task (CWST) evaluating overall executive functions including selective attention and conflict processing.
Methods: 14 PI patients (10 females, 49.0±12.3 years old) and 18 GS (14 females, 42.7±12.3 years old) were included in this study. All participants underwent functional magnetic resonance imaging (fMRI) scanning during the CWST. CBTi consisting of 5 sessions without any psychopharmacological administrations was delivered to PI patients. After 5-session CBTi, fMRI scanning was repeated using the same tasks for PI patients.
Results: In the voxel-based whole brain analysis, PI patients showed increased task-related blood oxygen level-dependent (BOLD) signals in the right anterior cingulate cortex (ACC) compared to GS. After CBTi, task-related BOLD signals in the right precentral cortex, right thalamus, and right supramarginal gyrus were increased compared to before CBTi.
Conclusion: ACC was known as a region that detects conflicts and modulates attention. Increased activation in the right ACC may support that PI patients need more compensatory recruitment in this area to achieve the similar level of task performance relative to GS. Increased activities in the right precentral cortex, right thalamus, and right supramarginal gyrus after 5-week of CBTi probably suggests that regional activity of the CWST-related cognitive attentional networks might be reversibly restored by CBTi alone without medication.
Support (If Any): National Research Foundation of Korea (Study No.: 2013R1A1A2062517) and Brain Research Program through the National Research Foundation of Korea funded by the Ministry of Science, ICT & Future Planning (Study No.: NRF-2016M3C7A1904336).

0299

TWENTY-FOUR HOUR LIGHT EXPOSURE PATTERN AND SLEEP CONSOLIDATION IN INSOMNIA PATIENTS

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Introduction: There is much evidence that links insufficient light exposure to sleep fragmentation. Previous studies reported that the exposure to lower light levels predicted more nighttime awakenings. This study aims to compare light exposure profiles across 24h between

insomnia patients and normal controls, and to examine the relationship of light exposure pattern with sleep consolidation.
Methods: Participants were recruited from three Public Health Centers in a rural area of Korea. The actigraphy recording for 7 days was conducted for each subject. One hundred six insomnia patients (62.27 ± 12.29 years) and 80 normal control (NC) subjects (55.64 ± 13.25 years) were included for our analysis. The raw light data across 24h were log transformed and averaged into hourly bins. The durations of exposure to four different light levels (< 10, 10 to <100, 100 to <1,000, and ≥1,000 lux) and the area under curve (AUC) values of 24h light exposure were obtained. The association of the duration of exposure to each light level with the wake after sleep onset (WASO) severity was examined using multinomial logistic regression analysis.
Results: In 24h light exposure profiles, the light intensity during the hour preceding 04h and 07h in the insomnia group was significantly higher than that of the NC group ($p<0.05$). There was no significant difference in the duration of exposure to each light level and the AUC of 24h light exposure between the insomnia and NC groups. In the combined group, the AUC was negatively correlated with WASO($r=-.22$, $p<0.01$). The duration of exposure to each light level was not significantly associated with the presence of moderate and severe degree of WASO.
Conclusion: Insomnia patients were exposed to higher light intensity in early morning hours compared to normal controls, although the light intensity across daytime was not different between the two groups. The sleep consolidation in community-dwelling adults would not be associated with the time spent at a certain light intensity, but with the total amount of 24h light exposure.
Support (If Any): Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (2013R1A1A2009888).

0300

STRESS SYSTEM DYSREGULATION IN INSOMNIA DISORDER

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Introduction: Insomnia disorder (ID) is highly co-morbid with chronic pain conditions. Dysregulation of the hypothalamus-pituitary adrenal (HPA) stress system suggests a contribution to both ID and chronic pain. We investigated HPA system integrity in individuals with ID, indicated by measures of resting cortisol levels and IL-6 expression in monocytes, glucocorticoid (GC) sensitivity (i.e., sensitivity of cells to the counter-inflammatory signal cortisol), and reactivity of cortisol to a repeated challenge. We hypothesized deterioration of HPA system integrity may represent a mechanistic pathway by which ID increases chronic pain vulnerability.
Methods: This is an ongoing study with N=19 participants (ages 18–49). Seven participants (1 male) diagnosed of insomnia disorder (ID) based on DSM-V criteria and 12 healthy controls (HC;3 male) completed an overnight polysomnographic (PSG) sleep recording in the Clinical Research Center. The following morning, resting blood samples were collected for measurements of basal serum cortisol levels, IL-6 positive monocytes, and GC sensitivity of monocytes as assessed by flow cytometry. To determine serum cortisol reactivity, participants completed a cold pressor test (CPT) challenge three times in succession (1300,1430,1600) by placing their hand in a temperature-controlled cold water bath for at least one minute. Blood was drawn 20 and 50 minutes after each CPT to measure post-challenge cortisol levels.
Results: ID participants had significantly shorter PSG sleep duration (ID:341 ± 110 min; HC:422 ± 31 min). Basal cortisol levels, IL-6 positive monocytes and GC sensitivity did not differ between groups, but cortisol levels in the ID group were significantly higher 20 min (ID:14.24 ± 3.34μg/dL; HC:10.86 ± 2.38μg/dL) and 50 min (ID:11.46 ± 2.40μg/dL; HC:8.99 ± 2.04μg/dL) after the first CPT challenge, and 20 min after the second CPT challenge (ID:11.24 ± 3.59; HC:7.92 ± 1.59μg/dL).
Conclusion: While basal levels of cortisol, IL-6 expression by monocytes, and GC sensitivity did not significantly differ between ID and HC cortisol reactivity in the first and second CPT challenge was increased. These preliminary results suggest a stronger stress system responsiveness to novel challenges, which may mechanistically contribute to the relationship between ID and vulnerability to chronic pain.
Support (If Any): Investigator-initiated grant from Merck Inc., NIH/UL1 RR02758 and M01-RR-01032 from National Center for Research Resources to Harvard Clinical and Translational Science Center.

0301

ALTERED INTRINSIC FUNCTIONAL CONNECTIVITY OF FRONTOSTRIATAL REGIONS IN PATIENTS WITH PSYCHOPHYSIOLOGICAL INSOMNIA: A RESTING-STATE FMRI STUDY

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Introduction: Insomnia has been characterized by state of hyperarousal. Patients with psychophysiological insomnia (PI) worry excessively about not being able to sleep. It disturbs relaxation and PI patients are less and less likely to fall asleep. In current study, we aimed to investigate intrinsic functional connectivity in patients with PI, especially in frontostriatal regions which is known as major nodes of circuit associated with arousal regulation.
Methods: Thirteen patients with psychophysiological insomnia (51.0 ± 10.2y, 10 females) and 18 healthy good sleepers (42.7 ± 12.3y, 14 females) underwent resting-state functional MRI scan. We implemented seed-to-voxel functional connectivity analysis using the Harvard-Oxford Atlas as frontostriatal seed regions.
Results: Compared with the good sleepers, PI patients showed increased frontal connectivity with the right lateral occipital, right occipital fusiform, right/left lingual gyrus and left amygdala. In addition, increased connectivity between right thalamus and right superior frontal, between right thalamus and right frontal pole, and between right pallidum and precuneus showed in PI patients. Decreased functional connectivity found between right caudate and right frontal pole, and between right pallidum and left lateral occipital in PI patients compared with the good sleepers. The strength of connectivity between the right pallidum and the precuneus in PI patients was positively correlated with the PSQI score ($r = .67$, $p < .05$).
Conclusion: Current findings provide changes of intrinsic functional connectivity between various corticostriatal regions in patients with psychophysiological insomnia. Particularly, increased couplings with frontal cortex may support the hyperarousal theory in psychophysiological insomnia.
Support (If Any): This research was supported by Basic Science Research Program through the National Research Foundation of Korea funded by the Ministry of Education (Study No.: 2013R1A1A2062517) and the Brain Research Program through the National Research Foundation of Korea funded by the Ministry of Science, ICT & Future Planning (Study No.: NRF-2016M3C7A1904336).

0302

NOCTURNAL BLOOD PRESSURE AND HEART RATE IN NORMOTENSIVE INSOMNIA PATIENTS

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Introduction: While sleep-wake cycles are known to affect cardiovascular functions, there is little information on nocturnal blood pressure (BP) and heart rate (HR) in patients with chronic insomnia. Given that insomnia is a risk factor for hypertension, the aim of the present study was to explore BP and HR patterns over the course of the night in normotensive patients with chronic insomnia.

Methods: Fourteen adults (M_{age} = 37.5 ± 12.3 years old; 71.4% women, IMC = 24.2 ± 4.9) with chronic insomnia participated in this study. They underwent two nights of baseline ambulatory polysomnography (PSG) using standard montage. In addition, pulse transit time (PTT) and EKG beat-to-beat measures via three-lead EKG were measured continuously throughout the night to obtain blood pressure (systolic and diastolic; SBP, DBP) and HR, respectively. Using data from the second PSG night, sleep was visually scored (WAKE, N1, N2, N3 and REM) and divided into three sleep periods (first, middle, last) throughout the night.

Results: The lowest DBP and SBP values were observed during N2 compared to other sleep stages (mean DBP: 72.2 vs 72.7–75.2, p<.0001; mean SBP: 113.9 *vs* 115–116.5, p =.01), and during the last sleep period (DBP 71.5 vs 72.8–74.5; p=.0007; SBP 112.4 vs113.6–116.9; p=.004). SBP was also significantly reduced in N3 during the middle sleep period (111.5 vs 112.8–115.3, p=.003). Similarly, HR was lowest during N2 (62.6 *vs* 64.4–69.0, p<.0001), especially during the middle sleep period (63.2 vs 65.1–67.5, *p*=.004). HR during REM sleep was lower during the late compared to early sleep periods (63.3 vs 65.4–66.9, p=0.02).

Conclusion: The lowest values for BP and HR were obtained during N2, particularly during the last sleep period. This pattern of sleep-related cardiovascular changes is different from that typically observed in good sleepers, which may suggest increased sympathetic activation during the earlier part of the night among individuals with chronic insomnia. Additional studies are needed to examine blood pressure and heart rate changes during sleep in order to document further the long-term cardiovascular risks associated with chronic insomnia.

Support (If Any): Canadian Institutes of Health Research (MOP42504) and Fonds de recherche du Québec - Santé (32207).

0303

INSECURE ATTACHMENT STYLE IS RELATED TO EMOTION DEREGULATION AND HYPERAROUSAL IN INSOMNIA

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Introduction: Cognitive theories provided evidence about the influence of unhelpful cognitive processes in the development and maintenance of insomnia, whereas interpersonal theories, which emphasize the role of interpersonal factors, have been less studied in insomnia. Attachment theory is one of the integrative theories that can be used as a cognitive-interpersonal framework for understanding the development and maintenance of insomnia. Attachment insecurity (vs security) is related to emotion deregulation in psychiatric disorders. Because, emotion and arousal regulation is a key factor in insomnia, the aim was to study the possible association between the attachment style and these factors, using a set of variables.

Methods: The study consisted of 51 subjects with Insomnia disorder according to the DSM-5 and 35 good sleepers. Insomnia Severity Index (ISI), Attachment Style Questionnaire (ASQ), Difficulties in Emotion Regulation Scale (DERS), Pre-sleep Arousal Scale (PSAS) were administered while controlling for anxiety and depressive symptoms. Differences in means between groups were assessed using t-test or Mann-Whitney U/Wilcoxon test. Univariate/ multivariate regression analyses and mediation analyses were performed.

Results: Subjects with Insomnia (F 26, mean age 48 ± 2.3) presented higher ISI, ASQ, DERS and PSAS scores than good sleepers (F 22, mean age 47.2 ± 1.2) (ISI: 16.1 ± 5.8 vs 5.1 ± 0.6, p<.01; ASQ: 114.2 ± 23.8 vs 56 ± 12, p<.01; DERS: 85.1 ± 3.1 vs 24.1 ± 12.1, p<.01; PSAS Cognitive 22.3 ± 10 vs 10 ± 0.6, p<.01, PSAS Somatic 15.1 ± 7 vs 10.2 ± 1.2, p<.01). After controlling for anxiety/depressive symptoms, insecure anxious-preoccupied attachment style was correlated to emotion deregulation-DERS (B=0.10, p=0.007), especially to non-acceptance of emotional responses (B=0.59, p=0.02), and to difficulties in engaging in goal directed behaviour (B=0.61, p=0.04). It also related to somatic hyperarousal-PSAS Somatic (B=0.37, p=0.04). Emotion deregulation-DERS mediated the relationship between insecure attachment and somatic hyperarousal-PSAS Somatic (Z=2.18, SE=0.07, p=0.02).

Conclusion: *Subjects with insomnia show insecure attachment style,* they seem anxious and preoccupied with relationships. Insecure attachment in subjects with insomnia seems to favor emotion deregulation and pre sleep hyperarousal. Especially, emotion deregulation may intervene in the relationship between insecure attachment and hyperarousal in insomnia. An interpersonal evaluation should be considered when dealing with insomnia; it may be useful for optimizing CBT-Insomnia treatment.

Support (If Any): any

0304

EVIDENCE OF BLUNTED PHYSIOLOGICAL RESPONSES TO ACUTE STRESS IN WOMEN WITH INSOMNIA IN THE MENOPAUSAL TRANSITION

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Introduction: Stress is a well-recognized factor implicated in the pathophysiology of insomnia; however, it is unknown whether women with insomnia developed in the context of the menopausal transition have altered stress responses.

Methods: We investigated cortisol and cardiac autonomic responses to an acute experimental stress (Trier Social Stress Task, TSST) in perimenopausal women with (n = 22, age: 50.95 ± 2.82 years) and without (n = 16, age: 48.81 ± 3.12 years) insomnia. After a night in the laboratory, participants completed the TSST, a well-established psychosocial stress protocol. Electrocardiograph was continuously recorded and saliva was taken at intermittent intervals before and after the task for cortisol analysis. Participants were tested in the luteal phase of the menstrual cycle if they were still cycling or on a random day if they had unpredictable cycles; progesterone was used as a covariate.

Results: There were no group differences in task-related perceived stress or in the cortisol stress responses. Women with insomnia showed a smaller increase in heart rate (HR) (i.e. smaller HR reactivity,

p=0.02), associated with a smaller drop in total heart rate variability (p=0.006) during the speech task, compared with controls. HR during baseline and recovery did not differ between groups. Progesterone was a significant factor in HR models, with higher HR associated with higher progesterone during the stress task (p=0.038), although progesterone was not a significant factor for task reactivity. Stress exposure was associated with one or more physiological hot flashes in a portion of women symptomatic for hot flashes.

Conclusion: Women with insomnia that developed in the menopausal transition have blunted cardiac activation in response to an acute stressor, suggesting altered physiological reactivity to stress. This altered autonomic function might be pre-existing or developed as a consequence of sleep disruption and/or other symptoms in the menopausal transition.

Support (If Any): HL103688.

0305

SYMPATHONEURAL AND CARDIOVASCULAR HYPERAROUSAL IN CHRONIC INSOMNIA

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Introduction: Recent epidemiological studies suggest that insomnia is associated with heightened cardiovascular risk, but underlying physiological mechanisms remain unclear. The present study examined sympathetic neural and cardiovascular regulation in clinically diagnosed insomniacs and controls. Consistent with the hyperarousal theory of insomnia, we hypothesized that insomniacs would demonstrate higher sympathetic neural outflow, blunted baroreflex control, and augmented neural cardiovascular reactivity to stress when compared to matched controls.

Methods: Thirteen insomniacs (40±4 years, 24±1 kg/m2) and 15 matched controls (35±3 years, 26±1 kg/m2; p>0.05) participated in an overnight laboratory polysomnography to exclude obstructive sleep apnea and other sleep disorders, two weeks of at-home actigraphy, and an overnight laboratory visit with an autonomic function test the subsequent morning. The autonomic function test included simultaneous recordings of heart rate (electrocardiogram), beat-to-beat blood pressure (finger plethysmography), and muscle sympathetic nerve activity (MSNA; microneurography) during 10 min supine baseline and 2 min cold pressor test.

Results: Baseline blood pressure, heart rate, and MSNA were not different between insomniacs and controls (p>0.05), but sympathetic baroreflex sensitivity was significantly blunted in insomniacs when compared to controls (-2.1±0.3 vs. -4.3±0.4 bursts/100 heart beats/mmHg; p<0.001). During cold pressor test, systolic blood pressure (Δ20±3 vs. Δ11±2mmHg; time × group = 0.031) and total MSNA (Δ131±29% vs. Δ65±17%; time × group = 0.038) reactivity were significantly augmented in insomniacs compared to controls. Heart rate reactivity to cold pressor test was not different between insomniacs and controls (Δ10±4 vs. Δ9±3 beats/min; time × group = 0.677).

Conclusion: Patients with insomnia demonstrated a blunted sympathetic baroreflex and augmented MSNA and blood pressure responsiveness to cold pressor test compared to matched controls. These findings support growing evidence of increased cardiovascular risk and physiological hyperarousal with chronic insomnia.

Support (If Any): Supported by Merck Investigators Studies Program.

0306

MULTISCALE ENTROPY OF NOCTURNAL HEART RATE IN CONJUNCTION WITH POLYSOMNOGRAPHY: A NOVEL APPROACH TO UNDERSTAND PHYSIOLOGICAL COMPLEXITY IN INSOMNIA

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Introduction: Insomnia is the most prevalent sleep disorder and one of the most common complaints in primary care. Despite this, the pathophysiology underpinning insomnia complaints are still poorly understood. There have been numerous attempts to investigate the possibility of nocturnal heart rate (HR) and its variability as physiological hallmarks of the hyperarousal experienced in insomnia, with mixed results.

Methods: We employed Multiple Scale Entropy analysis (MSE) of HR, a known hallmark of complexity in cardiac system controls, in conjunction with home polysomnography (PSG) over two nights, to investigate patterns of HR complexity across sleep stages in 23 students with subthreshold insomnia (ISI>9) and 20 good sleepers (18–30 years, gender matched). MSE was computed over multiple temporal intervals (scale factors) derived from uninterrupted periods of HR. Linear mixed models were fit for each sleep stage using scale factors as the outcome measures.

Results: We found a significant group X sleep stage interaction in the prediction of nocturnal HR ($F_{(41343, 5)}$) = 159.7, p<0.0001). Entropy-based trends revealed a *decrease* in entropy with increasing time series length in insomnia, while entropy *increased* with time series length in good sleepers. Significant differences in entropy were observed at scale 18 for Stage 2 sleep and in scales 9, 10,12,13,14 and 18 in Stage 3 (p= 0.023) and at scales 10 and 12 (p=0.011) in REM sleep between groups.

Conclusion: Our results indicate that the biological complexity of the HR signal significantly differs between the groups as coarse-grained time series become progressively more regular and less complex for the insomnia group across different stages of sleep. This could be a signal of degradation of control mechanisms over long time scales. MSE analysis of HR data, in conjunction with PSG, appears a promising avenue for distinguishing biological complexity in insomnia populations.

Support (If Any): The study is supported by both the Medical Research Council (studentship to JC) and a Wellcome Trust Strategic Award (098461/Z/12/Z) to the Oxford Sleep and Circadian Neuroscience Institute (SCNi).

0307

PHYSIOLOGICAL AND PSYCHOLOGICAL HYPERAROUSAL IN HOT-FLASH ASSOCIATED INSOMNIA

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Introduction: Insomnia occurs commonly in women with hot flashes, who are at increased risk of cardiovascular disease. Insomnia disorder is often attributed to "hyperarousal," yet specific indices of hyperarousal have been inconsistently characterized. We therefore examined whether women with hot-flash associated insomnia demonstrate greater

psychological arousal or an exaggerated cardiovascular response to a physiologic stressor consistent with the hyperarousal hypothesis.
Methods: Healthy, non-obese perimenopausal and postmenopausal women (n = 23) with hot flashes and a range of insomnia symptoms were enrolled. Insomnia symptom severity was reported via questionnaire (ISI) and one week of daily sleep diaries were collected to further describe insomnia. Cardiovascular responses to a laboratory-based 3-minute cold pressor task (CPT), a standardized nociceptive stimulus that generates consistently large increases in heart rate and blood pressure, were recorded. Average hemodynamic responses in RR interval (heart rate) and blood pressure were assessed as change from baseline. Anxiety was assessed by questionnaire (GAD-7). Correlations among variables were determined.
Results: The women (mean age 53±4 yrs) had frequent hot flashes (5.2±3.2 per 24 hrs) and a range of insomnia symptoms (ISI range 1−22, mean 11.4±5.8) and anxiety (GAD range 0–13, mean 2.5±3.2). Diary-reported sleep efficiency was low (mean 75.6±19.1%), and wake after sleep onset was prolonged (mean 63.2±61 min). Surprisingly, higher ISI was related to a smaller tachycardiac response to CPT (r=0.57, p<0.01). Anxiety was directly related to ISI (r=0.44, p=0.04) and modestly related to a smaller tachycardiac response (r=0.36, p=0.10).
Conclusion: These results suggest that hot-flash associated insomnia relates to increased anxiety, consistent with psychological hyperarousal, but a blunted hemodynamic response to a physiological stressor. Our findings may be consistent with prior work showing maladaptive blunted cardiovascular reactivity to challenge paradigms in those with anxiety and chronic stress. Further investigation of the seemingly paradoxical dampened physiologic response among women with hot flash-related insomnia is warranted.
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0308

SLEEP DISORDERS AND SLEEP LOSS ARE ASSOCIATED WITH OCCUPATIONAL BURNOUT IN FIREFIGHTERS

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Introduction: Occupational burnout is characterised by exhaustion, depersonalisation and low personal accomplishment related to work. Sleep loss and sleep disorders disrupt daily functioning and increase the risk of occupational burnout. Firefighters have a high prevalence of sleep disorders and are often exposed to sleep restriction due to their work schedules. The current study examined if sleep disorders and short sleep are associated with burnout in firefighters.
Methods: A national sample of US firefighters (n=6,933) completed the Maslach Burnout Inventory, including emotional exhaustion (EE), depersonalisation (DP), and personal accomplishment (PA). Firefighters self-reported habitual sleep characteristics and were screened for common sleep disorders. Multiple logistic regression models were used to examine associations between sleep disorders, sleep duration, and burnout.
Results: Almost half (43.7%) the firefighters exhibited high burnout on at least one subscale. Firefighters screening positive for insomnia were more likely to have high burnout on the EE (adjusted odds ratio 3.67, 95%CI 2.89–4.67), DP (2.15, 1.71–2.71) and PA subscales (2.15, 1.74–2.65, all $p<0.0001$). Those screening positive for obstructive sleep apnea were more likely to have high EE (3.08, 2.56–3.71), DP (2.00, 1.71–2.35, both $p<0.0001$) and PA (1.20, 1.07–1.34, $p=0.002$). Firefighters screening positive for shift work disorder were more likely to have high EE (2.60, 2.01–3.35), DP (2.49, 2.03–3.05, both $p<0.0001$) and PA (1.30, 1.07–1.60, $p=0.007$). Among all firefighters, those reporting short sleep (≤ 6 h) after working an overnight shift were more likely to have high burnout (EE 1.88, 1.59–2.23; DP 1.34, 1.17–1.54, both $p<0.0001$). When firefighters with a sleep disorder were excluded, those reporting ≤ 6 h sleep after an overnight shift were more likely to have high EE (1.55, 1.15–2.02, $p=0.003$).
Conclusion: Sleep disorders, in particular insomnia, increase the risk of high burnout on each subscale, most notably EE. Reduced sleep following an overnight shift, even in the absence of a sleep disorder, was also associated with increased risk of burnout. These findings highlight the importance of implementing interventions in fire departments that address sleep disorders and increase the opportunity for sleep to reduce burnout risk.
Support (If Any): FEMA Assistance for Firefighters Grants EMW-2007-FP-02197, EMW-2008-FP-02566.

0309

HIGHER MORNING FASTING PLASMA NEFA LEVEL IS ASSOCIATED WITH WORSE QUALITY OF SLEEP AMONG OVERWEIGHT MEN WITH CHRONIC INSOMNIA SYMPTOMS

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Introduction: High circulating non-esterified fatty acid (NEFA) level is an independent risk factor of type 2 diabetes and cardiovascular diseases. Recent study showed that sleep restriction elevated morning fasting NEFA among healthy adults, which implied a link between impaired sleep quality and NEFA. We investigated whether morning fasting NEFA level is associated with sleep parameters among overweight men with chronic insomnia symptoms.
Methods: The study involved 73 overweight and obese (body mass index ≥ 25.0) Finnish men aged 30–65 years, with insomnia symptoms for over three months. NEFA was measured from blood samples collected in the morning after overnight fasting. Seven-night sleep was measured by piezoelectric bed sensor and sleep diary within 14 days before blood sample collection. Other measurements included Basic Nordic sleep questionnaire, anthropometry, fat mass, energy expenditures, and dietary intakes. Pearson correlation, partial correlation, and analysis of variance were used for the relevant tests.
Results: NEFA was correlated with both objective-measured sleep onset latency (r = 0.245, P = 0.038), sleep efficiency (r= -0.326, P = 0.005) and subjective-reported frequency of difficulty initiating sleep (r= 0.287, P = 0.014). These correlations remained significant after adjusting for age, BMI, fat mass, total energy intake and expenditure (r = 0.304, P = 0.017; r = -0.269, P = 0.036; r = 0.284, P = 0.026, respectively).
Conclusion: Higher morning fasting NEFA level is independently related to longer sleep onset, lower sleep efficiency, and more frequent complaint of difficulty initiating sleep among overweight men with chronic insomnia symptoms.
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0310

INSOMNIA SYMPTOMS AGGRAVATES METABOLIC SYNDROME BY INCREASING GLUCOSE LEVELS: A POPULATION-BASED STUDY

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Introduction: Previous studies have suggested a relationship between metabolic syndrome (MetS) and sleep disturbances, such as obstructive sleep apnea and sleep deprivation. However, little is known about the potential interaction among MetS and insomnia. The aim of this study was to investigate the interaction effects between insomnia symptoms and MetS on sleep, metabolic and inflammatory parameters from a representative sample of an urban population.

Methods: This was a cross-sectional study that included a total of 1,006 individuals who fitted research criteria, answered questionnaires and underwent physical evaluation, polysomnography and blood collection for biochemical analysis. Insomnia and MetS were defined according to validated questionnaires and the National Cholesterol Education Program III, respectively, allowing the distribution of subjects into 4 groups: control (CTRL), insomnia symptoms (INS), MetS and MetS+INS.

Results: Insomnia increased the number of MetS positive criteria in the MetS+INS group, which showed an increase of 7.9% in the glucose levels compared to the MetS group. No significant changes in insulin sensitivity was found. Moreover, no interaction effects between MetS and insomnia symptoms were observed regarding sleep architecture, pro-inflammatory markers and cardiovascular parameters.

Conclusion: This study suggests that insomnia symptoms may potentiate some of the alterations in glucose metabolism caused by MetS. As insomnia complaints are highly prevalent in the general population, they should be assessed in clinical practice for better management and prevention of metabolic diseases.

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0311

DIFFERENCES IN ACTIVATION OF FEAR AND EXTINCTION CIRCUITRY IN INDIVIDUALS WITH PRIMARY INSOMNIA

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Introduction: Insomnia is a predisposing factor for anxiety disorders which are associated with fear extinction deficits. In good sleepers (GS) and persons with Primary Insomnia (PI), we examined neural activation in regions implicated in fear and extinction learning (amygdala, insula, anterior cingulate, vmPFC, hippocampus). We hypothesized that PI, relative to GS, would demonstrate abnormalities of fear- and/or extinction-learning networks.

Methods: Twenty-four participants completed diagnostic assessments and were classified as PI (N=12, 2males, average 32.9y) or GS (N=12, 2males, average 36y). Subjects underwent a validated fear conditioning/extinction paradigm in an fMRI scanner with simultaneous skin conductance responses recording. Functional activation during conditioning and extinction learning was quantified via BOLD signal. An ROI approach focused on a priori fear/extinction regions (cluster-determining threshold: p=0.005, cluster-size threshold:10 voxels). Contrasts compared GS and PI BOLD signal between the reinforced (CS+) and non-reinforced (CS-) conditioned stimuli at the beginning (early) and/or end (late) of learning as well as the CS+ between early and late time points.

Results: In responses to late vs. early CS+ across fear conditioning, GS showed greater activation in the left insula (cluster size: 68voxels) relative to PI. GS also showed greater activation than PI to CS+ vs. CS- in bilateral insula (R 176voxels, L 42vox) and dorsal ACC (dACC, 15voxels) in late conditioning. At early extinction, PI showed greater activation than GS to CS+ vs. CS- in the left insula (56vox) and dACC (56vox). However, in responses to CS+ vs CS- in late extinction, GS showed greater bilateral insula activation (R 50vox, L 61vox) relative to PI. In responses to late vs. early CS+ across extinction, GS again showed greater activation than PI in the left insula (32voxels) and rostral ACC (rACC, 10,38,18; 491voxels).

Conclusion: In PI, the lesser activation of fear-related structures during late fear learning phases and greater activation of these same structures during early extinction suggests disturbed encoding of fear memory. Greater rACC activation in GS across extinction learning suggests that GS may exert better top-down control over fear circuitry. A larger sample size is necessary to answer outstanding questions.

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0312

THE INSOMNIA SHORT-SLEEP PHENOTYPE: DOES ONE NIGHT OF LABORATORY SLEEP ACCURATELY CAPTURE THEIR HABITUAL SLEEP?

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Introduction: The insomnia-short sleep (ISS) phenotype has previously been characterized based upon one night of laboratory-based polysomnography (PSG). It is unknown if these individuals would be similarly classified based upon habitual sleep duration, as measured by sleep diaries or wrist actigraphy. Moreover, the stability of the ISS classification across multiple PSG nights is unknown. Our aim was to evaluate the agreement of ISS classification based on one laboratory-based PSG night compared to habitual diary- and actigraphy-assessed habitual sleep among adults diagnosed with insomnia. Our secondary aim was to examine whether ISS classification differed across multiple nights of PSG data.

Methods: 217 participants (58% female, 63.2±15.1 y) who met diagnostic criteria for insomnia were included in analyses. All had at least one PSG night, with 7–14 nights of diary and/or actigraphy data. A subset of the sample had second (n=170) and third (n=72) nights of PSG data. The ISS phenotype was classified using the criterion < 6 h of total sleep time (TST). Using this criterion and using the first PSG night as the referent classification, we calculated Cohen's Kappa statistic and percentage agreement between different methods of ISS classification.

Results: 58% of the sample was classified as the ISS phenotype based upon one night of PSG TST. There was 65% agreement in ISS phenotype classification between PSG and diary TST (ǀ=.28) and 57% agreement between PSG and actigraphy TST (ǀ=.22). There was 39% agreement in ISS phenotype classification between the first and second night of PSG TST (ǀ=.23) and 66% agreement between the first and third night of PSG for TST (ǀ=.31). All Kappa values indicated poor (<.20) to fair (0.21–0.40) agreement between different ISS classifications.

Conclusion: These results indicate low agreement between one PSG night and other methods of sleep assessment to classify the ISS phenotype, and low reliability of classification across PSG nights. This implies that the ISS phenotype may not reflect an individual's habitual sleep or a persistent or trait-like characteristic. Future research is needed to address this potential issue in methods of measurement for the ISS phenotype.
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0313

INSOMNIA WITH OBJECTIVE SHORT SLEEP DURATION AND ALL-CAUSE MORTALITY: SLEEP HEART HEALTH STUDY

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Introduction: Insomnia with objective short sleep duration has been associated with incident hypertension, cardiovascular disease, and mortality in men, suggesting it represents a more severe insomnia phenotype than insomnia with longer sleep duration. We examined the association of insomnia symptoms with polysomnographically-defined short sleep duration and all-cause mortality in both men and women.
Methods: We conducted a time-to-event analysis of Sleep Heart Health Study data. Baseline sleep questionnaires were administered and at-home polysomnography was performed between 1994 and 1998. Participants were followed for a median 11.4 years (Q1-Q3 8.8–12.4 years) until death or date of last contact. The primary exposure was insomnia with short sleep duration defined as: self-report of difficulty falling asleep, getting back to sleep, early morning awakenings, or use of a sleeping pill for 16–30 nights/month; and total sleep time of <6 hours on polysomnography. We used proportional hazards models to estimate the association between insomnia with short sleep duration and time to death.
Results: Among 4,994 participants (mean age 64.0 ± 11.1 years, 53.5% female), 14.1% reported insomnia, and 50.3% of these slept <6 hours. 255 deaths were observed. In an unadjusted analysis, insomnia with short sleep duration was significantly associated with mortality (HR 1.69; 95% C.I. 1.12, 2.55) relative to those without insomnia nor short sleep duration. After propensity-adjustment for age, sex, race, smoking, BMI, AHI, antidepressant medications, and history of CVD, insomnia with short sleep duration remained significantly associated with mortality (HR 2.05; 95% C.I. 1.35,3.11). Results did not differ substantively with adjustment for additional potential confounders and mediators. Sex-stratified analyses suggest similar estimates for men and women (p-value for interaction=0.36).
Conclusion: Insomnia with objective short sleep duration conferred elevated risk of all-cause mortality, providing further evidence that it represents a biologically vulnerable phenotype. Future studies should address potential mechanisms linking insomnia with short sleep duration to mortality.
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0314

NORMATIVE REFERENCES FOR THE SLEEP CONDITION INDICATOR: DERIVATIONS FROM A RANDOM SAMPLE OF 200,000 COMPLETERS

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Introduction: The Sleep Condition Indicator (SCI) was developed to screen for insomnia disorder based on DSM-5 criteria, and has been shown to have good psychometric properties. We gathered SCI data from a large sample of test completers to develop norm references to facilitate future use of the SCI in research and clinical settings.
Methods: A random sample of 200,000 persons (58% women, mean age 32 ± 13 years) was selected from those who had completed the SCI via several internet platforms. The SCI consists of 8 items which are scored on a 0 to 4 scale (range 0–32). A higher score indicates better sleep. These cross-sectional data were analysed by sex, 10-year age bands, and DSM-5 criteria for Insomnia Disorder.
Results: The mean score of the SCI for the overall population was 15.0 ± 5.9. Significant differences in distributions were observed by sex; women (14.3 ± 5.8) scoring lower than men (15.9 ± 5.9; Bootstrap Kolmogorov-Smirnov test: P<0.01). The analysis of 10-year age bands demonstrated a decreasing SCI score with age, with 18–30 year olds scoring a mean of 15.4 (± 5.7), and those older than 70 scoring a mean of 13.1 (± 5.8; Generalized Linear Model: -0.583 per 10-year increase in age, P<0.01). Those meeting criteria for possible DSM-5 insomnia disorder scored substantially lower (11.3 ± 4.0) than those who do not (19.1 ± 4.9; Bootstrap Kolmogorov-Smirnov test: P<0.01).
Conclusion: This large dataset demonstrated that SCI scores are lower in women and in older populations. The availability of reference categories for age and sex will improve the usability of the SCI in clinical practice and in research studies. In addition, estimation of the minimal important difference on the SCI will be reported to establish the clinical significance of change associated with insomnia treatment.
Support (If Any): This study supported by Big Health Ltd.

0315

INSOMNIA IN MENOPAUSAL WOMEN

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Introduction: Sleep disturbances become very common during menopause with an estimated 40% to 60% of menopausal women reporting poor sleep quality and about 25% meeting criteria for an insomnia disorder. Several factors contribute to the increased incidence of sleep disturbances during menopause including hot flashes, hormonal changes, mood disturbances and aging per se. Hormonal replacement therapy (HRT) is often used to treat hot flashes and other vasomotor symptoms, but its impact on sleep is equivocal. The present study examined the rate of sleep disturbances in menopausal women compared to non-menopausal women and the effect of HRT in the menopausal group.
Methods: 842 women between the age of 40 and 60 years old (mean age = 50.6) were selected from a larger population-based sample enrolled in a longitudinal study of insomnia. They were divided in two groups: menopausal (n=431) or non-menopausal (n=411) women. The menopausal women were further divided in two sub-groups: treated with HRT (n=89) or no HRT (n=342). Participants completed

several measures including one assessing sleep quality (Pittsburgh Sleep Quality Index; PSQI) and the other insomnia severity (Insomnia Severity Index; ISI).

Results: The group of menopausal women reported significantly poorer sleep quality than non-menopausal women (PSQI means of 7.44 vs. 5.49, p<0.001), although both groups exceeded the threshold of 5 typically used to define poor sleep quality. Menopausal women also reported significantly more severe insomnia than non-menopausal women (ISI means of 9.64 vs. 8.07, p<0.001), and both groups also exceeded clinical threshold on this variable. There was no significant group difference on either sleep quality or insomnia severity between menopausal women with or without HRT.

Conclusion: These findings suggest that menopausal women report poorer sleep quality and more severe insomnia than non-menopausal women. HRT does not seem to have a significant impact on these indices of sleep impairments. The development of therapies other than HRT is therefore warranted to reduce the impact of sleep disturbances on the quality of life of menopausal women.

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0316

INSOMNIA SYMPTOMS AND EXERCISE DOSE: RISK REDUCTION IN MIDDLE-AGED WOMEN

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Introduction: Women during menopause transition are at increased risk for insomnia. While exercise demonstrates significance to reduce symptoms, the dose is ill-defined in the literature. The purpose of this study was to describe sleep, insomnia symptoms, and exercise in efforts to develop a natural insomnia risk reduction exercise dose preference for 40-60-year-old (middle-aged) women.

Methods: A cross-sectional, descriptive, correlational design queried women about sleep, exercise, and nocturnal hot flashes. The Insomnia Severity Index (ISI) identified those with insomnia symptoms. The data analyzed by binomial regression statistics to identify insomnia risk reduction using exercise report and open-ended questions to describe the phenomena. An ISI, seven-component, factor analysis investigated useful items to improve Cronbach's Alpha for internal consistency in this population.

Results: Our study demonstrated significant differences in insomnia symptoms between reported exercise of participants (n=71) with control of hot-flashes, resulting in an identified dose for risk reduction ($p<.05$), and developed a brief prescreening set of questions for determining potential sleep problems ($p < .001$). Participants in group 1 exercise had an odds ratio 4.93 (CI 1.16–20.99, $p < .05$) for insomnia symptoms and the other variables, including hot flashes, had no statistical significance, $p > .05$. The ISI construct with seven questions resulted in a high level of internal consistency (Cronbach's Alpha of 0.89) and the internal consistency improved, if reduced to 6 items (removing item #4 satisfied) as determined by a Cronbach's Alpha 0.91.

Conclusion: Our study results allows for a preventative exercise dose suggestion for middle-aged women and a brief insomnia pre-screening (inquiring about nocturnal hot flashes, worry about sleep, and exercise) to prompt further investigation about their sleep problem. Our study is limited by sample size; however, we feel it provides insight into an existing exercise regimen that would be helpful in preventing insomnia symptoms during women's menopausal transition.

Support (If Any): None.

0317

COMPARISON OF TWO VALIDATION TECHNIQUES USING THE ALLIANCE SLEEP QUESTIONNAIRE (ASQ) INSOMNIA MODULE

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Introduction: The Alliance Sleep Questionnaire (ASQ) is a comprehensive, on-line sleep questionnaire containing ~600 variables in multiple formats, including questions where more than one answer can be selected. We analyzed ASQ data using regression and machine learning techniques to identify Stanford Sleep Disorders Clinic (SSDC) insomnia patients.

Methods: The population included SSDC patients who completed the ASQ and signed consent. Patients were considered positive for insomnia if they scheduled a Behavioral Sleep Medicine Program appointment. Remaining patients were considered negative for insomnia, as most SSDC patients are seen for OSA.

For the machine learning approach, we analyzed 154 continuous and categorical variables from the ASQ related to insomnia. Sequential forward feature selection was applied to identify a subset of variables. Bagged decision trees were used as a classification model to accommodate missing values and categorical data.

Two regression models were created. The first approach included 15 potential variables selected using clinical judgement. The second, hybrid model, included the initial 15 variables plus 4 additional variables identified in the machine learning approach and considered clinically relevant. Backward elimination stepwise selection was used to build the regression models.

Performance was evaluated using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the receiver operator curve (AUC). Optimal diagnosis point threshold was selected by weighting sensitivity and specificity equally.

Results: 5701 patients (3239 males, 2462 females) were analyzed and 944 met insomnia criteria. Machine learning selected 35 features using a learning dataset, resulting in Sensitivity=73.2%, Specificity=73.1%, PPV=35.0%, NPV=93.3%, and AUC=0.80 when applied to the test data. The original ASQ model included 8 covariates with Sensitivity=71.1%, Specificity=69.6%, PPV=29.5%, NPV=92.8%, and AUC=0.78. The hybrid model contained 13 covariates with Sensitivity=75.1%, Specificity=73.0%, PPV=35.7%, NPV=93.6%, and AUC=0.81.

Conclusion: Although the machine learning approach had slightly higher specificity and sensitivity compared to the original regression model, it took longer to build and process the data. The hybrid regression model, with covariates selected using a combination of clinical judgement and machine learning, had the best overall performance.

Support (If Any): Philips Respironics Foundation grant, the Stanford Center for Sleep Sciences and Medicine, and gift funds.

0318

INTERNATIONAL VARIABILITY IN THE PREVALENCE OF INSOMNIA AND USE OF SLEEP-PROMOTING MEDICATIONS, SUPPLEMENTS, AND OTHER SUBSTANCES

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Introduction: Few studies have compared insomnia prevalence across multiple countries using standardized measures. Further, it is

likely that medications/supplements/substances used to treat insomnia varies across countries.

Methods: An international web-based survey was conducted across 10 countries (United States, France, Japan, China, Brazil, South Korea, Germany, Australia, United Kingdom, and Netherlands), with 7,817 respondents (3,723 men; 25% of respondents aged 30–39 years). History of insomnia was assessed, as was prevalence of prescription medications, over-the-counter medications, supplements, alcohol, and other beverages. Regression analyses adjusted for age, sex, shift-work, other sleep disorders, and presence of other relevant medical conditions.

Results: Prevalence of insomnia was 5.4% (Netherlands), 10.0% (Japan), 10.5% (Australia), 11.0% (UK), 13.4% (US), 14.6% (Germany), 21.7% (France), 23.5% (South Korea), 24.0% (China), and 30.5% (Brazil). Compared to the US, increased prevalence was seen in France (RR=2.01,p<0.0001), China (RR=1.77,p<0.0001), Brazil (RR=2.74,p<0.0001), and South Korea (RR=1.92,p<0.0001) and less in the Netherlands (RR=0.43,p<0.0001). Compared to the US, use of prescription medication was less common in Japan, China, South Korea, Germany, Australia, and the Netherlands. Use of over-the-counter medications and supplements was less common in all countries. Use of alcohol for insomnia was more common in Japan and less common in France, China, Brazil, and Germany. Use of other sleep-promoting beverages was less common in Japan, Brazil, South Korea, and the Netherlands, and more common in the UK.

Conclusion: There was wide international variation in prevalence of insomnia, as well as in methods for handling sleep difficulty. Use of over-the-counter medications and supplements was consistently more common in the US. There was heterogeneity for other substances, though US were generally more likely to use medications, alcohol, and other beverages. Understanding geographic variation in insomnia and use of sleep medications is vitally important, as this knowledge can guide appropriate country-based public health interventions to target sleep disorders.

Support (If Any): N/A

0319

FAMILY PHYSICIAN MANAGEMENT OF INSOMNIA IN AUSTRALIA: THE BEACH STUDY (2000–15)

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Introduction: To characterize the management of insomnia by family physicians (FPs) in Australia.

Methods: The Bettering the Evaluation And Care of Health (BEACH) study is a yearly nationally-representative cross-sectional survey of 1,000 newly randomly sampled family physicians' activity in Australia. We investigated encounters with patients aged 15+, where insomnia or difficulty sleeping were managed and assessed annual trends in treatment recorded for these problems (2000–15).

Results: Insomnia was managed by FPs at a relatively steady rate until 2007–08 and then dropped after a stimulated reporting event surrounding the side-effects of zolpidem, from 1,535 per 100,000 encounters [95%CI: 1,490–1,580] in 2000–07 to 1,309 per 100,000 encounters [95%CI: 1,270–1,350] in 2008–15. Pharmacotherapy was used for insomnia at about 90% of management occasions; non-pharmacological advice was given at about 20% of encounters; and onward referral at about 1% of encounters. Prescription of temazepam declined steadily over time from 54.6 [95%CI: 51.4–57.9] per 100 insomnia problems in 2000–01 to 43.6 [95%CI: 40.1–47.0] in 2014–15, while zolpidem increased steadily from introduction in 2000 until 2006–07 to 14.6 [95%CI: 12.2–17.1] per 100 insomnia problems, and then decreased to 7.3 [95%CI: 5.4–9.2] per 100 insomnia problems by 2014–15. In the last year of data collection melatonin was recommended in 6.7 [95%CI: 4.9–8.4] per 100 insomnia problems.

Conclusion: Overall management rate of insomnia cases by FPs decreased after a 2007–08 media stimulated reporting event. Australian FPs remain reliant on pharmacotherapy for the management of insomnia but the prescribing mix has changed.

Support (If Any): Research supported by Australian NHMRC grants 571421 & 1060992.

0320

IS THE RELATIONSHIP BETWEEN REGULAR PHYSICAL ACTIVITY AND SUPERIOR SLEEP QUALITY INTERNATIONALLY ROBUST

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Introduction: Minimum levels of moderate to vigorous physical activity (MVPA) recommended by WHO guidelines for optimal cardiovascular outcomes (150 minutes/week) have recently been associated with superior sleep quality and the effective management of insomnia symptoms in European samples. However, while types and levels of MVPA vary across cultures and countries, relationships between activity variables and the prevalence of insomnia symptoms has not previously been explored in an international context.

Methods: Demographic, subjective health, sleep and physical activity profiles were obtained from a detailed online survey of 11,381 people (age = 18–75+; 24% male) in the UK, South Africa, China, South Korea and Australia, conducted June-September, 2016. Physical activity levels were categorized as <150 minutes/week or ≥150 minutes/week (after WHO, 2011). The category 'insomnia symptoms' included all those reporting sleep onset or maintenance problems, or unrestorative sleep (all with daytime consequences) on ≥3 nights/week for the previous ≥3 months. Predictive relationships between activity and 'insomnia symptoms' categories were examined in logistic regression models adjusted for age, sex and health status.

Results: Overall, only 19% of respondents met the international physical activity guidelines, with South Africa showing the lowest adherence (10%), and the UK the highest (25%). Insomnia symptom prevalence was broadly similar across the UK (21.2%), South Africa (20.7%), China (21.0%) and Australia (19.5%); South Korea reported the highest prevalence (28.7%). In the adjusted multivariate models, the higher level of walking was significantly associated with lower levels of reported insomnia symptoms [OR = 0.81 (95% CI = 0.71–0.92), p<0.01], when adjusted for gender, age, health, and level of education.

Conclusion: Internationally recommended levels of physical activity provide a common threshold for superior health *and* sleep outcomes across the world. The results support the international inclusion of sleep quality outcomes among the benefits of regular MVPA.

Support (If Any): The Sleep Census was supported by Sealy (UK) Ltd.

0321

PREVALENCE, ASSOCIATIONS AND RACIAL DIFFERENCES OF POSTTRAUMATIC STRESS DISORDER, INSOMNIA, AND DEPRESSION AMONG ADULTS EXPOSED TO INTERPERSONAL VIOLENCE

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Introduction: In addition to posttraumatic stress disorder (PTSD) and depression, exposure to traumatic events is often associated with sleep disturbance. Compared to other forms of trauma, little work has examined sleep and mental health morbidity associated with interpersonal violence (IPV) exposure. We sought to do so in a large, ethnically diverse sample of persons at risk for IPV exposure and to determine whether race was associated with any differences in comorbidity.
Methods: Some 2,500 adults were approached for screening at community-based locations, primarily a County Domestic Integrated Family Court and a battered women's shelter outpatient service. Nearly 800 participants completed surveys on demographics, past year exposure to IPV and current living arrangement. Measures included the PTSD Checklist (PCL), Insomnia Severity Index (ISI), and 8-item Patient Health Questionnaire depression scale (PHQ-8). Descriptive statistics on morbidity prevalence, Spearman's rank correlations between measures, and mean symptom severity differences by race were calculated.
Results: Among 797 participants, with mean age 34.5 (SD=10.6) years, 764 (95.9%) were female, 44.0% African American (AA), 41.4% white, 14.6% other or multiple races and 18.5% reported Hispanic background. Approximately 95% of participants experienced IPV in the past year (the remainder in prior years). Mean(SD) total scores were ISI = 18.6(6.0), PCL = 59.6(14.2) and PHQ-8 = 15.7(5.6). Based on the ISI, 17.4% of participants had subthreshold, 42.6% moderate, and 34.7% severe insomnia. For the PCL, 84.2% scored above the cut-point for PTSD. PHQ-8 scores indicated 22.6% had moderate and 62.6% severe depression. The ISI was strongly positively correlated with both PCL (rs = .620, p < .001) and PHQ-8 scores (rs = .592, p < .001), after removing sleep items. There were no significant differences between white and AA participants in mean symptom severity on the ISI, PCL or PHQ-8.
Conclusion: The prevalence of insomnia and other trauma-related morbidities is exceptionally high among people exposed to IPV. In this sample, insomnia severity did not differ by race, though data to control for socioeconomic status was unavailable. While sampling bias may have occurred, nearly 8 in 10 participants endorsed symptoms consistent with moderate to severe insomnia.
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0322

PLASMA AMINO ACID CHANGES IN PATIENTS WITH INSOMNIA AND SLEEP DISORDERS BREATHING

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Introduction: Chronic sleep disturbance is known to impair dietary metabolisms. Altered dietary metabolisms, such as amino acid level changes, may conversely affect sleep. In accordance with this hypothesis, we reported altered amino acid metabolisms in severe sleep disorders breathing (SDB) patients at Sleep 2016.We have extended the analysis and found that disease specific amino acid changes may exist in SBD and insomnia.
Methods: 981 participants with insomnia and SBD were recruited randomly from 1999 to 2010 at the Stanford Sleep Medicine Center. and had undergone Polysomnography to calculate respiratory disturbance index (RDI). We divided the patients into two groups; SDB defined as RDI≥5 (n=833) and non-SDB (n=148) defined as RDI<5. SDB patients were further divided into mild (RDI<15) and moderate/severe cases (RDI≥15). Non-SDB patients were also dichotomized at their median total sleep time (TST) (i.e., TST<369mins vs. ≥369mins).
Results: We applied multivariate logistic regression models with stepwise selection to select final confounding variables chosen at p<0.25 in univariable logistic models, with sex, age, and BMI forcedly included. The variables significant in the final model for SDB were sex, age, BMI, 2-aminoadipic acid [a 1mg increase had 0.83 odds ratio (OR) to be moderate/severe cases compared to mild cases; the average value was 2.89±1.90mg in moderate/severe cases vs. 3.43±1.92mg in mild cases], glutamine (1.00 OR; 603.0±92.1mg vs. 590.6±91.4mg), and phenylalanine (1.02 OR; 59.78±10.06mg vs. 56.19±8.06mg). The variables significant in the final model for short sleep time were sex, age, race, β-alanine (a 1mg increase had 2.46 OR to be a shorter sleep cases compared to longer sleep cases; the average value was 4.68±1.93mg in shorter sleep time cases vs. 4.07±2.10mg in longer sleep time cases), hydroxyproline (1.06 OR; 19.04±8.92mg vs. 16.24±10.18mg), and citrulline (0.90 OR; 36.31±7.10mg vs. 34.78±8.57mg).
Conclusion: Our findings suggest that specific amino acid changes may occur depending on the sleep and sleep/breathing disorders. Interestingly, plasma 2-aminoadipic acid was recently shown to be tightly associated with glucose tolerance and the risk for diabetes. Studies on functional significances of the findings are warranted.
Support (If Any): This study was supported by Ajinomoto Co., Inc.

0323

SLEEP AND COGNITIVE PERFORMANCE: CROSS-SECTIONAL ASSOCIATIONS FROM THE UK BIOBANK (N=477,966)

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Introduction: The relationship between insomnia symptoms and cognitive performance is unclear, particularly at the population level. We conducted the largest examination of this association to date through analysis of the UK Biobank, a large population-based sample of adults aged 40–69 yrs. We also sought to determine associations between cognitive performance and self-reported chronotype, sleep medication use, and sleep duration.
Methods: This cross-sectional, population-based study involved 477,966 participants, comprising 133,582 with frequent insomnia symptoms (age: 57.4±7.7 yrs; 62.1% female) and 344,384 controls without (age: 56.1±8.2 yrs; 51.9% female). Cognitive performance was assessed through a touchscreen test battery probing reasoning, basic reaction time, numeric memory, visual memory and prospective memory. Adjusted linear and logistic regression models included relevant demographic (age, gender, socioeconomic status), clinical (depressive symptoms, psychiatric medication use, BMI) and sleep variables.

Results: Insomnia symptoms were associated with cognitive impairment in unadjusted models, however these effects were reversed after full adjustment, leaving those with frequent insomnia symptoms showing statistically better cognitive performance over those without (for reasoning, reaction time, visual memory and prospective memory). Relative to intermediate chronotype, evening chronotype was associated with superior task performance, while morning chronotype was associated with the poorest performance. Sleep medication use and both long (>9hrs) and short (<7hrs) sleep duration were associated with impaired performance.
Conclusion: Our results suggest that frequent insomnia symptoms are not reliably associated with cognitive impairment at the population level after adjustment for relevant confounding variables. Further work is required to examine mechanistic underpinnings of an apparent evening chronotype advantage in cognitive performance, as well as impairment associated with morning chronotype, sleep medication use, and sleep duration extremes.
Support (If Any): N/A

0324

RELATIONSHIPS BETWEEN PERSONALITY DOMAINS, NIGHTMARES, AND SLEEP QUALITY

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Introduction: Previous research suggests certain personality traits (e.g., neuroticism) and dysfunctional sleep-related cognitions may perpetuate sleep difficulties, but few studies have examined this relationship. The current study examines personality domains as predictors of sleep quality and nightmare severity, frequency, and intensity in a college sample.
Methods: Participants were 348 undergraduate students (64% female; *M* age = 20.17 [*SD*=2.77]) from a large university in Texas (U.S.) who were administered an online questionnaire battery including the Disturbing Dreams and Nightmare Severity Index (DDNSI), Pittsburgh Sleep Quality Index (PQSI), and Big Five Inventory (BFI) of personality traits. Two multiple regressions were conducted in order to determine if personality traits predicted nightmare symptoms and overall sleep quality/insomnia.
Results: The omnibus regression for personality factors predicting DDSNI was significant, $F(5, 342) = 12.75$, $p < .001$, $R2 = .16$. Higher levels of Neuroticism ($\beta = 0.35$, $p < .001$) and Openness ($\beta = 0.21$, $p < .001$) significantly predicted greater nightmare symptoms. The omnibus regression for personality factors predicting PSQI was significant, $F(5, 342) = 13.66$, $p < .001$, $R2 = .15$. Higher levels of Neuroticism ($\beta = 0.27$, $p < .001$) significantly predicted worse sleep quality/insomnia symptoms.
Conclusion: The study indicates that the personality factor of neuroticism is related to several dimensions of disturbed sleep including nightmare symptoms and sleep quality/insomnia. Hyperarousal may moderate this relationship, but more research is needed. Additionally, greater openness was related to greater nightmare symptoms, which may reflect propensity of more impressible and imaginative individuals to have and/or report unusual experiences like frequent nightmares. More research is needed to understand the relationship between personality factors and sleep disturbances like nightmares and insomnia.
Support (If Any): None.

0325

INSOMNIA IN RELATION TO DISASTER-RELATED EXPERIENCES AMONG FUKUSHIMA NUCLEAR PLANT WORKERS: THE FUKUSHIMA NEWS PROJECT STUDY

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Introduction: The Fukushima Nuclear Energy Workers' Support (NEWS) project study previously showed that experiences related to the Fukushima nuclear disaster had a great impact on psychological states, which may be linked with insomnia among the nuclear plant workers. However, the complex mechanisms that disaster-related experiences cause insomnia are not fully understood.
Methods: A total of 1,456 nuclear power plant workers who responded a questionnaire on insomnia-related symptoms measured by Athens Insomnia Scale (AIS) and disaster-related experiences in 2011. Path analysis was used to examine the potential effect of disaster-related experiences, age and gender on three types of insomnia (difficulty in initiating sleep; difficulty in maintaining sleep; early morning awakening). We hypothesized that disaster-related experiences had a direct effect on insomnia and an indirect effect mediated by the experience of discrimination.
Results: Five disaster-related experiences were found to significantly influence insomnia: discrimination, life-threatening danger, major property loss, witnessing of plant explosion, and home evacuation. Difficulty in initiating sleep was significantly related to all five events but mainly to the experiences of life-threatening danger and witnessing of the explosion. Difficulty in maintaining sleep was significantly related to experiences of discrimination and life-threatening danger. Early morning awakening was significantly related to age and experiences of discrimination, life-threatening danger and home evacuation. Major property loss and experience of life-threatening danger were the two main significant determinants of discrimination.
Conclusion: Life-threatening experiences (i.e., life-threatening danger, witnessing of the explosion) may conjure up disturbing scenes that hamper sleep initiation. However, early morning awakening might be related to uncertainty of living (home evacuation). Discrimination was found to be associated with all three types of insomnia and was also influenced by other experiences, suggesting that providing comprehensive supports to these workers suffering from discrimination might be the most beneficial way of reducing insomnia-related problems.
Support (If Any):

0326

EVALUATION OF THE WATCH-PAT APPARATUS AS A SLEEP-STAGING TOOL

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Introduction: Polysomnography (PSG) is the gold standard for evaluating sleep. Ambulatory monitoring alternatives offer advantages over PSG in terms of cost, availability and convenience. In this study we compared Itamar Medical's Watch-PAT sleep scoring to PSG's in normal and insomnia subjects.
Methods: Subjects (n=17) were simultaneously recorded overnight using PSG and Watch-PAT. Age range was 19 - 68, and included 8 normals [(Insomnia Severity Index (ISI) 0–7], 5 mild insomniacs

(ISI 8–14) and 4 moderate to severe insomniacs (ISI 15–28), 11 females and 6 males. PSG scoring was performed by a Registered Polysomnographic Technician. Watch-PAT scores sleep and wakefulness using actigraphy, and stages sleep as light sleep (LS), deep sleep (DS), rapid-eye-movement sleep (REMS) with proprietary algorithms utilizing peripheral autonomic tone. For comparison purposes, non-REMS stages 1 and 2 were classified LS, and stage 3, DS.

Results: The sleep concordance index [number of epochs scored the same by both systems: wakefulness, LS, DS or REMS) divided by total number of epochs] was 63.4%. The majority of the misscoring resulted from some quiet wakefulness being misscored LS (12.3 ± 1.8%), and some stages 1, 2 being misscored DS (6.6 ± 1.0%). The concordance index was higher in subjects with an ISI 15+ and 8–14, compared to normals (69.8 ± 5.3%, 68.8 ± 2.5% and 56.8 ± 4.3%, respectively). Watch-PAT was equally reliable in evaluating sleep of females and males (64.3 ± 3.9% vs. 61.8 ± 4.0%) and across age groups (age 46–72: 66.3 ± 3.2%, age 31–45: 61.1 ± 5.1% and age 18–30: 62.4 ± 6.4%). Total sleep time was significantly higher as measured by Watch-PAT compared to PSG (428.5 ± 12.8 vs. 374.0 ± 15.0 minutes).

Conclusion: While a concordance of 63% can only be deemed moderate, such agreement makes the Watch-PAT a reasonable tool when sleep-staging would be of benefit in clinical and research studies.

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0327

WEEKNIGHT VERSUS WEEKEND DIFFERENCES IN TOTAL SLEEP TIME ACROSS SLEEP GROUPS

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Introduction: Americans exhibit discrepant sleep on weekends compared to weeknights. However, research on this phenomenon has been limited to healthy sleepers. This study utilized multilevel modeling to characterize differences in weeknight-weekend total sleep time (TST) among four sleep groups: 1) insomniacs (INS), 2) noncomplaining poor sleepers (NP), 3) complaining good sleepers (CG), and 4) healthy sleepers.

Methods: We recruited community-dwelling adults ages 20 to 98. This study analyzed 14 days of sleep diary data from 633 participants classified into 4 sleep groups based on quantitative sleep criteria and subjective sleep complaint. Data was modeled according to a two-level repeated-measures structure with time points (level 1) nested within individuals (level 2) predicting TST. To examine intraindividual variability in TST, we estimated a random-intercept model with no predictors (Model 1). Next, dummy-coded day-type (weekday=0, weekend=1) was entered as a level-1 predictor (Model 2). Lastly, significant demographic covariates and dummy-coded sleep groups were entered at level 2 to examine weeknight-weekend differences in TST among sleep groups (Model 3).

Results: Model 1 revealed that 61% of the variance in TST was attributable to intraindividual differences across time. When day-type was added in Model 2, it accounted for 6.3% of the intraindividual variance in TST ($p < .001$). Across participants, the average TST on weeknights was 6.9 hours, and TST during weekend nights was 0.32 hours longer than during weeknights ($p < .001$). For Model 3, compared to healthy sleepers, CG's average TST was 0.31 hours shorter ($p < .01$) and NP's average TST was 0.26 hours shorter ($p < .01$). When comparing INS to healthy sleepers, there was a significant interaction of day-type by sleep group. Compared to healthy sleepers, INS's TST was shorter, and they exhibited less weekend-weeknight discrepancy ($p < .01$).

Conclusion: Compared to healthy sleepers, CG, NP, and INS exhibited shorter TSTs, and INS exhibited less weeknight-weekend discrepancy in TST. Consideration of day-type and sleep group is important for better characterization of sleep behavior. Future studies will examine the effect of day-type and sleep group on other sleep parameters.

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0328

WORK HOURS, SLEEP DURATION, AND INSOMNIA SYMPTOMS IN DEVELOPED AND EMERGING ECONOMIES

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Introduction: The prevalence of short sleep durations (≤6 hours/night) has been linked to industry sector, with the highest levels found in transportation and manufacturing. Typically such findings are based on single sleep items in national surveys (e.g. the US National Health Interview Survey) which offer few insights into cross-national trends, or workplace-related sleep health. We examined sleep duration in relation to working hours, industry sector and insomnia symptoms in 5 countries.

Methods: Demographic and sleep profiles were obtained from an online survey of 7068 working people (18-74y; 25% male) in the UK, South Africa, China, South Korea and Australia, conducted June-September, 2016. Industry sector was based on the World Bank classification. Sleep parameters were subjectively reported. 'Insomnia symptoms' included those reporting sleep onset or maintenance problems, or unrestorative sleep (all with daytime consequences) on ≥3 nights/week for the previous ≥3 months. Analyses included chi-square and multiple regression models adjusted for age, sex and country.

Results: Proportions working 40–60 hrs/week were significantly greater in emerging (South Africa = 57%; China = 56%; South Korea = 70%) compared with the more developed economies (UK = 24%; Australia = 35%). A similar dichotomy emerged in proportions stating they *often* felt they could function better at work if they slept better (South Africa = 61%; China = 75%; South Korea = 72% v UK = 44%; Australia = 47%). Across sectors, the shortest sleep times were found in agriculture, transportation and manufacturing; the longest sleep times were in retail, public administration and banking. Working hours negatively correlated with sleep time ($p<0.001$); proportions sleeping <6 hour/night ranged from 10% (Australia) to 31% (South Korea). Insomnia symptom prevalence was similar across the UK (21.2%), South Africa (20.7%), China (21.0%) and Australia (19.5%), but highest in South Korea (28.7%).

Conclusion: The findings are consistent with a 2-way relationship between work and sleep, with longer working hours associated with both lower sleep times, and a greater conviction that better sleep would improve work performance. This relationship is strongly influenced by industry sector and economic development

Support (If Any): The Sleep Census was supported by Sealy (UK) Ltd.

0329

INSOMNIA PREVALENCE AMONG VETERANS REFERRED FOR DIAGNOSTIC TESTING FOR SLEEP DISORDERED BREATHING

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Introduction: Insomnia can be a barrier to adherence with positive airway pressure (PAP) therapy among those diagnosed with sleep disordered breathing (SDB). However, rates of insomnia (based upon the International Classification of Sleep Disorders, 3rd Edition [ICSD3] diagnostic criteria) among those presenting for SDB evaluation are not well-described. We evaluated rates of insomnia disorder among veterans scheduled for SDB diagnostic testing at a Veterans Administration sleep disorders center and identified characteristics associated with meeting ICSD3 insomnia criteria.
Methods: Within the recruitment phase of a behavioral treatment trial, we telephoned veterans (aged ≥ 50 years) who were scheduled for a SDB diagnostic study (polysomnography or home sleep apnea test). The telephone survey included ICSD3 diagnostic criteria, use of sleep medications over the past month; average pain severity over the past week; and usual bedtime, rise time, minutes to fall asleep and total hours of sleep.
Results: We completed telephone surveys in 787 patients (95.0% male, mean age 63.3 years). Of these, 626 (79.5%) met ICSD3 criteria for insomnia disorder. In bivariate analyses, those with insomnia were older ($p<.05$), had more severe pain ($p<.001$), were more likely women ($p<.05$) and more likely to use sleep medications ($p<.001$). In logistic regression, only pain ($p<.001$) and use of sleep medications ($p<.01$) were significant independent predictors of insomnia disorder. Those with insomnia disorder had mean sleep onset latency of 46.6 minutes, mean sleep efficiency 64.8%, mean total sleep time 5.0 hours, and 47.0% reported taking sleep medications.
Conclusion: Insomnia disorder was highly prevalent among veterans aged ≥ 50 years who were scheduled for SDB diagnostic testing. Those with more pain and those using sleep medications were at highest risk. Given the known impact of insomnia on PAP use, further research is needed to determine whether concurrent treatment can improve outcomes of insomnia and SDB.
Support (If Any): Veterans Administration Health Services Research and Development; and VA Greater Los Angeles Geriatric Research, Education and Clinical Center.

0330

AT-HOME ACTIGRAPHY VS IN-LABORATORY PSG IN INSOMNIA

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Introduction: Actigraphy (ACT) is widely used as an objective measure of sleep. It has validity in normal sleep, but its validity in insomnia with disturbed sleep remains equivocal. A critical issue in insomnia is ACT's lack of specificity in detecting wakefulness. One approach to enhancing validity to PSG is taking multiple samples. We sought to determine how many nights of ACT sleep will best represent PSG in insomnia.
Methods: Persons (N=16), aged 23–61 yrs, meeting DSM-V criteria for insomnia, a PSG sleep efficiency of ≤85%, no other sleep, psychiatric, or drug dependency disorders, and in good health were recruited. Following a screening 8-hr PSG participants returned home with Actiwatchs (Spectrum Plus, Phillips Healthcare, Bend OR) to be worn nightly for 7 consecutive nights. Instructions were spend 7–9 hrs in bed and press event markers when trying to sleep and arising in the morning. ACT data were analyzed by Phillips Actiware 6 software and PSGs according to the R&K scoring. The sleep parameters compared were total sleep time (TST), sleep efficiency (SE), sleep latency (LAT), wake after sleep onset (WASO), and number of awakenings (NWAK).
Results: The best relation between ACT and PSG was found on the ACT mean of the first 3 nights following the PSG (TST $r = .61$; SE $r = .83$; LAT $r = .58$, all $p<.05$). ACT means over 4 or 7 nights did not relate better than 3 night means. WASO and NWAK correlations never achieved statistical significance. Comparing 3 night ACT means to PSG, ACT overestimated TST ($t = -1.76$, $p<.10$) and SE ($t = -2.82$, $p<.01$) and underestimated WASO ($t= 3.54$, $p<.001$).
Conclusion: Three-night ACT means best represent PSG in insomnia, producing moderate correlations. In insomnia ACT insensitivity to wakefulness yields overestimation of SE and underestimation of WASO.
Support (If Any): NIDA, grant#: R01DA038177 awarded to Dr. Roehrs.

0331

ACTIGRAPHY IN INSOMNIA WITH AND WITHOUT EVENT-MARKING

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Introduction: Use of actigraphy (ACT) in insomnia to objectively document sleep remains problematic primarily due to its insensitivity for wakefulness. One approach to enhancing validity is use of participant event marking to document time-in-bed (TIB). We sought to determine whether event marking TIB enhances ACT validity to PSG compared to soft-ware determined TIB.
Methods: Persons (N=16), aged 23–61 yrs, meeting DSM-V criteria for insomnia and a PSG sleep efficiency of ≤85%, no other sleep, psychiatric or drug dependency disorders and in good health were recruited. Following a screening 8-hr nocturnal PSG participants returned home with Actiwatchs (Spectrum Plus, Phillips Healthcare, Bend OR) to be worn nightly for 7 consecutive nights. Instructions were to spend 7–9 hrs in bed and to press event markers when trying to sleep and arising in the morning. ACT data were analyzed using the Phillips Actiware 6 software. The sleep parameters derived from the software (AUTO) determined TIB were compared to those of the event-marked (MARK) TIB for validation to PSG. The sleep parameters compared were total sleep time (TST), sleep efficiency (SE), sleep latency (LAT), wake after sleep onset (WASO), and number of awakenings (NWAK).
Results: TIB was not marked in 10% of the total 112 nights and means over the first 3 nights were used for comparisons. While MARK data correlated significantly ($p<.05$) to PSG on TST($r=.61$), SE ($r=.83$), and LAT ($r=.58$), no AUTO generated parameters did. The correlation coefficient for PSG to AUTO vs MARK SE was significantly smaller ($t=2.46$, $p<.05$). Relative to MARK, AUTO overestimated TST ($t=2.61$, $p<.02$) and showed a trend ($p<.10$) for underestimating WASO and NWAK.
Conclusion: In insomnia ACT validity to PSG is enhanced by requiring that participants use an event marker to indicate TIB and data loss due to failure to use the event marker is relatively low (10%).
Support (If Any): NIDA, grant#: R01DA038177 awarded to Dr. Roehrs.

0332

VALIDATION OF THE ALLIANCE SLEEP QUESTIONNAIRE (ASQ) INSOMNIA MODULE IN SLEEP DISORDERED PATIENTS

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Introduction: The Alliance Sleep Questionnaire (ASQ) is a comprehensive, on-line sleep questionnaire that uses branching logic to assess sleep symptoms. The survey contains novel questions and validated measures, including the Insomnia Severity Index (ISI) and other insomnia related questions. We evaluated whether the additional information collected in the ASQ increased its ability to correctly detect insomnia cases compared to the ISI.

Methods: The population included Stanford Sleep Disorders Clinic (SSDC) patients who completed the ASQ and signed consent. Patients were considered positive for insomnia if they scheduled a Behavioral Sleep Medicine Program appointment. Remaining patients were considered negative for insomnia, as most SSDC patients are seen for OSA. Nineteen variables were selected for evaluation using a combination of clinical judgement and machine learning techniques. Backward elimination stepwise selection was used to build the regression model. Criteria for entry into the model was a p-value <0.3 in the bivariate analysis and a p-value <0.05 to remain. Receiver operating characteristic (ROC) curve analyses were performed on the ASQ model and the ISI. Specificities, sensitivities, positive predictive values (PPV), negative predictive values (NPV), and areas under the curve (AUC) were calculated to assess the two models. Optimal diagnosis point threshold was selected by weighting sensitivity and specificity equally.

Results: 5701 patients (3239 males, 2462 females) were analyzed and 944 met insomnia criteria. The final ASQ model included 13 covariates including: age, gender, BMI, primary complaint, previous insomnia diagnosis, current treatment (medication or CBTi), ISI score, Epworth, anxiety, circadian preference, quality of life, and OSA symptoms. The ISI had a Sensitivity=71.5%, Specificity=62.0%, PPV=27.2%, NPV=91.6%, and AUC=0.72. The ASQ model had a Sensitivity=75.1%, Specificity=73.0%, PPV=35.7%, NPV=93.6%, and AUC=0.81.

Conclusion: The multi-variate ASQ model performed significantly better than the ISI alone. However, a major limitation of the study was the gold standard definition of cases and controls. Reaching higher sensitivity and specificity may not be possible without improving these definitions. Before attempting to optimize performance, we will verify insomnia diagnostic information in a nested sample.

Support (If Any): Philips Respironics Foundation grant, the Stanford Center for Sleep Sciences and Medicine, and gift funds.

0333

BETWEEN SPORT DIFFERENCES IN SLEEP QUALITY AND INSOMNIA SYMPTOMATOLOGY: A NATIONAL SURVEY OF ELITE BRITISH ATHLETES

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Introduction: It is widely recognised that the sleep of elite athletes is repeatedly challenged by training, competition and international travel, with much attention focussing on the sporting impact of sleep *deprivation*. However, since different sports involve very different training schedules and competitive cycles they may also pose different levels of risk to sleep *quality*. The present analyses were designed to assess sport-related differences in sleep quality and insomnia symptoms among a representative sample of elite British athletes.

Methods: 412 (183 female) elite British athletes (mean age = 26.5) from 25 Olympic and Paralympic (139 athletes) sports completed the online English Institute of Sport National Sleep Survey. All athletes performed at an international level, with 80% having competed at an Olympic or Paralympic games, Commonwealth games or senior world championships. Sleep quality was measured using Pittsburgh Sleep Quality Index (PSQI) augmented with questions addressing non-restorative sleep, nocturnal/early morning awakenings, and excessive day-time fatigue. Sports were categorised as: team; endurance; technical (e.g. shooting, archery); combat and power. Within-sport comparisons were made between gender, age groups (<23, 23–27 and >27 y) and ability (Paralympic vs. Olympic).

Results: Across all sports the mean global PSQI score was 5.6 (SD = 2.8; range 0–17), with 45% scoring >5, and 16% scoring >8. Between-sport comparisons showed no significant differences in global PSQI scores, though a significantly greater proportion of technical sport athletes scored >8 (relative risk = 2.7, 95% confidence interval = 1.7 to 4.1; $p<0.05$). A greater proportion of combat athletes reported nocturnal or early morning awakenings >3 times per week for one month ($p<0.01$). Within-sport comparisons revealed no significant differences in sleep quality between gender or age groups ($p>0.05$). Paralympic athletes were, however, more likely than Olympic athletes to score >8 on the PSQI (prevalence = 27%; relative risk = 2.6, 95% confidence interval = 1.7 to 4.0; $p<0.05$).

Conclusion: High proportions of elite athletes experience poor sleep quality. It is likely that the lower levels of athleticism required in technical sports allow elite performance in these activities to be less influenced by degraded sleep quality.

Support (If Any): NA.

0334

PREVALENCE, PREDICTORS, AND CORRELATES OF INSOMNIA IN U.S. ARMY SOLDIERS

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Introduction: Insomnia is one of the most common reasons military personnel seek behavioral health treatment; its consequences may adversely impact military readiness and performance. The majority of research conducted on insomnia and its impact on military personnel has focused on treatment-seeking samples and/or isolated symptoms of DSM-IV insomnia disorder criteria. Representative and larger-sample studies using full insomnia diagnostic criteria are needed. This study investigated the prevalence, predictors, and correlates of insomnia disorder in a national sample of U.S. Army Soldiers.

Methods: Data were analyzed from the Army Study to Assess Risk and Resilience in Service members (STARRS)--All-Army Study (AAS).

A representative sample of 21,499 U.S. Army Soldiers responded to the cross-sectional AAS self-administered questionnaire. The Brief Insomnia Questionnaire was used to define DSM-5 insomnia disorder; biopsychosocial correlates and predictors were assessed with measures validated with this population. Chi-square and logistic regression analyses identified correlates and predictors of insomnia status at a small effect size or greater.

Results: The rate of DSM-5 insomnia disorder was 22.76%. Insomnia was associated with less intention to build an Army career and poorer functioning in health (mental, physical, and cognitive), social support, morale, and work performance domains. Multivariable analyses showed that number of current and lifetime mental health disorders, poor stress coping, feeling unsupported by leadership, and less education predicted insomnia disorder (overall model R^2=.37, p<.001).

Conclusion: Insomnia disorder is associated with many facets of military readiness and well-being. Education and opportunities for healthier sleep practices are needed--specifically those supported by leadership and that address stress coping skills.

Support (If Any): Data were collected as part of the Army STARRS, sponsored by the Department of the Army and funded under cooperative agreement U01MH087981 with the U.S. Department of Health and Human Services, National Institutes of Health, and National Institute of Mental Health. Research was supported with resources and use of facilities at the VA Capitol Health Care Network (VISN 5) MIRECC and U.S. Department of Veterans Affairs, Veterans Health Administration, Rehabilitation Research and Development Service-1IK2RX001836. Views expressed here are those of the authors and do not necessarily represent views of the Department of Veterans Affairs.

0335

DOES OBJECTIVE SLEEP DURATION MODERATE TREATMENT RESPONSE IN PATIENT WITH COMORBID DEPRESSION AND INSOMNIA? A REPORT FROM THE TRIAD STUDY

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Introduction: A recent AASM/SRS report recommends a self-reported minimum of 7 hr. of sleep nightly as "healthy sleep." Research among insomnia patients suggests objective sleep durations of < 5 or 6 hrs. are predictive of morbidity and poor treatment response. This study examined cutoffs of 5, 6, and 7 hrs. of sleep for predicting treatment response in patients with comorbid depression/insomnia.

Methods: Participants (N=104; 75 women; M_{Age} = 47.8 ± 12.4 yrs.) enrolled in the Treatment of Insomnia and Depression Study and completed 1 baseline night of polysomnography. All received 16 weeks of anti-depressant medication plus a randomly assigned CBTI or sham (CTRL) insomnia therapy. The HAMD-17 and Insomnia Severity Index were administered at baseline and then bi-weekly during treatment to determine depression and insomnia remission (scores < 8 on last observation). Logistic regressions were conducted to test effects of treatment assignment, sleep duration cutoffs (5, 6 & 7 hrs.) and their interactions on insomnia and depression remission rates.

Results: A 5 hr. cutoff, produced a treatment x sleep duration interaction (W (1) = 6.20, p = .01) for insomnia remission. CBTI recipients sleeping ≥ 5 hrs. were more likely to achieve insomnia remission than were CTRL recipients with ≥ 5 sleep (OR = 4.5; CI =1.6–12.7) or CBTI recipients with shorter sleep (OR = 11.8 CI = 1.4–101.7). CBTI and CTRL patients sleeping > 5 hours did not differ. A 7 hr. cutoff produced significant treatment arm effects (W (1) = 5.68, p = .02) in predicting insomnia remission (i.e., CBTI > CTRL) and for the treatment x sleep duration interaction (W (1) = 4.07, p = .04) in predicting depression remission. CBTI recipients with ≥ 7 hrs. of sleep showed a 62.5% depression remission rate; remission rates for the other 3 subgroups ranged from 18.2 to 42.1%. The 6 hr. cutoff showed more equivocal results.

Conclusion: Depressed patients with insomnia may need ≥ 5 hr. of sleep per night for CBTI response, but those sleeping ≥ 7 hrs. seem more likely to benefit by CBTI and achieve depression remission.

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0336

IMPACT OF BRIEF BEHAVIORAL TREATMENT FOR INSOMNIA (BBT-I) ON SLEEP AND COGNITION IN OLDER ADULTS WITH INSOMNIA: THE REST RANDOMIZED CONTROLLED TRIAL

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Introduction: Brief (≤4 sessions) behavioral treatment for insomnia (BBT-I) has been shown to improve sleep in older adults with insomnia (OAWI). Despite evidence linking insomnia to complaints of and actual impairments in attention, memory, and executive functioning, behavioral trials rarely include cognitive outcomes. The Research Examining Sleep and Thinking (REST) trial addressed this shortcoming in the literature by examining the effects of BBT-I on sleep and cognitive outcomes in OAWI.

Methods: Older adults with chronic insomnia [*N*=62, *M*age=69.45(*SD*=7.71)] were randomized to 4-weeks of BBT-I (*n*=32; education, sleep hygiene, stimulus control, sleep restriction, relaxation) or waitlist control (WLC;*n*=30). Subjective (sleep diaries) and objective (actigraphy) sleep were assessed daily for 2-weeks, and cognitive tasks were administered during single, 2-hour sessions at baseline, post-treatment, and 3-month follow-up. Sleep variables were averaged over 2-weeks and included: sleep onset latency (SOL), wake after sleep onset (WASO), sleep efficiency (SE), and total sleep time (TST). Cognitive variables included: overall cognitive functioning (WAIS-III-Vocabulary and Digit Symbol); attention, working memory, and processing speed (Trails A & B); language (Controlled Oral Word Association, Boston Naming Test); and memory (California Verbal Learning Test-II, Rey Osterreith Complex Figure, WMS-III-Logical Memory).

Results: Using intent-to-treat analyses, subjective SOL, WASO, and SE improved in both groups. Post-treatment improvements were larger for BBT-I versus WLC (all *p*s<.05; SOL,-23.95 vs -7.11 minutes,l^2_p=.06; WASO,-26.11 vs -5.65 minutes,l^2_p=.12; SE,+10.91 vs +3.27%,l^2_p=.15). At follow-up, gains were well-maintained for BBT-I only. Subjective TST and objective WASO and SE trended toward improvement at post-treatment and follow-up for BBT-I only

(TST,+22.80 vs +3.39 minutes,l^2_p=.05,*p*=.06; WASO,-10.55 vs .85 minutes,l^2_p=.04,*p*=.09; SE,+1.74 vs -.84,l^2_p=.05,*p*=.07). Cognitive performance did not improve.

Conclusion: BBT-I improved subjective sleep, but did not improve objective sleep or cognitive performance. One possible explanation for our null findings for cognition is that BBT-I may be too short to impact cognition. Another is that our 'single shot' laboratory-based assessments may not be sensitive enough to detect changes in cognition. Future research involving longer treatment and/or daily home-based cognitive assessment may better capture treatment-related cognitive changes in OAWI.

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0337

COGNITIVE BEHAVIORAL THERAPY FOR MENOPAUSAL INSOMNIA IN MIDLIFE WOMEN WITH INSOMNIA AND NOCTURNAL HOT FLASHES

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Introduction: Between 30–60% of peri- and postmenopausal women in the United States suffer from insomnia symptoms. Menopausal women with nocturnal hot flashes often report worse sleep quality and are more likely to meet criteria for insomnia disorder than those without nocturnal hot flashes. Thus, tailoring interventions to treat both insomnia and hot flashes may improve sleep and quality of life of millions of women. This pilot study examined the efficacy of cognitive behavioral therapy for insomnia and hot flashes among midlife women.

Methods: Forty women (mean age= 55±6.2) self-described as peri- or post-menopausal who reported ≥ 1 nocturnal hot flash/night and met diagnostic criteria for insomnia disorder were randomized to cognitive behavioral therapy for menopausal insomnia (CBTMI) or menopause education control (MEC). Treatment included four individual 50-minute sessions over eight weeks, delivered by social workers or psychologists in gynecology clinics. Pre and posttreatment measures included: Insomnia Severity Index (ISI), Center for Epidemiologic Studies Depression Scale (CES-D), and Self-Efficacy Scale for Sleep (SES).

Results: Mixed models revealed a significant time x treatment arm interaction for insomnia severity (p=.003), depression severity (p=.019), and sleep self-efficacy (p=.021), with significant main effect for time for all domains (p's <.001) and for treatment arm for insomnia severity (p=.007). Women receiving CBTMI had significantly greater decreases from pre to post treatment in ISI (15±3.5 to 4±3.7) and CES-D (16±9.0 to 8±7.4) scores and significantly greater increase in SES scores (26±5.0 to 36±7.4) compared to women receiving MEC [pre to post treatment changes for MEC group: ISI (16±4.2 to 10±5.0), CES-D (15±11.1 to 13±9.2), and SES (26±5.6 to 31±7.7)].

Conclusion: For midlife women experiencing insomnia and nocturnal hot flashes, a 4-session CBT intervention targeting both insomnia and hot flashes led to clinically meaningful improvements in sleep and depressive symptoms.

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0338

WOMEN WITH INSOMNIA AND DEBILITATING MIGRAINES: SEQUENTIAL ADMINISTRATION OF ONLINE TREATMENT- THE WINDSOR STUDY

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Introduction: Insomnia commonly co-occurs with chronic migraines (CM). Treatments for insomnia that accommodate the debilitating nature of CM remain understudied. This is a proof-of-concept study, which aims to evaluate the feasibility, acceptability and effectiveness of digital Cognitive Behavioral Therapy for Insomnia (dCBT-I) for individuals with CM and insomnia (CM-I).

Methods: A multiple baseline design was employed following SCRIBE (single-case reporting guidelines in behavioral interventions). Forty-two females with CM-I were randomized to receive dCBT-I (www.sleepio.com) after 2, 4 or 6 weeks of baseline sleep assessment. Completion and acceptability rates, and changes in sleep and migraines after treatment were assessed. Daily sleep diary data across baseline and treatment periods were examined visually according to guidelines and changes in sleep temporally associated with the initiation of dCBT-I were identified.

Results: Out of 39 participants who started the program, 35 (89.7%) completed dCBT-I. Of these completers, 33 (94.3%) reported being satisfied (n=16) or very satisfied (n=17) with treatment. In addition, 65.7% of completers reported a clinically meaningful difference in their sleep as indicated by a change of ≥ 8 on the Insomnia Severity Index (ISI). There was a significant change in ISI scores from baseline (mean [SD]=17.6 [4.0]) to post-treatment (mean[SD]=7.7 [4.1]), t(34)=10.8, p<0.001, Cohen's d=1.82. Based on visual analysis, there was a change in sleep efficiency that was temporally associated with the initiation of dCBT-I in 22–25 (56–64%) of all participants who started dCBT-I. The interclass correlation coefficient for the visual analysis by two authors (MC, HT) was high (ICC=.85). There was a trend for the reduction in headache-related disability impacting academic, social, vocational and household work performance at post-treatment, z(61.05)=-1.8, p=0.07, with a small effect size of r=0.2.

Conclusion: The results of this study provide evidence of the feasibility and acceptability of dCBT-I, with large effects on reducing insomnia and small effects on reducing headache disability. We hope these results will be a catalyst for evaluating the efficacy of dCBT-I in a randomized control trial.

Support (If Any): This research project was made possible by an award from the American Sleep Medicine Foundation, a foundation of the American Academy of Sleep Medicine.

0339

DOES COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA ENHANCE THE EFFECTS OF COGNITIVE PROCESSING THERAPY FOR PTSD AMONG SURVIVORS OF INTERPERSONAL VIOLENCE?

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Introduction: Insomnia frequently co-occurs with posttraumatic stress disorder (PTSD). Evidence-based trauma treatments like cognitive processing therapy (CPT) are efficacious, but do not directly target insomnia. We tested whether delivering cognitive behavioral therapy for insomnia (CBT-I) followed by CPT, produced greater reductions in symptom severity compared to CPT alone in a unique and underserved population of survivors of interpersonal violence (IPV).

Methods: Over 2500 individuals were approached in family court and women's shelters and 797 agreed to be screened. A total of 138 met eligibility criteria including past-year IPV exposure and diagnostic criteria for PTSD, Major Depression (MDD) and insomnia. We randomized 110 subjects to individual CBT-I (4 sessions) followed by CPT (12 sessions) or Attention Control (AC; 4 supportive phone calls) followed by CPT. Assessments occurred at baseline (T1), after CBT-I/AC (T2), and after CPT (T3) and included the Insomnia Severity Index (ISI), the Clinician-Administered PTSD Scale (CAPS), and the Hamilton Rating Scale for Depression (HRSD). General linear models with repeated measures tested time x group interactions from T1-T2 and across T1-T2-T3, for ISI, CAPS and HRSD total scores.

Results: The sample was diverse (50% minorities), socioeconomically disadvantaged, mostly female, and had a mean age of 35.4. Mean baseline severity scores were: ISI=20.5, CAPS=72.1 and HRSD=24.9. CBT-I and AC groups did not differ by demographic factors or clinical severity at baseline. Time(T1,T2) x group interactions were significant for all outcomes with a greater decline in the CBT-I condition on the ISI ($F(1,81)=28.4$; $p<.001$), HRSD ($F(1,81)=23.8$; $p<.001$), and CAPS ($F(1,81)=10.1$; $p<.01$). Using all three time points, time x group interactions indicated significantly greater declines in the CBT-I+CPT condition, compared to AC+CPT, on the ISI ($F(2,56)=8.2$; $p<.01$), HRSD ($F(2,56)=9.8$; $p<.01$), and CAPS ($F(2,56)=7.7$; $p<.01$). Notably, the mean reduction in CAPS score from T1 to T3 was 33.3(SD=22.6) in the CBT-I+CPT condition compared to 17.0(15.5) in the AC+CPT condition.

Conclusion: The findings suggest that CBT-I effectively reduces insomnia severity in patients with IPV who have concurrent PTSD and MDD and, in addition, augments the effects of subsequent CPT on PTSD and depression symptoms.

Support (If Any): R01NR013909.

0340

EFFECTIVENESS OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA IN PATIENTS WITH COMORBID OBSTRUCTIVE SLEEP APNEA

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Introduction: Co-morbid insomnia and Obstructive Sleep Apnea (OSA) is a prevalent and debilitating condition. The most recommended treatment for these co-morbid patients includes initial treatment with Cognitive Behavioral Therapy for Insomnia (CBTi), before managing the OSA with positive airway pressure (PAP) therapy. CBTi is an effective treatment for patients with insomnia, however less is known about its effectiveness in patients with co-morbid OSA. This randomized controlled trial compared the effectiveness of CBTi to a no-treatment control condition in patients with co-morbid insomnia and OSA.

Methods: Participants included 77 adults (72% Male) with specialist diagnoses of both insomnia (ICSD-2) and OSA (AHI≥15). Participants were randomly allocated to either 4-weekly 45-minute sessions of CBTi or a no-treatment control condition. Insomnia symptoms including subjective sleep parameters, global insomnia severity, dysfunctional cognitions, anxiety, stress, and daytime impairments, were assessed at pre- and post-treatment with sleep diaries, and self-report questionnaires.

Results: Among patients in the CBTi condition, significant changes were observed in subjective sleep onset latency (23 minute decrease), wake after sleep onset (46 minute decrease), sleep efficiency (16 percent increase), and Insomnia Severity Index (ISI; 6 points improvement) scores from pre- to post-treatment (all $p\leq.05$). These improvements were significantly greater than those observed in the control condition (all $p\leq.05$). Furthermore, CBTi was associated with significantly greater improvements in daytime symptoms including fatigue, dysfunctional beliefs and attitudes about sleep, and stress, compared to the control condition. Following CBTi, a significantly greater number of participants were categorised as 'improved', according to post-treatment ISI < 7, compared to participants in the control condition (CBTi = 19.5%; Control = 2.8%, $p = .032$, phi=.26).

Conclusion: CBTi is an effective treatment for insomnia in the presence of co-morbid OSA. Clinicians should consider initial treatment with CBTi to treat insomnia symptoms, in patients with co-morbid insomnia and sleep apnea. Furthermore, future research should also trial CBTi with this co-morbid population before beginning PAP therapy.

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0341

SEQUENTIAL THERAPIES FOR COMORBID AND PRIMARY INSOMNIA: A RANDOMIZED CONTROLLED TRIAL

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Introduction: Despite evidence supporting pharmacological and cognitive/behavioral insomnia therapies, it remains unclear how best to combined these therapies to optimize outcomes. This paper reports findings from a two-site randomized clinical trial examining the efficacy of these therapies, employed individually and in various sequences.

Methods: Patients were 211 adults (132 women; M age = 45.6 ± 14.9 years old) with insomnia disorder, including 72 who also presented a comorbid psychiatric disorder. They were randomly assigned to first-stage 6-week therapy involving either behavioral therapy (BT) or zolpidem. Patients in remission continued on maintenance therapy for 12 months. Those not achieving remission were randomized to a second, 6-week treatment involving either pharmacotherapy (zolpidem or trazodone) or psychological therapy (BT or cognitive therapy-CT). The primary end points reported here include Insomnia Severity Index - defined treatment response (≥ 8 point decline) and remission (total score < 8).

Results: Intent-to-treat analyses showed that there were similar proportions of treatment responders (45% vs. 41%) after initial treatment with BT or zolpidem, but a larger proportion of remitters in BT (33% vs. 25%). For those who did not remit with BT, the addition of zolpidem or cognitive therapy as a second treatment yielded equivalent response rates (54% and 56%, respectively), but larger remission rates when there was a switch of treatment modality (BT to zolpidem; 35%) than when patients remained within the same treatment modality (BT to CT; 22%). For those who did not remit with zolpidem, the addition of BT or trazodone yielded identical response rates (44%) and remission rates (22%). Although response/remission rates were generally lower among patients with psychiatric comorbidity, treatment sequences that involved BT followed by CT or zolpidem followed by trazodone led to better outcomes for comorbid insomnia than for insomnia without comorbidity.

Conclusion: These preliminary, descriptive, findings suggest that sequential therapy is an effective strategy to optimize insomnia management. Adding a second treatment produces an added value for those who fail to respond to initial therapies. Patients with comorbid insomnia may benefit from therapies (cognitive therapy, antidepressant) that target mood in addition to sleep.

Support (If Any): National Institutes of Health (MH091053).

0342

A META-ANALYSIS OF PLACEBO EFFECTS ACROSS HYPNOTIC RCTS: A FIRST PASS ANALYSIS

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Introduction: While there have been at least three meta-analyses on the subject of placebo effects in insomnia and several theory papers addressing the factors that may account for such effects, little is known about the relative magnitude of placebo effects on sleep continuity as assessed both objectively (PSG) and subjectively (Sleep Diaries). The prior studies notwithoutstanding, it is generally assumed that placebo effects disproportionately affect self-report outcomes. In order to address this issue, placebo effects (in terms of pre-post treatment outcome) were independently evaluated as part of a larger meta-analytic study on the relative efficacy of pharmacologic treatments for insomnia.

Methods: PubMed searches, 1967-June 2016, yielded 327 possible articles of RCTs evaluating BZs, BZRAs, SADs, DORAs, or melatonin agonists [MELA]). Of these investigations, 30 studies met the inclusion and exclusion criteria for the present sub-analysis. Average change, average percent change and weighted effect sizes (ES) were computed for SL, WASO and TST from the studies that provided data on acute treatment (studies that were between 1 and 14 days in duration).

Results: Pre-to-post change on PSG measures across all medication studies were as follows: SL (-19.2 min. -29.8%, ES=0.43); WASO (-16.9 min, 15.7%, ES=0.35); and TST (36.1 min, 11.1%, ES=0.62). Pre-to-post change on Sleep Diary measures across all medication studies were as follows: SL (-19.5 min, -23.8%, ES=0.28); WASO (-12 min, -13%, ES=0.55); and TST (37 min, -10.5 %, ES=0.42).

Conclusion: The acute effects of placebo administration corresponded to between 10% and 30% pre-to-post change in the various sleep continuity measures with corresponding effect sizes of between 0.28 and 0.62. The overall average ESs for PSG measures and Sleep Diaries appeared to be comparable (PSG=0.47 vs. SD=0.42), although the ESs for PSG measures on SL and TST were larger than the corresponding Sleep Diary measures.

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0343

USE OF SEDATIVE-HYPNOTICS AND MORTALITY: A POPULATION-BASED RETROSPECTIVE COHORT STUDY

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Introduction: Previous research suggests a possible link between sedative-hypnotics use and increased mortality. However, the relationship

between sedative-hypnotics and mortality is still controversial, and large population-based studies are lacking. In current study, we investigate a relationship between sedative-hypnotics use and mortality using a large population-based database in Republic of Korea.

Methods: We utilized the data from National Health Insurance Service (NHIS) from January 2002 to December 2015. The study population was 5% samples of population, registered in NHIS, who are 50 years old or older. We excluded the patients who died, and had been diagnosed with severe mental illness from January 2002 to December 2003. We defined the sedative-hypnotic users who were diagnosed with insomnia (G470, F510) and prescribed over 30 defined daily dose (DDD) per year between January 2002 and December 2003. We classified sedative-hypnotics by types, total amount of prescribed hypnotics and half-life for benzodiazepine. We estimated the risk of all-cause mortality (death from January 2004 to December 2015) by Cox proportional hazard model after adjusted for age, gender, and Charlson comorbidity index (CCI) between January 2002 and December 2003.

Results: We identified 8,176 sedative-hypnotics users and 327,835 non-users. After adjusting for age, gender and CCI, sedative-hypnotics users had significantly higher mortality risk than non-users (HR, 1.16; 95%CI, 1.11–1.21). Patients who use non-benzodiazepine had a higher increased mortality (HR, 1.52; 95%CI, 1.28–1.80) than those who use benzodiazepine (HR, 1.12; 95%CI, 1.07–1.18). The use of short-acting benzodiazepine (HR, 1.24; 95%CI, 1.05–1.48) and a higher prescribed dose predicted a greater increased mortality. (HR of 30-60DDD, 60-90DDD, >90DDD; 1.08< 1.20< 1.30, p<0.001).

Conclusion: Current results suggest that sedative-hypnotics uses can be associated with an increased mortality risk, especially those with use of non-benzodiazepine, short-acting benzodiazepine, and long-term or high dose uses. However, possible reverse causality for current results could not be excluded. In the future, prospective study to elucidate causal relationship is necessary.

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0344

TRENDS IN PRESCRIPTIONS OF SEDATIVE-HYPNOTICS AMONG KOREAN ADULTS: A NATIONWIDE PRESCRIPTION DATABASE STUDY 2011–2015.

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Introduction: Abundant prescription of sedative-hypnotics has been a serious issues because of the abuse, dependence, and side effects including cognitive impairement. we expect to contribute our results to monitor the usage of sedative-hypnotics and establish a basis for reducing sedative-hypnotic abuse.

Methods: Data from Health Insurance Review & Assessment (HIRA) Service 2011–2015 of Republic of Korea on prescriptions of sedative-hypnotics was analyzed. We included prescriptions from hospitals record of inpatients and outpatients and from community health care centers. After analyzing the entire population above age 18 in HIRA data, analyses were limited to the people with diagnostic codes F510 (nonorganic insomnia), G470 (insomnia). After analyzing the prescription numbers by individual items, prescription codes were grouped as 1) benzodiazepines (with their half-life: short-acting, intermediate-acting, and long-acting), 2) non-benzodiazepine sedative-hypnotics (such as zolpidem, zolpidem tartrate), 3) antidepressants, and 4) antipsychotics(Low-dose formulation of quetiapine, chloropramazine). We also calculated monthly percent change of the number of prescriptions by drug group, using join point regression.

Results: Diazepam was the most frequently prescribed for the entire population regardless of diagnosis (about 2,000,000 per month). Diazepam's prescription has been declining over time, but about 1,700,000 prescriptions per month have been assigned by the end of 2015. Zolpidem was the most frequently prescribed item among patients with insomnia (about 120,000 per month). The number of sedative-hypnotic prescription divided by the number of mid-year population showed a statistically significant increase in both men and women. When evaluating the prescription change by sedative-hypnotics type in monthly percent change analysis, antipsychotics showed a statistically significant increase about 20% in the age range of 50–59 years and over 70 years.

Conclusion: Diazepam is the most frequently prescribed sedative-hypnotics for total population in Korea, while zolpidem is the most frequently prescribed for insomnia patients. The prescription frequency of zolpidem has been increasing.

Support (If Any): This study was supported by research fund of Mental Health Technology Development Project. (Project No. HM15C1197).

0345

EFFICACY OF UNPOLISHED RICE GERM-DRIVED GABA ON SUBJECTIVE AND OBJECTIVE QUALITY OF SLEEP IN PATIENTS WITH INSOMNIA: A RANDOMIZED, PLACEBO-CONTROLLED TRIAL

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Introduction: Gamma-aminobutyric acid (GABA) has potential benefits in counteracting the sleep disruption and potential therapeutic effects on blood pressure, stress, cancer, and inflammatory diseases. Recently, High-dose GABA can be extracted from fermented rice germ using lactic acid bacteria. This study aimed to evaluate the subjective and objective improvement in sleep quality after unpolished rice-germ extracts-GABA treatment (300mg).

Methods: This is a prospective randomized placebo-controlled trial performed at Kyung-Hee University hospital at Gangdong from April 2016 to July 2016. Adult (age ≥30) patients who complained sleep disturbance for more than 1 month, and was diagnosis of insomnia according to DSM-IV criteria was enrolled. They were randomized into two groups: GABA treatment group and placebo group. Polysomnography was performed with questionnaires including Pittsburgh Sleep Quality Index (PSQI), insomnia severity index (ISI), Beck depression (BDI) and anxiety inventory (BAI) before and after 1 week of the treatment.

Results: Total 40 patients were enrolled and randomized: GABA treatment group (n=30), and placebo group (n=10). Initial demographics and questionnaire score were similar between the groups. Placebo group had less N1 sleep (9.4±4.7% vs 15.2±7.5%, p=0.008) and arousals (17.6±8.5/hr vs 28.0±14.1/hr, p=0.009). At 1 week after the treatment, PSQI (pre: 11.0±2.2, post: 9.8±2.5, p=0.002) and ISI score (pre: 14.6±4.6, post: 11.5±4.3, p<0.0001) significantly decreased in GABA treatment group but not in placebo group, however, there were no significant group effect. On follow-up

PSG, there were no significant difference in placebo group, however sleep latency significantly decreased (pre: 13.4 ± 15.7, post: 5.7 ± 6.2, p=0.001) and sleep efficacy significantly increased (pre: 79.4 ± 12.9, post: 86.1 ± 10.5, p=0.018) in GABA treatment group. Also, there was significant group effect in sleep latency before and after the treatment (ANCOVA, p=0.021). Three patients in GABA treatment group complained either drowsiness, headache or mild abdominal discomfort, and one patients in placebo group complained drowsiness.
Conclusion: This study shows that treatment of unpolished rice-germ derived GABA improved not only subjective sleep quality but also improves objective sleep efficacy without severe adverse events.
Support (If Any): None.

0346

COGNITIVE AROUSAL IN OLDER INDIVIDUALS WITH INSOMNIA COMPLAINTS AROUSAL IN OLDER INDIVIDUALS WITH INSOMNIA COMPLAINTS

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Introduction: In an ongoing study of cognitive behavioral treatments for insomnia (CBT-I), older community-living individuals with insomnia complaints completed the Glasgow Content of Thought Inventory (GCTI), a measure of pre-sleep thought content (25 questions on a 0-3-point frequency scale; range=0–75), at baseline and after 6-week treatment. We applied the GCTI to volunteers with onset, maintenance, and early morning awakening insomnia.
Methods: We examined the GCTI in 80 volunteers (aged 70.6 ± 6.46 years; 58 female), 61 of whom completed treatment. Participants also completed the Insomnia Severity Index (ISI), Geriatric Anxiety Scale, Geriatric Depression Scale, Dysfunctional Beliefs About Sleep, Perceived Stress Scale, Penn State Worry Questionnaire, Epworth Sleepiness Scale, and several cognitive scales.
Results: Most (85%) participants had evidence of insomnia of mixed etiology. The GCTI (26.9 ± 13.5, range 3–67) was not different among those with onset (46, 27.1 ± 11.9), maintenance (67, 27.8 ± 14.0), or early awakening (60, 28.2 ± 13.8) insomnia. At baseline, GCTI was correlated (Spearman) with dysfunctional beliefs about sleep (r=0.41, p<0.001), worry (r=0.40, p<0.001), and anxiety (r=0.34, p<0.01), but not associated with stress (r=0.21, p=0.066), depressive symptoms (r=-0.035, p=0.77), daytime sleepiness (r=0.096, p=0.41), cognitive status (r=0.015, p=0.91), age (r=0.13, p=0.28) or sex (r=0.21, p=0.067). GCTI was moderately correlated with ISI (r=0.42, p<0.001), but with only 18% of variance shared, GCTI may represent a different aspect of sleep disruption. The GCTI decreased after treatment (15.5 ± 14.9 points, p<0.0001, paired t-test), as did the ISI (9.3 ± 4.9, p<0.0001, paired t-test). Change in ISI following treatment, however, is only mildly associated with change in GCTI (r=0.28, p=0.034; Spearman) [<8% shared variance].
Conclusion: Our data indicate GCTI may represent a novel measure of sleep disruption in older individuals. Results further suggest CBT-I can have a beneficial impact on negative pre-sleep thought content and may apply to maintenance insomnia. Future research will determine whether this scale predicts response to specific aspects of CBT-I.

Support (If Any): National Institutes of Mental Health (1R01MH101468-01) and the Mental Illness Research, Education, and Clinical Center (MIRECC) at the VA Palo Alto Health Care System.

0347

SUICIDE ATTEMPTS IN THE 12 MONTHS FOLLOWING INCIDENT PRESCRIPTIONS OF SEDATIVE-HYPNOTIC MEDICATIONS IN A LARGE HEALTHCARE SYSTEM

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Introduction: Both sleep medications in general and insomnia have been associated with suicide risk. We sought to ascertain the frequency of suicide attempt (SA) by patients using any such medications and to provide SA rates by individual medication.
Methods: Subjects were receiving care in the US Veterans Health Administration (VHA) with an index (first time) prescription for a sleep medication in 2011, no SAs and no sleep medication prescriptions in 2010, and no additional sleep medication prescribed for 12 months after the incident prescription. Medications included benzodiazepines, z-drugs, ramelteon, sedating antidepressants, and antihistamines in dosages (e.g., 50–100 mg of trazodone) and dosing schedules (e.g., excluding 1 day prescriptions) consistent with insomnia treatment. SA frequencies in the 12 months after the index prescription were tabulated by medication. Data were obtained from the VHA Corporate Data Warehouse and the Suicide Prevention Application Network, which captures all VHA veteran SAs known to VHA. SA incidence was calculated according to accepted methods and presented as events per 100,000 person years (PYs) with a 95% confidence interval (CI).
Results: 226,482 VHA users had an incident sleep medication prescription, representing 3.4% of VHA users. Among 15 medications identified, the most commonly prescribed were trazadone (24.4%), zolpidem (18.4%), hydroxyzine (15.3%), lorazepam (11.6%), and mirtazapine (8.1%). The total of recorded SAs within one year of incident prescription was N=454, representing 207 SAs per PYs (95% CI=188–227). Those with the highest rate of SA per PY had been prescribed mirtazapine (330), trazadone (296), hydroxyzine (188), zolpidem (178), and lorazepam (180). The lowest rates among medications with at least 10,000 incident prescriptions was observed for temazepam (99), diazepam (117) and amitriptyline (131).
Conclusion: The rate of SA following incident sleep medications was similar to that observed in other large veteran cohorts, though there was variability of SA rates across individual medications. An observation is that the incident prescription rate is low compared to expected rates of incident insomnia.
Support (If Any): VA Center of Excellence for Suicide Prevention.
Disclaimer: The authors' views or opinions do not necessarily represent those of the Department of Veterans Affairs or the US Government.

0348

RESIDUAL EFFECTS OF SUVOREXANT, ZOLPIDEM AND RAMELTEON IN HEALTHY ELDERLY SUBJECTS: A RANDOMIZED DOUBLE-BLIND STUDY

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Introduction: Next-day residual effects are a common problem with current hypnotic agents. The purpose of the present study was to evaluate the residual effects of the new agent - suvorexant that doesn't have the muscle relaxation effect - on the physical and cognitive functions of healthy elderly people in the early morning and the day following drug administration. In this study, the next-day residual effects of suvorexant, zolpidem and ramelteon following bedtime dosing in elderly subjects were evaluated.

Methods: Six men and eight women aged 63–75 years received a single tablet (at 23:00), suvorexant 10 mg, zolpidem 5mg, ramelteon 4mg or placebo in a randomized, double-blind and crossover design. Measures of objective parameters (Timed up and Go test, Functional Reach Test, body sway test, critical flicker fusion test, simple discrimination reaction test and short-term memory test) and subjective ratings were obtained every 2 hour from 4:00 to 16:00. Akita University Ethics Committee approved the protocol. Written informed consent was obtained from all subjects.

Results: During our study, no subjects showed serious side effects, since physical observations and vital sign checks were done before and after hypnotics were taken. Furthermore, safety management was ensured such as by having a standby physician at all times. For the body sway test (closed eye), we find the main effects of the drug ($p=0.012$) with R-ANOVA and zolpidem was significant better than suvorexant and ramelteon in a multiple comparison using Bonferroni. The other parameters showed no significant differences.

Conclusion: Based on the above results, the changes of physical and cognitive functions in healthy elderly after taking hypnotics, it would be recognized that hypnotics are likely to be suitable for the elderly people with insomnia.

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0349

HOW ACCURATELY CAN THE COMBINATION OF A LARGE NUMBER OF SLEEP PARAMETERS MEASURED BY POLYSOMNOGRAPHY PREDICT SUBJECTIVE SLEEP QUALITY?

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Introduction: Different from our previously reported studies examining the bivariate correlation between each of the sleep parameters assessed objectively by polysomnography (PSG) and patient-reported sleep quality (SQ), we investigated how accurately a large number of PSG parameters can jointly predict (explain) SQ.

Methods: PSG recordings from two clinical trials involving 1518 insomnia patients treated with suvorexant or placebo were used post-hoc to build regression/classification models associating SQ and 98 PSG parameters and evaluate the accuracy of SQ prediction as a function of these parameters. PSG recordings from 882 primary insomnia patients from two clinical trials in which patients were treated with gaboxadol or placebo, were used to confirm the findings.

Results: Overall accuracy of the SQ prediction given a large number of PSG parameters is moderate (area under the ROC curve (AROC) =~70%). In contrast, subjective total sleep time and subjective number of awakenings explain SQ with much higher accuracy (AROC > 80%). Ranking of PSG parameters by their contribution to SQ revealed several clusters of correlated parameters contributing equally.

Conclusion: Accuracy of SQ prediction using a large number of PSG parameters was quantified. Obtained results may serve as the baseline for novel PSG parameters developed to improve SQ prediction accuracy.

Support (If Any): Funding: Merck & Co., Inc.

0350

EFFECT OF MINDFULNESS-ORIENTED INTERVENTIONS FOR INSOMNIA: A META-ANALYSIS

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Introduction: Mindfulness-based intervention is proposed and practiced as an alternative treatment, however, current evidence supporting the treatment effect of mindfulness-based interventions remains unclear. The study proposed to evaluate the effectiveness of mindfulness-based interventions for insomnia.

Methods: Eight databases (including PubMed, Medline and PsycInfo) were searched and the reference list of relevant records were screened for identifying eligible studies. Randomized controlled trials examining any forms of mindfulness-based intervention which containing meditation will be included for optimizing the search. Clinical trials with very small sample were excluded. Statistical analyses were performed using Review Manager version 5.3 using random effect model. The quality of included studies were assessed according to the Cochrane Collaboration tool for assessing risk of bias.

Results: An initial search result of 7462 records was then reduced to a final sample of fourteen selected trials for meta-analyses. A sampling of 1295 participant with sleep complaint was recruited, aged 57.5 in average and varied in health conditions. Subgroup analyses were conducted for the substantial heterogeneity among studies noted. Significant improvements were found in subjective insomnia severity when compared with no treatment/usual care in both healthy sample (SMD -0.78, 95% CI -0.99 to -0.57, $p<0.001$, 388 subjects) and cancer sample (SMD -0.25, 95% CI -0.40 to -0.10, $p=0.001$, 678 subjects). Inconsistent results were found in the specific sleep parameters measured by sleep diary and actigraph. However, insufficient data were available for comparing the efficacy of mindfulness-based intervention with other comparators, such as sleep hygiene education, psychotherapy and western medication.

Conclusion: Despite the mindfulness-based interventions demonstrate clinical benefit for improving the subjective sleep quality, the validity of evidence was limited for the diversity of treatment contents, heterogeneity of sample, the small sample size of included trials and cultural influence.

Support (If Any): N/A.

0351

INSOMNIA: A TRIVIALIZED CONDITION IN PRIMARY CARE SETTING

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Introduction: Insomnia is one of the leading sleep complaints in general practice settings. It is now considered as a modifiable risk factor in cardiovascular and mental health, besides imposing social and economic consequences. General practitioners (GPs) or family physicians are in a position to help patients manage insomnia and improve sleep health. This exploratory study aimed to gauge clinical presentations and treatment modalities of insomnia in general practice settings.
Methods: This project involved a qualitative pilot study with General Practitioners (GPs) recruited using a convenience sampling and snowballing technique. Semi-structured interviews were conducted with the GPs from metropolitan of Sydney, New South Wales using a schedule of questions to explore how insomnia is managed in general practice setting. Interviews were audio-recorded and transcribed verbatim. Transcripts were then analysed using the framework approach.
Results: Twenty-four interviews were conducted with consenting GPs. Forty-two percent (n=24) of the participants reported consulting "at least three patients per week". However, insomnia was only occasionally considered a primary problem. The majority of the participants reported rarely treating insomnia as a priority, treating comorbid issues in preference. Interviews demonstrated that there were no specific guidelines that GPs consult regarding sleep disorders. Medications commonly mentioned by the participants as being prescribed included: sedative antihistamine (doxylamine), melatonin, antidepressants (amitriptyline, agomelatine) and benzodiazepines (temazepam). Sleep hygiene was mentioned as the non-pharmacological advice provided to patients with insomnia.
Conclusion: The findings of this study emphasize the significance of raising awareness among GPs about prioritizing sleep complaints during any consultation. Introducing an updated comprehensive guideline for GPs to diagnose and manage insomnia effectively is paramount. Involving GPs in group discussions to exchange information, experiences, and opinions would also be a prudent step for improving the management of insomnia in primary care settings.
Support (If Any): N/A

0352

CORRELATIONS BETWEEN ADHERENCE TO CBT-I RECOMMENDATIONS AND CHANGE IN INSOMNIA SEVERITY: A REPORT FROM AN RCT ON THE TREATMENT OF PERINATAL INSOMNIA

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Introduction: The purpose of this study was to examine how therapists' ratings of patient adherence to stimulus control (SC) instructions, sleep restriction therapy (SRT), and hyperarousal reduction guidelines are related to change in insomnia severity among participants in an ongoing randomized controlled study on the treatment of perinatal insomnia.
Methods: Data from 46 participants randomized to receive 5 sessions of individual Cognitive-Behavioral Therapy for Insomnia (CBT-I) during pregnancy are included in the study. Therapists rated adherence to 4 SC instructions (i.e., go to bed only when sleepy; get out of bed when unable to sleep in the beginning of the night; get out of bed when unable to sleep in the middle of the night; use bed and bedroom only for sleep;), 3 SRT instructions (i.e., go to bed no earlier than prescribed; wake up at prescribed time; get out of bed shortly after waking), and 3 recommendations targeting hyperarousal (i.e., buffer zone, worry time, and relaxation). Three composite adherence ratings were constructed (SC, SRT, Hyperarousal) as the average of relevant items across sessions. Insomnia severity was measured using the Insomnia Severity Index (ISI).
Results: Greater percent improvement in insomnia severity was correlated with better therapist rated adherence to SRT (r=.310, p=.036) and hyperarousal reduction guidelines (r=.322, p=.033). Among the three hyperarousal guidelines, only adherence ratings of the 'use of buffer zone' recommendation were correlated with percent improvement in insomnia severity (r=.545, p=.001).
Conclusion: Prior studies of non-pregnant individuals have shown that greater adherence to SRT guidelines is related to larger treatment gains. This study extends past findings using a sample of pregnant women and assessing adherence to treatment components beyond SRT. We found that therapist-rated adherence to hyperarousal reduction guidelines, particularly setting aside time to unwind before bedtime, was positively related to improvement in treatment. It is unclear if this result will generalize to non-pregnant individuals with insomnia. Multi-modal assessment of adherence that includes both therapist and patient derived data could deepen our understanding of change processes in CBT-I.
Support (If Any):

0353

PRELIMINARY DATA FOR THE SLEEP TO PREVENT EVOLVING AFFECTIVE DISORDERS (SPREAD) TRIAL

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Introduction: Digital (i.e., internet delivered) cognitive behavioral therapy for insomnia (dCBT-I) has shown promise as an efficacious and widely accessible treatment for insomnia. Furthermore, reduction of insomnia may also reduce and prevent depression; however, the effectiveness of dCBT-I for insomnia and depression across a range of demographic patient types have not been established.
Methods: 330 individuals with insomnia (DSM-5 criteria) were randomized into two conditions: dCBT-I (N=146; age 49.7±14.1, 76.0% female, 25.3% black, 25.3% <$35k), or an online sleep education control (N=184; age 50.2±14.9, 78.8% female, 32.1% black, 32.1% <$35k). Outcome measures included the Insomnia Severity Index (ISI) and the Quick Inventory of Depressive Symptomatology (QIDS; sans sleep items), measured pre- and post-treatments. Effectiveness of dCBT-I for insomnia and depression symptoms were determined by sex, race, age (≤50, >50), socioeconomic status (annual household income <$35k and ≥$35k), and education.
Results: dCBT-I resulted in a robust significant improvement in ISI (-8.2±5.3 points) compared to control (-4.0±4.2 points). The post-treatment remission rate (ISI≤10) was significantly greater in the dCBT-I condition (67.1%) compared to the control group (33.7%; $p<.01$). Similar results were observed for depression symptoms, with the dCBT-I condition exhibiting decreased depression severity (-3.0±4.1 points, from 7.2±4.2 pre-treatment) compared to the control condition (-1.2±3.2 points, from 7.1±3.9 pre-treatment, $p<.01$).

Whereas depression rates (QIDS≥10) were comparable between conditions at pre-treatment (control: 28.3%; dCBT-I: 24.0%, $p>.05$), the dCBT-I condition exhibited a significantly lower rate of clinically significant depression at post-treatment (8.2%) compared to the control group (19.0%, $p<.01$). Results stratified by demographics indicated that dCBT-I yielded a near identical and significant decrease in both insomnia and depression symptom severity across all demographic groups.

Conclusion: Findings from this study provide further evidence for the effectiveness of dCBT-I, and also suggests its potential for reducing or preventing depression. This may enable large scale reduction of insomnia and depression for a wide range of demographics, including sex, race, socioeconomic status, and education.

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0354

EFFECTIVENESS OF LOW-FREQUENCY ELECTRICAL STIMULATION ON PATIENTS WITH CHRONIC INSOMNIA

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Introduction: Although transcutaneous electrical nerve stimulation (TENS) was known as relieving neuromuscular pain, it has been rarely used to treat insomnia. The aim of this study was to investigate additional effects of low-frequency electrical stimulation on chronic insomnia.

Methods: Fifty-four patients with chronic insomnia who took medications more than 6 months participated in the study, and they received TENS with low-frequency applied on trapeziums muscles (back and neck) via transcutaneous electrodes. They were required to apply the TENS for 30 minutes to an hour before taking sleep medications, more than 5 days per week, and for 4 weeks. Demographic characteristics, Pittsburgh sleep quality index (PSQI), insomnia severity index (ISI), Epworth sleepiness scale (ESS), hospital anxiety and depression scale (HADS) and quantitative EEG at wakefulness were evaluated before and after the treatment. Responders was defined when PSQI, ISI or ESS scores decreased more than 1standard deviation or dosage of medication was reduced after treatment.

Results: In 44 patients, poor sleep quality and insomnia severity at baseline decreased significantly after treatment (PSQI=12.53±3.65 to 11.05±3.73, $p<0.001$; ISI=13.48±7.24 to 11.72±5.98, $p=0.006$). Relative delta power in occipital region also decreased (15.08±9.38 to 12.7±10.56, $p=0.038$). Overall response rate was 57.5% and predictive factors of treatment response were excessive daytime sleepiness (OR=1.79, 95%CI=1.09–2.95, $p=0.021$), and depressive and anxious mood (OR=1.36, 95%CI=1.02–1.81, $p=0.038$) at baseline. A significant group-by-time interaction was observed in the relative delta power of occipital region between the two groups (responders=16.51±9.69 to 14.52±11.98; non-responders=13.66±9.14 to 14.52±11.98, $F=5.806$, $p=0.024$).

Conclusion: Low-frequency electrical stimulation had additive positive effects on patients with chronic insomnia who were on medications. Daytime sleepiness, and depressive and anxious mood were predictors of treatment response and decreasing occipital delta power was associated with relieving insomnia symptoms.

Support (If Any): None.

0355

A PLANNING STUDY: INSOMNIA INTERVENTION FOR CARDIOVASCULAR DISEASE REDUCTION

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Introduction: Insomnia is associated with a >2-fold increased risk of recurrent acute coronary syndrome comparable to traditional risk factors, thereby representing a novel target for coronary heart disease (CHD) prevention and reduction. We conducted a pilot randomized control trial to evaluate the efficacy of a web-based cognitive behavioral therapy for insomnia (wCBT-I) intervention for patients with comorbid insomnia and CHD.

Methods: We randomized 33 patients with insomnia (difficulty falling or staying asleep for ≥3 months with insomnia severity index (ISI) score >10) and CHD to 6 weeks of access to wCBT-I (Go! To Sleep) compared to 6 weeks of a sleep education website, followed by wCBT-I access (wait-list control group). The primary endpoint was change in ISI score, and secondary endpoints included change in blood pressure (BP), Patient Health Questionnaire-8, and Epworth Sleepiness Scale score. Two-sample t-tests were used to assess mean change in outcome between control and intervention groups.

Results: A total of 34 individuals were enrolled and 27 completed the study. There were no significant differences in sample characteristics between arms. Mean age was 71.6±9.5, 75% were male, and mean BMI was approximately 29±4.5 kg/m^2. Baseline ISI scores were 15.6 and systolic BP was 126 mmHg in both arms. At 6 weeks, there was a 6.2±5.3 reduction in ISI scores in the intervention arm and a 3.3±5.1 reduction in the control arm. Additionally, there was a 2.9±19.2 mmHg reduction in systolic BP in the treatment arm compared to a 0.5±6.6 mmHg increase in the control arm.

Conclusion: A web-based CBT-I intervention appeared to be feasible in an older sample with prevalent CHD, who did not present for insomnia symptoms. Despite low statistical power, these preliminary data suggest that w-CBT-I improves both insomnia and BP in patients with comorbid CHD.

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0356

CLINICIAN PERCEPTIONS RELATED TO THE USE OF CBT-I COACH MOBILE APP

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Introduction: Clinicians' perceptions of CBT-I Coach, a free mobile app for cognitive-behavioral therapy for insomnia (CBT-I), are critical for influencing the app's integration into practice. Five perceptions of the diffusion of innovations theory include: the relative advantage to current practice; the compatibility to clinician's needs; complexity, or ease of use; the innovation's trialability, or degree of experimentation; and observability, capacity to observe results. Clinicians' use, feedback, and perceptions of the app were evaluated a year after CBT-I Coach became available.

Methods: VA CBT-I trained clinicians (N = 108) were surveyed about their CBT-I caseload and CBT-I Coach use. A measure of the perceived innovation attributes was created to assess clinicians' perceptions of the app.
Results: Fifty percent of clinicians treating CBT-I patients in the past year reported using CBT-I Coach. Of those not using the app, 83% endorsed intention to use it. Overall perceptions of CBT-I Coach were favorable. Those using CBT-I Coach had more favorable perceptions across all constructs ($p < .01$ - $p < .001$), except relative advantage, compared to those not using it. Perceiving the app as not complex and compatible with care were most strongly related to use ($r_{pb} = -.45$, $p < .001$; $r_{pb} = .53$, $p < .001$, respectively). Qualitative data corroborated these findings, as frequently cited reasons for not using the app were due to lack of patient access to smartphones, not having time to learn the app, and lack of direct access to app data. Positive qualitative themes also emerged indicating the app provides accessibility to helpful tools and improves homework adherence.
Conclusion: While all participants perceived the advantage to using CBT-I Coach, it is imperative that this tool be relatively simple to use and compatible to clinicians' practice. Continued efforts are needed to improve ease of use and to evaluate its effectiveness.
Support (If Any): The writing of this project was supported by the Department of Veterans Affairs, Office of Academic Affiliations, NCPTSD D&T Division VA-Sponsored Fellowship in PTSD Research and Treatment.

0357

DETERMINANTS OF POOR RESPONSIVENESS IN PATIENT TO COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA

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Introduction: Previous studies have argued that insomnia with short sleep duration (I-SSD) is poor candidate for cognitive behavioral therapy for insomnia (CBT-I).
Methods: Sixty-four chronic insomnia disorder patients at the Gifu Mates Sleep Clinic, who met the International Classification of Sleep Disorders-3 criteria were included. All patients underwent polysomnography (PSG), and flexible protocol CBT-I. The participants were divided into three groups according to the Insomnia Severity Index score (ISI) after intervention (post-ISI): post-ISI ranged less than 10; the good response (GR) group, 10 to 14; moderate response (MR) group, or more than 15; poor response (PR) group. Demographic, PSG variables, and the scores of questionnaires (ISI, the Pittsburgh Sleep Quality Index, the Dysfunctional Beliefs and Attitudes about Sleep (DBAS-16), the Self-rating Depression Scale (SDS), the Hyperarousal Scale, and the Ford Insomnia Response to Stress Test) were compared among three groups via Kruskal-Wailles test, analysis of variance, or chi-squared test. Furthermore, we explored significant factors for poor response via stepwise multiple logistic regressions analysis.
Results: PSG variables including objective sleep time were not different among three groups. Age was significant higher in PR than GR and MR (67.8 ± 11.6 (s.d.) vs 54.1 ± 13.9, P = 0.039, 51.9 ± 18.2, P = 0.048). DBAS-16, SDS were significant higher in PR than GR (121.1 ± 14.8 vs 91.3 ± 24.6, P = 0.009, 53.6 ± 12.0 vs 41.4 ± 8.6, P = 0.002). Logistic regression analysis revealed adjusted odds ratio for PR of age and DBAS-16 were 1.11 (95% confidential interval (CI), 1.03 to 1.25, P = 0.021), 1.06 (95% CI, 1.01 to 1.13, P = 0.043), respectively.
Conclusion: I-SSD may not be poor candidate for CBT-I. High age and high DBAS may be determinant factors of poor responsiveness to CBT-I.
Support (If Any): None.

0358

RESIDUAL EFFECTS OF ESZOPICLONE AND PLACEBO IN HEALTHY ELDERLY SUBJECTS, A RANDOMIZED DOUBLE BLIND STUDY

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Introduction: Next-day residual effects are a common problem with current hypnotics. The purpose of the present study was to evaluate the residual effects of the eszopiclone on the physical and cognitive functions of healthy elderly people in the early morning and the day following drug administration.
Methods: Four men and six women aged 63–72 years were administered, eszopiclone 1 mg or placebo in a randomized, double-blind and crossover design. Measures of objective parameters and subjective ratings were obtained at 4:00, 6:00, and every 2 h from 6:00 to 16:00.
Results: For the Timed Up-and-Go test, the main effects of time were seen. For the Critical Flicker Fusion, eszopiclone had significantly worse results compared to placebo in early morning (4:00). There were no significant differences between eszopiclone and placebo in other objective assessments. For the sleep latency, eszopiclone had significantly shorter results compared to placebo(eszopiclone vs placebo = 28.4 min vs 52.5 min, p=0.047). Feeling of deep sleep and the number of wake after sleep onset did not show any significant differences between eszopiclone and placebo.
Conclusion: Based on the above results, the changes of physical and cognitive functions in healthy elderly after taking hypnotics, it would be recognized that eszopiclone 1mg is likely to be suitable for the elderly people with insomnia.
Support (If Any): none.

0359

EFFICACY OF BEHAVIORAL INSOMNIA TREATMENT ON POST-MENOPAUSAL QUALITY OF LIFE

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Introduction: Insomnia and reduced quality of life are very common among post-menopausal women. We examined the efficacy of Cognitive Behavioral Therapy for Insomnia (CBT-I) in comparison to Sleep Restriction Therapy (SRT) and an Information-only Control (IC) condition on improving insomnia and quality of life symptoms.
Methods: Post-menopausal females (n=122, mean age 55.6 ± 5.42) meeting DSM-5 criteria for insomnia concurrent with menopause but without contraindicative psychopathology were recruited. Participants were screened for other sleep disorders via polysomnography (PSG). All participants showed an average wake after sleep onset ≥ 45 minutes across two nights of PSG. They were then randomized to a 6-week CBT-I (n=41), 2-week SRT (n=41), or a 6-week IC condition (n=40). Participants completed the Insomnia Severity Index (ISI) and Menopause-Specific Quality of Life (MENQOL) questionnaire before and after treatment.
Results: One-Way ANOVA showed no significant differences in baseline ISI score or MENQOL domains (vasomotor, psychosocial,

physical, and sexual) between groups. For ISI, both SRT and CBT-I produced a significant reduction in symptoms post-treatment (p<.0001). Paired t-tests revealed that the CBT-I group had significant decreases in vasomotor (p=.008), physical (p=.006), and sexual symptoms (p=.001), with psychosocial symptoms approaching significance (p<.1). The SRT group only showed a significant decrease in sexual symptoms post-treatment (p=.038). Independent samples t-tests showed significant differences between the CBT-I and control groups for physical (p=.03) and sexual symptom (p=.04) change scores.

Conclusion: These results suggest that both CBT-I and SRT are associated with an improvement in insomnia and sexual functioning in women with menopausal-insomnia. However, unlike SRT, CBT-I also resulted in a reduction of vasomotor, psychosocial, and physical menopause symptoms, suggesting that brief sleep restriction treatment has limited efficacy for addressing broad (non-sleep) menopause-related quality of life symptoms.

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0360

COGNITIVE BEHAVIOURAL THERAPY FOR INSOMNIA REDUCES THE DISCREPANCY BETWEEN ACTIGRAPHY AND SELF-REPORT ESTIMATES OF SLEEP QUALITY AND QUANTITY IN COMORBID INSOMNIA AND MAJOR DEPRESSIVE DISORDERS

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Introduction: Self-reported symptoms of insomnia are often inconsistent with objective measures of sleep, including measures derived from actigraphy. Cognitive behavioural therapy for insomnia (CBT-I) effectively improves insomnia symptoms, but whether it reduces subjective-objective sleep discrepancy is not well understood. This study examined whether CBT-I reduces subjective-objective sleep discrepancy against a control condition, and explored associations between changes in discrepancy and changes in sleep-related attitudes.

Methods: Participants were 112 (age *M*±*SD*=47.1±12.3, 67.9% female) adults with comorbid insomnia and major depressive disorder from the TRIAD (Treatment of Insomnia and Depression) study. They were randomized to 7-session CBT-I or control interventions to augment antidepressant pharmacotherapy over 16 weeks. 2-week actigraphy and sleep diary were collected at baseline, in the middle, and at the end of the trial. Subjective-objective sleep discrepancy was operationalised as the discrepancy between self-report and actigraphy time-in-bed (TIB), total sleep time (TST), sleep onset latency (SOL), and wake after sleep onset (WASO). The Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS) was administered at baseline and mid-intervention.

Results: At baseline, self-report TIB and TST were significantly shorter, whilst SOL and WASO longer than those from actigraphy. Multilevel models using daily data showed that after controlling for age and sex, the CBT-I group showed significantly greater reduction in subjective-objective sleep discrepancy in all (except TIB) domains compared to the control group (all *p-values*<.01). Improvements were evident from mid-intervention. The differential effects of the two interventions on the overall reduction of subjective-objective sleep discrepancy in TST, SOL, and SE (but not WASO) was significantly associated with changes in DBAS from baseline to mid-intervention (all *p-values*<.05).

Conclusion: CBT-I was effective in reducing the subjective-objective sleep discrepancy in patients with comorbid insomnia and major depression. Improvements in subjective-objective sleep discrepancy was associated with improved sleep-related attitudes, a therapeutic target of CBT-I.

Support (If Any): MH078924, MH078961, MH079256.

0361

LONG-TERM OUTCOME OF GROUP COGNITIVE-BEHAVIORAL THERAPY FOR INSOMNIA (CBT-I)

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Introduction: Cognitive-Behavioral Therapy has been recognized as the first-line treatment for chronic insomnia. No published study evaluated the long-term maintenance of clinical outcomes longer than three years.

Methods: Non-randomized clinical series of 292 consecutive sleep clinic insomnia patients (mean age 40.7±12.3 yrs, 38.4% males, 61.6% females) were included to evaluate the long-term effect of 7-session group CBT-I after a mean of 7.8±1.6 years (range 4–10 yrs) from the end of treatment. Primary outcome was Insomnia Severity Index (ISI) score. Secondary outcomes included presence of insomnia relapses and how patients dealt with insomnia episode (i.e. use of drugs-D, use of cognitive-behavioral techniques-CBT, use of both-D+CBT). ISI score at pre-treatment baseline assessment (T0), end of treatment (T1) and follow-up (T2) were compared.

Results: 11% of patients did not complete ISI at T1 and 46% at T2, primarily due to loss of contact from relocating residence. Between patients who responded to follow-up evaluation and the ones who did not, there was no significant difference in terms of ISI scores at T0 and T1, age and duration of insomnia. A significant effect of treatment was observed in ISI score, $F(1.78, 207.38) = 89.09$, $p < 0.001$ across times without effect of the length of follow-up. 90.3% of patients no longer had clinical insomnia (ISI ≤14) at T1 (ISI 17±4.5 at T0 vs 9.5±4.2 at T1) and 78% at T2 (ISI score 9.9±6.3 at T2). 89 patients (77%) reported at least one episode of insomnia relapse at T2. To deal with relapse, 29 patients (33%) took D, 38 patients (43%) used CBT and 22 patients (24%) used D+CBT. The lowest ISI score at T2 was found in patients who used only CBT-I techniques when facing relapse. Means ISI score were: D=13±7.2, CBT=9±6.2 (p<0.05), D+CBT=10.2±5.5.

Conclusion: CBT-I in group format resulted in clinically meaningful improvement as assessed by ISI at the end of treatment, and most of the patients sustained the improvement at a long-term follow-up.

Support (If Any): none.

0362

LONG-TERM FOLLOW UP OF THE EFFICACY OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA (CBT-I) IN RELATION TO DEPRESSIVE SYMPTOMS

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Introduction: Depressive symptoms very often are co-existing with insomnia. Cognitive behavioral treatment for insomnia (CBT-I) has been demonstrated to improve also symptoms of depression. This study evaluated whether depressive symptom severity is associated with poorer response to CBT-I at the end of 7-session treatment (T1) and at a long-term follow of a mean of 7.8±1.6 years (range 4–10 years) (T2).
Methods: Non-randomized retrospective study of 286 sleep clinic patients (mean age 40.7±12.3, 38.4% males, 61.6% females) with chronic insomnia who completed 7-session group CBT-I. We compared low depression (LD) and high depression (HD) groups, based on a cutoff of 14 on the Beck Depression Inventory (BDI).
Results: Compared to baseline (T0), a significant decrease of ISI and BDI scores were observed in both LD and HD groups at the end of treatment (T1) and at the long-term follow-up (T_2) (P<.001). HD group improved more than LD group in both ISI and BDI scores. ISI scores of the LD patients were 15.9±4.3 at T0, 9±3.9 at T1, p<.05 and 8.5±5.2 at T2. BDI was 7.8±3.5 at T0, 4.8±3.6 at T1, p<.05 and 5.7±3.7 at T2. Delta score for ISI at T1 was 7.5±4.8 and 6.5±5.1 at T2 while for BDI 2.8±5.1 at T1 and 0.59±6.1 at T2.HD patient's ISI scores were 19.5±3.7 at T0, 12.7±4.8 at T1, p<.05 and 15.6±6.5 at T2. Delta score for ISI at T1 was 8.8±5 and 8.1±7.1 at T2 while for BDI 9.9±7 at T1 and 6±8.2 at T2.
Conclusion: Results demonstrate that CBT-I improved not only insomnia severity but also comorbid depressive symptoms at the end of treatment. Improvements were sustained at a long-term follow-up evaluation after a mean of 7.8 years. Greater depression symptoms did not lead to poorer response to CBT-I. Thus, the benefits of CBTI are sustained long-term, and extend beyond insomnia and include improvement in depressive symptoms severity.
Support (If Any): None.

0363

IN SUBJECTS WITH INSOMNIA, USE OF A CLOSED-LOOP ACOUSTIC STIMULATION NEUROTECHNOLOGY IMPROVES HEART RATE VARIABILITY AND BAROREFLEX SENSITIVITY: RESULTS OF A PLACEBO-CONTROLLED CLINICAL TRIAL

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Introduction: Sympathetic hyperarousal contributes to insomnia, and there is a need for effective strategies for improving autonomic regulation. High-resolution, relational, resonance-based, electroencephalic mirroring (HIRREM®) is a closed-loop, allostatic, acoustic stimulation neurotechnology that uses software-guided algorithmic analysis to translate selected brain frequencies into audible tones, to support real time self-optimization of brain activity.
Methods: In this IRB-approved study of HIRREM for insomnia, 694 subjects were screened, and 122 with Insomnia Severity Index (ISI) scores of ≥15 were enrolled and randomized to receive either ten, 90 minute sessions of HIRREM plus current care (HCC), or placebo (random audible tones) plus current care (PCC), over 1–2 weeks. Ten-minute recordings of blood pressure and heart rate were obtained at enrollment (V1), 1–2 weeks (V2), and 2 (V3, primary outcome) and 4 months (V4) post-intervention to evaluate changes in autonomic cardiovascular regulation as measured by baroreflex sensitivity (BRS) and heart rate variability (HRV).
Results: 101 completed intervention (52 HIRREM, 49 placebo; mean age 53.3 +/- 14.6, 69 women). Preliminary analysis (n=97) shows significant increases at V3 for multiple BRS and HRV measures in the HCC group, with durability to V4, including increases in HF alpha (ms/mmHg, V1=18.2, V3=25.3, p=0.001, V4=24.4, p=0.006), BRS Sequence All (ms/mmHg, V1=12.9, V3=20.6, p<0.001, V4=17.98, p=0.003), rMSSD (ms, V1=28.6, V3=54.5, p<0.001, V4=52.2, p<0.001), and HF absolute power (ms^2, V1=393, V3=1241, p=0.02, V4=928, p=0.03). There were no significant increases in these measures in the PCC group at V3 or V4.
Conclusion: In individuals with insomnia, use of HIRREM was associated with significant improvements in multiple BRS and HRV measures, suggesting durable increase in parasympathetic influence. These findings may have special significance in the context of recent studies showing autonomic dysregulation in insomnia and other sleep disorders.
Support (If Any): The Susanne Marcus Collins Foundation, Inc.

0364

NIGHT-TO-NIGHT SLEEP VARIABILITY IN OLDER ADULTS WITH CHRONIC INSOMNIA: A RANDOMIZED CONTROLLED TRIAL OF BRIEF BEHAVIORAL THERAPY FOR INSOMNIA

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Introduction: Night-to-night variability in sleep is a clinical feature in understanding and treating insomnia in older adults. The present study examined changes in sleep variability in the course of a brief behavioral treatment for insomnia (BBT-I) in older adults who had chronic insomnia. Additionally, the present study examined the mediating mechanisms underlying reductions of sleep variability and the moderating effects of baseline sleep variability on treatment responsiveness.
Methods: Sixty-two elderly participants were randomly assigned to either BBT-I or waitlist control (WLC). Sleep was assessed by sleep diaries and actigraphy from baseline to posttreatment and at 3-month follow-up. Mixed models were used to examine changes in sleep variability (within-person standard deviations of weekly sleep parameters) and the hypothesized mediation and moderation effects.
Results: Variability in diary-assessed sleep onset latency (SOL) and actigraphy-assessed total sleep time (TST) significantly decreased in BBT-I compared to WLC (Pseudo *R2*=.12, .27; *p*=.018, .008). These effects were mediated by reductions in bedtime and wake time variability and time in bed. Significant time by group by baseline sleep variability interactions on sleep outcomes indicated that participants who had higher baseline sleep variability were more responsive to BBT-I; their actigraphy-assessed TST, SOL, and sleep efficiency improved to a greater degree (Pseudo *R2*=.15-.66; *p*<.001-.044).

Conclusion: BBT-I is effective in reducing sleep variability in older adults who have chronic insomnia. Increased consistency in bedtime and wake time and decreased time in bed mediate reductions of sleep variability. Baseline sleep variability may serve as a marker of greater treatment responsiveness to BBT-I.
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0365

INSOMNIA SEVERITY INDEX SCORE CHANGES IN RESPONSE TO POSITIVE AIRWAY PRESSURE IN SLEEP DISORDERED BREATHING IN A LARGE CLINIC-BASED COHORT

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Introduction: Clinical effectiveness data of the impact of positive airway pressure (PAP) therapy on insomnia symptoms in sleep disordered breathing (SDB) are limited. We hypothesize that PAP improves Insomnia Severity Index (ISI) scores in a large clinic-based cohort.
Methods: Patients with SDB who initiated PAP (1/1/2010–12/31/2014) and ISI were retrospectively analyzed. Paired and two-sample t-tests were used to evaluate ISI changes with PAP and stratified based on PAP adherence (usage >4 hours nightly >70% of the time). Post-PAP ISI scores were estimated using multivariable linear regression models, adjusted for: pre-PAP ISI score, age, gender, race, socioeconomic status (SES), smoking, and co-morbidities (cancer, chronic renal failure, diabetes, depression, coronary artery disease, hypertension, stroke, and atrial fibrillation) as covariates.
Results: The analytic sample was comprised of 1,183 patients with mean age 55.7±13.1 years, 49.8% male, 77.4% Caucasian, and BMI 33.1±9.0 kg/m^2. PAP therapy resulted in significantly improved ISI scores (-3.26±6.57,p<0.001) including all ISI items. Objectively PAP adherent patients demonstrated a significant improvement (-4.03±6.26) versus non-adherent (-2.28±6.42,p<0.001) in total ISI score as well as all ISI items except falling asleep & early waking. Multivariable linear regression models demonstrated: median income, per $10,000 [-0.31 (-0.54,-0.08)p=0.01]; active antidepressants [1.76 (0.77,2.74)p<0.001]; AHI, per 5 units [-0.09 (-0.18,-0.01)p=0.03]; and PAP adherence [-2.30 (-3.21,-1.37)p<0.001] were strong predictors of post-PAP ISI changes after adjusting for covariates.
Conclusion: Results from this clinic-based cohort indicate improvement in ISI scores in SDB with PAP treatment irrespective of adherence, albeit more pronounced in adherent patients. Objectively PAP adherent patients demonstrated significant improvements in staying asleep. Patient characteristics of lower SES, using antidepressants, lower AHI, and PAP non-adherence demonstrated resistance to PAP-related improvement in ISI scores. These are key data to inform risk stratification to target enhanced insomnia treatment for these vulnerable subgroups.
Support (If Any): Research was made possible by the Cleveland Clinic Neurological Institute Research Project Pilot Funding. We acknowledge the Knowledge Program Data Registry of Cleveland Clinic, Cleveland, OH for providing the data used in these analyses. We acknowledge the Neurological Institute Center for Outcomes Research and Evaluation (NICORE) Cleveland Clinic, Cleveland, OH for providing biostatistical resources and NICORE Scholars Award.

0366

SUBJECTIVE-OBJECTIVE DISCREPANCIES IN TREATMENT OUTCOME WITH FOUR TYPES OF HYPNOTICS: A FIRST PASS ANALYSIS

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Introduction: Hypnotics may have different effects on subjective (sleep diary [SD]) and objective (PSG) measures of sleep continuity. Thus, the concurrent examination of both measurement strategies, while rarely done, is important because improvement in one domain may not be paralleled by improvement in the other domain. Meta-analytic data were used to assess the association of subjective and objective treatment outcomes by drug class.
Methods: PubMed searches, from 1967-June 2016, yielded 327 possible articles of RCTs evaluating BZs, BZRAs, SADs, DORAs, or melatonin agonists (MELA). Weighted effect sizes (ES) were computed for the pre-post change data and were compared to the study placebo condition. Between measurement strategy differences were assessed using ES difference scores. Note: positive values favor sleep diary outcomes and negative values favor PSG outcomes.
Results: Sufficient data were available for only BZRAs, SADs, DORAs, and MELA. When examining subjective-objective ES difference scores the following was observed: SL (BZRAs = 0.04; SADs = 0.02; DORAs = -0.03; MELA = -0.14); WASO (MELA = 0.03; BZRAs = -0.01; DORAs = -0.17; SADs = -0.26); and TST (BZRAs = 0.03; SADs = -0.03; DORAs = -0.10; MELA = -0.11).
Conclusion: These preliminary results indicate that, overall, BZRAs produce the most concordant results on PSG and self-report measures (when taking into account placebo responding). The most discordant results, overall, were found with the DORAs and MELA, although the single most discordant value was for SADs on WASO. In each of these cases, PSG measures were found to show greater levels of efficacy. Given that subjective and objective treatment gains may reflect different benefits to the patient, discordance need not be viewed as better or worse efficacy. This said, medications that disproportionately affect objective measures may not be viewed favorably by patients and this may, in turn, adversely affect treatment adherence.
Support (If Any): Partial support provided by R56AG050620 and R01AG041783.

0367

EFFECTS OF BLUE BLOCKING LENSES ON SLEEP QUALITY AND DURATION IN INDIVIDUALS WITH INSOMNIA

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Introduction: Nocturnal blue-wavelength light exposure may contribute to insomnia by suppressing and delaying melatonin secretion, thereby prolonging sleep onset latency (SOL), and altering sleep

quality. We aimed to determine if wearing amber-tinted blue blocking (BB) lenses before bedtime improves sleep in individuals with insomnia.
Methods: The effects of BB and clear lenses, worn for 2 hours preceding bedtime for 7 nights, were compared in a randomized crossover trial (4-week washout). A total of 11 participants (n=6 females), age (± SEM) 46.5 ± 3.3 y and body mass index 27.4 ± 1.4 kg/m^2, diagnosed with insomnia based on the Insomnia Symptom Questionnaire, were included. Ambulatory sleep measures included the Pittsburgh Insomnia Rating Scale (PIRS), a daily post-sleep questionnaire, and wrist-actigraphy.
Results: PIRS total scores were lower (improved) in BB vs. clear (78.6 ± 8.0 vs. 96.0 ± 10.1; p=0.05). Scores for Quality of Life, Distress, and Sleep Parameter subscales of the PIRS were lower in BB vs. clear (p=0.007, p=0.09 and p=0.10, respectively). In BB vs. clear, for mean values across the 7-day intervention period, subjective estimates of total sleep time (TST; 396.5 ± 25.9 vs. 344.3 ± 23.7 min; p=0.004) and sleep efficiency (SE; 87.3 ± 4.1 vs. 82.3 ± 5.1 %; p=0.09) were higher, and wake after sleep onset (WASO; 37.9 ± 13.1 vs. 56.8 ± 20.1 min; p=0.06) was lower. Actigraphy-derived measures of TST (7-day mean) were significantly higher in BB vs. clear (359.9 ± 12.7 vs. 318.2 ± 11.7 min; p=0.01), but not significantly higher for SE (78.4 ± 2.7 vs. 75.0 ± 2.4 %; p=0.15). Subjective and objective measures of SOL were not affected by treatment (p-values ≥0.30). Mean arterial pressure at the end of each treatment was decreased in BB vs. clear (92.6 ± 4.1 vs. 100.4 ± 4.0 mmHg; p=0.05).
Conclusion: Wearing BB lenses before bedtime improved sleep in individuals with insomnia. These findings have public health relevance given the high rates of insomnia and prevalent use of light-emitting devices before bedtime. BB lenses represent a safe, affordable, and easily implemented therapeutic intervention for insomnia symptoms.
Support (If Any): American Sleep Medicine Foundation #144-FP-16.

0368

OPEN LOOP AUDIO VISUAL STIMULATION INDUCES DELTA ACTIVITY IN OLDER ADULTS WITH PAIN AND INSOMNIA

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Introduction: Human brainwaves mimic frequencies of stimuli received. Insomniacs often have excessive gamma (35–45 Hz), suggesting cortical hyperarousal. We tested an open-loop Audio and Visual Stimulation (AVS) program that progressively downward stimulates brainwaves to induce slow (delta; 1–3 Hz) brainwaves.
Methods: We conducted a small randomized controlled trial in 15 older adults with clinically significant co-morbid insomnia and osteoarthritis (OA) pain (mean age 68.3 ± 4.8 years). The Procyon (MindPlace) AVS device with goggles (flashing light) and earphones (pulsing sound) was used to stimulate brainwaves from 8Hz to 1Hz over 30 minutes in the experimental group. The control group received placebo AVS that idled below 0.5Hz, outside of the brainwave entrainment range. Cortical activity was evaluated using a 19-channel quantitative electroencephalographic system (Discovery 24E, BrainMaster) at baseline (immediately prior to AVS training) and during the initial AVS training. All initial trainings were scheduled in the early afternoon (1-3pm).
Results: Compared to norms, mean baseline gamma (35–45 Hz) was elevated in both groups (experimental: gamma z-score 4.5 ± 2.3 versus control: 3.6 ± 1.3). After AVS, delta induction mean average of all 19 channels was different between the groups (p=.02) with the experimental group showing significant delta induction from baseline (p<.001) compared to the placebo (n.s.). Brain locations corresponding to the sensory-thalamic pathway had most delta induction compared to placebo: Cz (p=.003), Fp (p=.02), O1 (p=.03), and O2 (p=.003).
Conclusion: AVS increased delta brainwaves, the brainwaves that characterize deep sleep. Further research is needed to test AVS as a sleep promoting approach for home use.
Support (If Any): Research & Intramural Funding Program; School of Nursing University of Washington.

0369

A RANDOMIZED CONTROLLED INTERVENTION OF WORKPLACE-BASED GROUP COGNITIVE BEHAVIOURAL THERAPY FOR INSOMNIA: THE MODERATING EFFECT OF CHRONIC STRESS

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Introduction: Sleep disturbance is common in the working population, often associated with work stress, health complaints and impaired work performance. This study investigated if a group intervention at work, based on Cognitive Behavioral Therapy (CBT) for insomnia, may improve sleep and if the effects were moderated by burnout levels at baseline.
Methods: This is a randomized controlled intervention with a waiting list control group. Participants were employees working at least 75% of full time, reporting self-perceived moderate sleep problems (N=51, 63% women). The intervention consisted of five group sessions at the workplace plus homework. Data were collected at baseline, post-intervention and at a three-month follow-up through diaries, wrist actigraphy and questionnaires including the Insomnia Severity Index (ISI) and the Shirom-Melamed Burnout Questionnaire (SMBQ).
Results: A multilevel mixed model showed no significant interaction effects for sleep. However, by adding burnout levels at baseline into the model, a moderating effect on insomnia symptoms was observed through a significant three-way interaction (Coeff.=3.28; p=0.009; C.I.=0.82–5.75). Individuals in the intervention group with low to moderate levels of burnout at baseline (SMBQ<3.75) displayed significantly reduced ISI score at follow-up as compared to individuals with high levels of burnout at baseline (Coeff.=2.51; p=0.005; C.I.=0.77–4.24).
Conclusion: Group CBT for insomnia given at the work place did not reduce sleep problems, while there were some indications that the intervention reduced symptoms of insomnia in employees with low burnout levels. The results suggest that group CBT may improve sleep in individuals with primary insomnia.
Support (If Any):

0370

IMPACT OF CO-MORBID OBSTRUCTIVE SLEEP APNEA IN THE TREATMENT OF INSOMNIA

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Introduction: Co-morbid insomnia and obstructive sleep apnea (OSA) is a highly prevalent and debilitating condition. However, physicians and researchers are still uncertain as to the most effective treatment approach. Several research groups have suggested that these patients should initially receive treatment for their insomnia with cognitive/behavior therapy (CBTi) before the OSA is targeted. The current study

aimed to determine whether the effectiveness of CBTi is reduced in the presence of mild, or moderate-severe co-morbid obstructive sleep apnea.
Methods: A retrospective chart review was conducted to examine 455 insomnia patients entering a CBTi treatment program in a hospital outpatient setting. Of these 455, 314 patients were diagnosed with insomnia-alone, 103 were found also to have mild sleep apnea, and 38 also had moderate or severe OSA. Improvements in sleep diary parameters, the Insomnia Severity Index, and several daytime functioning questionnaires from baseline, to post-treatment, to 3-month follow-up were compared between these groups.
Results: Patients with co-morbid insomnia and OSA experienced significant improvements in insomnia symptoms during treatment. For example, among patients with mild sleep apnea, sleep onset latency was reduced by 46 minutes, wake after sleep onset was decreased by 66 minutes, and sleep efficiency was increased by 19%. Among patients with moderate and severe sleep apnea, sleep onset latency reduced by 18 minutes, wake after sleep onset by 70 minutes, and sleep efficiency increased by 16%. These improvements in average sleep-diary parameters as well as global insomnia severity, and daytime functioning measures were not significantly different between patients with insomnia-alone, patients with mild sleep apnea, or patients with moderate to severe sleep apnea.
Conclusion: Cognitive/behavioral therapy for insomnia is an effective treatment in the presence of mild, moderate, and severe co-morbid obstructive sleep apnea. This information offers some support for the suggestion that patients with co-morbid insomnia and OSA should be treated with CBTi prior to initiating treatment of the OSA.
Support (If Any): No support.

0371

EFFECT OF SLEEP AID ON SLEEP: COMPARISON OF SLEEP TIME PARAMETERS USING POLYSOMNOGRAPHY AND DRUG INFORMATION DATABASE

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Introduction: Many different sleep aids are used to manage insomnia symptoms. Nevertheless, there is paucity of literature comparing this wide range of sleep aids comprehensively by measuring the effect of sleep aids using the gold standard, polysomnography (PSG). We conducted a study showing the effect of each sleep aid category on the sleep time parameters using PSG database.
Methods: Twelve months of diagnostic polysomnographic data and drug information from the University Sleep Disorders Center database totaling 847 subjects of 18 years of age or older were collected and analyzed. The sleep aids were categorized into: benzodiazeping (BDZ) receptor agonists (Z-drugs), BDZs, melatonin agonists (MTN), antihistamines (AH), sedating tricyclic antidepressants (TCA), 5HT2A antagonists (5HTA: trazodone, mirtazapine, quetiapine). We examined the PSG time parameters of total sleep time (TST), sleep efficiency (SE), sleep latency (SL), and wake after sleep onset (WASO) based on the sleep aid category including sleep aid non-users.
Results: Out of 847 subjects, 607 were sleep aid non-users and 240 were sleep aid users. Sleep aid non-users showed TST 333 min, SE 77.5%, SL 24.3 min, WASO 72.3 min. When adjusted for age, sex, body-mass index and apnea-hypopnea index, sleep aid users showed significantly better sleep parameters in SE (79.8 %; $p < 0.05$) and WASO (64.2 min; $p < 0.05$). Further analysis based on sleep aid categories showed the following: TST was significantly increased in MTN (413 min; $p < 0.001$) and BDZ (357 min; $p < 0.05$); SE was significantly increased in 5HTA (81.4 %; $p < 0.05$) and elevated in MTN (84.8%; p = NS); WASO was significantly lower in 5HTA (57.5 min; $p < 0.05$). AHs showed worse parameters than sleep aid non-users across all four sleep time (TST 298 min, SE 72.4%, SL 32.6 min, WASO 83.8 min).
Conclusion: All sleep aids except antihistamine can benefit sleep quantity in patients with insomnia. The best categories are melatonin and 5-HT2A antagonists such as trazodone. On the other hand, antihistamines may worsen sleep. Melatonin receptor and 5-HT2A receptor might be more effective target of interest in future insomnia research.
Support (If Any): none.

0372

NURSE DELIVERED BRIEF BEHAVIORAL THERAPY-INSOMNIA FOR LUNG CANCER SURVIVORS

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Introduction: Insomnia occurs in 45 to 57% of lung cancer survivors. Cognitive behavioral therapy for insomnia (CBT-I) is the standard treatment for insomnia; however access is impaired by treatment length and shortage of trained psychologists to deliver CBT-I. Nurses are uniquely positioned to deliver a modified version of CBT-I, i.e., Brief Behavioral Therapy-Insomnia (BBT-I) involving sleep restriction, stimulus control, sleep hygiene education and brief telephone therapy. This study determined efficacy of BBT-I compared to attention control (healthy eating education) for insomnia in lung cancer survivors.
Methods: Lung cancer survivors were randomized to either the experimental (BBT-I) or attention control (healthy eating education). The study inclusion criteria were Insomnia Severity Index (ISI) >7, stage I/II non-small cell lung cancer ≥ 6 weeks from surgery, and ≥21 years of age. Exclusion criteria included untreated pre-existing sleep disorders or medical or psychiatric instability. Objective measures included screening for sleep apnea (ApneaLink) and 14-day actigraphy before and after the interventions. Subjective measures included Pittsburgh Sleep Quality Index, Dysfunctional Beliefs & Attitudes about Sleep, Epworth Sleepiness Scale, Profile of Moods Fatigue Scale, Hospital Anxiety and Depression Scale, Functional Assessment of Cancer Therapy-Lung and 14-day sleep diaries.
Results: Demographics on randomized sample (n=40): 66 years of age (± 7.6; range 53–82), 40% (n=16) male, 87.5% (n=35) Caucasian, 50% (n=20) married, BMI 27.7 (± 5.8), and 10% (n=4) never smokers. Disease-treatment characteristics included 80% (n=32) adenocarcinoma, 60% (n=24) stage 1A, and 90% (n=36) lobectomy. At baseline there was no significant difference between the groups (p=.12). Post-treatment mean ISI for the experimental intervention was 6.40 ± 4.98, while the attention control mean was 14.10 ± 4.48 (p=.001) with an effect size of 1.61. One third of patients screened required referral for treatment: 4/44 (9%) screened positive for sleep apnea and 12/44 (27%) had low nighttime oxygenation.
Conclusion: This study demonstrated efficacy of nurse delivered BBT-I in lung cancer survivors and will inform a larger study to evaluate implementation strategies to promote dissemination and sustainability. Brief, practical interventions can significantly improve sleep in cancer survivors with insomnia.
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0373

DE-CLUTTERING THE BEDROOM AS A POSSIBLE SLEEP HYGIENE STEP TO IMPROVE SLEEP QUALITY

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Introduction: Clinicians often suggest sleep hygiene interventions for sleep disorders, such as developing a bedtime routine, sleeping in

one's own bed, and regular bed/waketimes. Contextual cues such as cluttered bedrooms may also interfere with sleep quality, perhaps by contributing to rumination or anxiety. Our study examined whether de-cluttering the bedroom helps improve sleep.

Methods: Participants were 1052 subscribers to a website offering help with housekeeping routines, particularly de-cluttering and discarding (95% female, mean age 50.5 years). Subscribers were given access to an on-line study link for five consecutive days in December 2015. Measures included demographics; Pittsburgh Sleep Quality Index (PSQI); Daytime/Nighttime Sleep Problems (DNSP), and Housekeeping Habits Survey (HHS). The HHS asked participants which of four recommended habits they had adopted on an at-least weekly basis: 1) regular, brief de-cluttering (tidying and discarding objects in the bedroom); 2) planning for next day's activities; 3) self-care (eating regular meals and keeping "reasonable" bedtimes; and 4) keeping thoughts positive and avoiding perfectionism.

Results: Hierarchical regression revealed that De-cluttering and Self-Care habits predicted increased sleep quality (PSQI; beta = -.13 and -.13, respectively) and fewer sleep-related problems (DNSP: beta = -.08 and -.17); earlier bedtimes accounted for the largest amount of variability (beta = -.18 and -.23). Length of website subscription predicted better sleep quality. Global PSQI was highest (M:13.2) for new subscribers, positive outcomes were achieved (p=.04) after as little as 4 weeks of regular engagement with the recommended habits, although PSQI scores remained elevated (global score: 11.4) even for those who spent 3 years on the website.

Conclusion: De-cluttering the bedroom area is not typically recommended to insomnia patients by health care providers; our results indicate that for some patients, recommendations to tidy the bedroom area may be helpful as a way to improve sleep. Because many insomniacs attempt to fall asleep too early, practitioners usually emphasize delaying bedtimes, to keep sleep efficiency high. Some patients, however, may be delaying sleep excessively, and directions to advance bedtimes may be more appropriate.

Support (If Any): No support to declare.

0374

GROUP COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA (GCBT-I) AND PREDISPOSING FACTORS IN COLLEGE STUDENTS

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Introduction: Insomnia is prevalent in college students, who may be vulnerable, due to high academic demands, to predisposing factors such as perceived stress, pre-sleep arousal, and perfectionism. Although the effectiveness of group cognitive behavioral therapy for insomnia (GCBT-I) on insomnia severity in the general population is well established, its effects on predisposing factors are unclear. Our objectives were to assess (1) the effects of GCBT-I on symptoms of insomnia, perceived stress, pre-sleep arousal, and perfectionism; and (2) how changes in predisposing factors relate to changes in insomnia among college students.

Methods: This prospective study included 39 undergraduate students (mean age 25 ± 5; 21% male), with an insomnia severity index (ISI) > 14, indicating mild to severe insomnia, who volunteered to take part in a GCBT-I intervention lasting four weekly sessions. The multi-component intervention included sleep restriction, stimulus control, sleep education, sleep hygiene and relaxation methods. Students completed validated questionnaires to assess insomnia symptoms (ISI), stress (perceived stress scale - PSS), arousal (pre sleep arousal scale - PSA), and perfectionism (perfectionism cognitions inventory - PCI), before treatment and at seven weeks post-treatment. Paired t-tests were performed to assess changes pre to post treatment. Linear regression was performed to assess change scores in predisposing factors as predictors of change scores in insomnia.

Results: ISI total scores decreased from 16.08 ± 3.93 to 12.69 ± 4.58 ($p<0.01$), indicating lower symptom severity. Changes in predisposing factors included decreases in PSS (21.58 ± 7.90 to 14.89 ± 6.59; $p<.001$), PSA (44.77 ± 9.69 to 40.33 ± 10.95; $p<.05$), and PCI (49.82 ± 24.38 to 38.97 ± 21.31; $p<.01$). Changes in predisposing factors accounted for 61% of the explained variance for change in insomnia (PSA: $\beta=0.57$, $p<0.001$; PCI: $\beta=0.24$, $p=0.04$; PSS: $\beta=0.16$, $p=0.21$).

Conclusion: Results support the effectiveness of GCBT-I in college students, and suggest that the beneficial effects of GCBT-I extend beyond symptoms of insomnia, to affect predisposing factors that may be state-dependent.

Support (If Any): None.

0375

CHANGES IN EPWORTH SLEEPINESS SCALE DURING BEDTIME RESTRICTION THERAPY IN CO-MORBID INSOMNIA AND OBSTRUCTIVE SLEEP APNEA

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Introduction: Co-morbid insomnia and sleep apnea (COMISA) is a highly prevalent and debilitating condition. Recommended treatment for COMISA includes initial treatment with Cognitive Behavioral Therapy for Insomnia (CBTi). Bedtime restriction therapy is an effective component of CBTi that involves temporarily reducing time spent in bed to consolidate sleep periods and decrease pre-sleep hyperarousal. However bedtime restriction also temporarily increases daytime sleepiness. As sleep apnea is commonly associated with increased sleepiness at baseline, it is important to monitor the effect of bedtime restriction therapy in COMISA patients during CBTi to avoid potentially dangerous excessive daytime sleepiness.

Methods: 72 patients with co-morbid insomnia (ICSD-2) and sleep apnea (AHI ≥ 15) who were participating in a randomized controlled trial completed 7-day sleep diaries, and Epworth Sleepiness Scales at baseline, during 4-weekly sessions of CBTi, and at post-treatment. Paired t-tests were used to compare differences in average sleep parameters and sleepiness between baseline and each week of treatment.

Results: Epworth Sleepiness Scale scores did not increase significantly during any week of CBTi compared to baseline. Instead they showed a small significant reduction by week-4 (2 point reduction, $p\leq0.001$) and post-treatment (1.5 point reduction, $p\leq0.001$) compared to baseline. Subjective total sleep time showed a 30 minute decrease by the second CBTi session ($p\leq0.001$), but was significantly greater than baseline by week-4 (15 minute increase, $p\leq0.01$) and post-treatment

(25 minute increase, p≤0.001). Finally, sleep efficiency scores were significantly increased compared to baseline at week-2, week-3, week-4 and post-treatment (10–18 percent increase from baseline, all p≤0.001).

Conclusion: Bedtime restriction therapy did not lead to increased levels of subjective sleepiness during CBTi in patients with COMISA. In fact, by the fourth week of CBTi, sleepiness scores were significantly lower than at baseline. This decrease in subjective sleepiness was accompanied by increased total sleep time and sleep efficiency throughout treatment. These data suggest that CBTi is a safe and effective treatment in patients with COMISA.

Support (If Any): This research was made possible by an on-going National Health and Medical Research Council-funded grant examining different treatment options in patients with co-morbid insomnia and sleep apnea (nhmrc 104959).

0376

PATTERN OF SLEEP MEDICATION USE IN THE DEPARTMENT OF DEFENSE

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Introduction: Use of sleep medications in the U.S tripled from 1998–2006, with current estimates leveling off at 4% of the adult population. Although data on overall use in the military population is scarce, one small survey found 18% of active duty service members (ADSM) post-deployment used sleep medications. This study uses dispensing data to compare the prevalence of sleep medication use and demographic characteristics of users among ADSM and non-ADSM receiving care in the Joint Health Services Enterprise (JHSE) from 2009–2015

Methods: Patients dispensed estazolam, flurazepam, quazepam, temazepam, triazolam, eszopiclone, zalepon, zolpidem, ramelteon, doxepin or trazodone during the study time period were included in the study. Demographic characteristics were assessed at the first dispensing within each year. Prevalence of sleep medication use was calculated as the number of patients receiving one or more prescriptions divided by the total number of eligible beneficiaries within each year. Chronic therapy was defined as 90 days or more of any sleep medication dispensed within a six month time period among new users.

Results: Use of sleep medication in ADSM increased from 5.7% in 2009 to 6.8% in 2012 and declined to 5.4% in 2015. However, use in non-ADSM remained consistent over time, with a slight decline from 4.0% in 2009, to 3.8% in 2015. Overall and age-specific use was consistently 1%-3% higher for ADSM compared to non-ADSM with greater differences in the older age group. Specifically, ADSM 18–24 years had about 1% higher use while ADSM 45–64 years had 3.5% higher use compared to non-ADSM of similar ages. In both populations, use was consistently higher among females and increased with age. Zolpidem, temazepam and eszopiclone comprised more than 70% of all medications dispensed. Approximately 25% and 35% of all users had at least one episode of chronic therapy for ADSM and non-ADSM, respectively.

Conclusion: While military beneficiaries have similar rates of sleep medication use to the U.S. population, ADSM have higher overall and age-specific usage. Although use in ADSM is decreasing, sleep disturbances and insomnia are highly prevalent disorders in this population that require further evaluation.

Support (If Any):

0377

ACTIVITY MEASURES POST CBT-I FOR CHRONIC PAIN

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Introduction: CBT-I has been shown to improve both sleep and pain in chronic pain patients. The mechanisms by which CBT-I improves pain are poorly understood. While studies have shown that increase in physical activity is associated with positive outcomes, the impact of CBT-I on activity has been largely unexplored. In the present analysis, the association between improved pain and diurnal activity was assessed.

Methods: 15 patients (Mean Age=42.9±10.4; f=12) with chronic pain (non-cancer neck or back pain) who received 8-session CBTI were evaluated by 7-day actigraphy at baseline and post-treatment (only 10 subjects completed actigraphy at both time-points), and completed the Multidimensional Pain Inventory (MPI) for a pain severity score (MPI-Severity) at both time-points (all 15 participants completed both MPI assessments). Activity was averaged per-hour using minute-by-minute activity count epochs. Mixed models were utilized to allow for actigraphic missing data and to evaluate the relationship between pain improvement (Responders vs. Non-Responders), phase (baseline vs post-CBTI), and diurnal time (24-hr day) with activity counts per hour. Treatment response was determined based on improvement on MPI-Severity≥30% from baseline. Additionally, exploratory paired-sample t-tests were utilized to evaluate time-of-day of improved activity.

Results: Based on the MPI-Severity score, there were 8 Responders and 7 Non-Responders. There were no significant differences in activity at baseline. Mixed models revealed a significant phase*group interaction (p=0.003) with significant main effects for phase (p=0.003) and time of day (p<0.001). While there was no, phase*group*time-of-day interaction, paired-sample t-tests revealed that Responders significantly increased activity in the morning (6-9AM) while no significant activity increase is noted for Non-Responders.

Conclusion: These pilot findings suggest that CBTI improvements in pain severity are associated with diurnal activity increase. Chronic pain patients who achieved clinically meaningful pain reduction tended to have increased activity during the day compared to Non-Responders. The change was more notable with the morning activity. The results suggest the potentially greater role of improving morning activities for pain management. Future studies utilizing larger sample sizes are necessary.

Support (If Any): Supported by: NINR NR5R21NR009080-02.

0378

OCCUPATIONAL THERAPIST DELIVERED COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA TO POST-9/11 VETERANS IN COLLEGE: A WAIT LIST CONTROL PILOT STUDY

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Introduction: The prevalence of chronic insomnia in post-9/11 Veterans is substantial, especially for those with service-connected injuries. Veterans' access to cognitive behavioral therapy for insomnia

(CBT-I) is limited and expanding access to CBT-I is a critical need. Sleep is an area of concern for occupational therapists (OTs) and studies of OT-delivered CBT-I are warranted to ensure safe and effective care.
Methods: Design: Wait list control pilot study. Sample: 6 treatment (1 female) and 8 wait list control (1 female) post-9/11 Veterans with service-connected injuries and chronic insomnia in college. Intervention: 7-weeks of multi-component CBT-I (i.e., sleep restriction, stimulus control, psycho-education, sleep hygiene, and mindfulness) delivered by OTs with advanced training in CBT-I using weekly 1-hour group meetings concurrent with weekly individual meetings. Outcomes: Insomnia Severity Index, Patient Health Questionnaire-Depression, Generalized Anxiety Disorder 7-item, Perceived Stress Scale, Dysfunctional Beliefs about Sleep, PROMIS-Satisfaction with Social Roles, Engagement in Meaningful Activities Survey. Sleep Onset Latency (SOL), Wake after Sleep Onset (WASO), Total Sleep Time (TST), and Sleep Efficiency (SE) were collected only in the treatment group. All data were collected using an internet-based interface. Analyses: 2X2 (condition X time) repeated measures ANOVA and paired t-test (SOL, WASO, TST, SE) with Generalized Eta-Squared (GES) effect sizes (.01 = small, .06 = medium, .14 = large).
Results: The treatment group had reduced insomnia ($p < .001$; GES = .27), depression ($p = .02$; GES = .05), anxiety ($p = .02$; GES = .04), and stress ($p = .01$; GES = .07), fewer dysfunctional sleep beliefs ($p < .001$; GES = .39), trending greater social role satisfaction ($p = .07$; GES = .11) and meaningfulness in daily activities ($p = .08$; GES = .06); and reduced SOL ($p = .03$; GES = .48) and higher SE ($p = .04$; GES = .44) with non-significant changes found in WASO ($p = .11$) and TST ($p = .20$). There were no adverse events.
Conclusion: It is feasible for OTs trained in multi-component CBT-I to safely and effectively deliver CBT-I to Veterans with service-connected injuries in college.
Support (If Any): Wounded Warrior Project grant awarded to Dr. Eakman.

0379

EFFECTS OF AN INTERNET-BASED VIDEOCONFERENCE COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA INTERVENTION

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Introduction: Insomnia is a prevalent condition affecting 30–50% of breast cancer survivors (BCS). Insomnia can originate during primary cancer treatment and persist for years, affecting long-term health and wellness throughout survivorship. Cognitive Behavioral Therapy for Insomnia (CBTI) is an effective treatment, but a dearth of trained providers requires the exploration of creative methods of CBTI delivery. Rural BCS, already vulnerable due to a lack of healthcare providers, have little access to specialty care such as CBTI. The aim of this study was to examine the results of an internet-based videoconference CBTI in a rural BCS population.
Methods: Eighteen rural BCS were enrolled in a 6-week CBTI intervention, using a pre/post study design. The individualized CBTI was provided via an internet-based videoconference using Adobe Connect. Participants completed sleep diaries daily throughout the 6-week CBTI, and symptom and quality of life surveys before and after the intervention. Dependent t-tests were used to compare changes in primary sleep outcomes, symptom burden, and quality of life.
Results: All primary sleep measures improved significantly after the CBTI intervention, including sleep efficiency ($p < .001$), sleep latency ($p < .001$), wake after sleep onset ($p = .001$) and total sleep time ($p = .001$). Symptoms including fatigue ($p < .001$), pain ($p < .001$), and menopausal symptoms ($p < .001$) decreased significantly after treatment. Global quality of life increased significantly ($p < .001$), as well as the subscales of emotion ($p < .001$) and cognition ($p < .001$).
Conclusion: CBTI is an established treatment for insomnia in BCS, but many rural survivors lack access to CBTI as a face to face intervention. This study contributes to the evidence that an online, videoconference CBTI intervention can be an effective method to help treat insomnia in rural BCS.
Support (If Any): NINR 1F31NR012097-01A1.

0380

OBJECTIVE AND SUBJECTIVE EFFECTS OF FOUR CLASSES OF HYPNOTICS ON SLEEP CONTINUITY IN PATIENTS WITH CHRONIC INSOMNIA: A FIRST PASS ANALYSIS

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Introduction: Little is known about the relative efficacy of the medications used to treat insomnia. Accordingly, a meta-analysis was undertaken to examine how objective (PSG) and subjective (sleep diary) measures of sleep continuity vary by drug class.
Methods: PubMed searches, from 1967-June 2016, yielded 327 possible articles. Inclusion criteria were that the studies: 1) were randomized placebo controlled trials of medications commonly used as hypnotics (BZs, BZRAs, SADs, DORAs, or melatonin agonists [MELA]); 2) were between 1 and 14 days in duration; 3) had pre- and post-treatment sleep continuity data and reported as means and standard deviations (or equivalent). Studies were excluded if they allowed for non-nightly dosing (or middle-of-the-night dosing) and/or included participants not diagnosed with insomnia based on DSM or ICSD criteria. Weighted effect sizes (ES) were computed for the pre-post change data and were compared to the study placebo condition. Between class differences were assessed using a threshold approach (if the ES of one class was 2x larger than another, the difference [for this preliminary analysis] was considered to be significant).
Results: Sufficient data were available for only BZRAs, SADs, DORAs, and MELA. On PSG measures, the relative efficacy for the four classes of medications were as follows: *SL* (BZRAs=MELAs>DORAs=SADs); *WASO* (SADs>BZRA=DORAs>MELAs); and *TST* (BZRAs=SADs=DORAs>MELAs). On sleep diary measures, the relative efficacy for the four classes of medications were as follows: *SL* (BZRAs >MELAs=DORAs=SADs); *WASO* (BZRAs=SADs > DORAs=MELAs); and *TST* (BZRAs=SADs>DORAs=MELAs).
Conclusion: These preliminary results suggest that, on PSG measures, BZRAs and MELAs have larger effects on sleep initiation and SADs have larger effects on sleep maintenance. On sleep diary measures, BZRAs have larger effects on sleep initiation and BZRAs and SADs have larger effects on sleep maintenance. Overall, BZRAs appear to

have the best average hypnotic efficacy of the classes of medications evaluated in the present analysis.
Support (If Any): Partial support provided by R56AG050620 and R01AG041783.

0381

A NOVEL FOREHEAD TEMPERATURE REGULATING DEVICE FOR INSOMNIA: A RANDOMIZED CLINICAL TRIAL

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Introduction: Insomnia is among the most common disorders in the general population. While hypnotic medications are efficacious, their use is limited by adverse events. Safe, effective alternatives are needed. The aim of this study was to evaluate the safety and efficacy of a forehead temperature-regulating device that delivers frontal cerebral thermal therapy (maintained at 14–16 °C, equivalent to 57- 61 °F) for the treatment of insomnia.
Methods: This was a prospective, randomized parallel group controlled trial involving 106 adults meeting DSM 4 diagnostic criteria for primary insomnia treated at seven sleep centers. Participants received two nights frontal cerebral thermal therapy or sham vestibular stimulation. Outcome measures included the latency to persistent sleep and sleep efficiency derived from polysomnographic (PSG) recordings and adverse events.
Results: Frontal cerebral thermal therapy produced improvements over sham on convergent measures of sleep latency. The safety profile was comparable to sham treatment. While there were numerical improvements over sham in absolute change from baseline in latency to persistent sleep and in sleep efficiency (the two a priori co-primary end-point measures), these changes did not achieve statistical significance. However, other sleep latency measures were significantly different from sham supporting the efficacy of the device in sleep induction. These measures included latency to persistent sleep (relative change p= 0.013), the latency to stage 1 NREM sleep (p=0.006), the latency to stage 2 NREM sleep (p=0.002) and suggestive for the latency to stage 3 NREM sleep (p=0.055).
Conclusion: Convergent analyses support that frontal cerebral thermal therapy produces improvements in insomniacs' ability to fall asleep as shown by improvements in sleep latency similar to the effects seen with the most commonly prescribed hypnotics, but with a superior safety profile.
Support (If Any): Cerêve Inc.

0382

BED PARTNER ACCOMMODATION OF INSOMNIA IN TREATMENT-SEEKING COUPLES

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Introduction: Insomnia is largely seen as an individual condition despite the fact around 60% of adults sleep with a partner. There is emerging evidence that bed partners affect a patient's insomnia. For example, relationship problems and mismatched bed/wake times within couples have been linked to insomnia. However, there are currently no data documenting the specific behaviors engaged in by partners of individuals with insomnia, which may perpetuate the disorder. Research in other disorders (e.g., OCD, depression) indicates that partners can inadvertently reinforce maladaptive behaviors, and thus interventions should address relevant partner behaviors. Here, we provide initial data on bed partner accommodating behaviors in insomnia.
Methods: Eighteen partners (9 female, 19–75 years) of individuals seeking treatment for insomnia completed baseline questionnaires as part of a larger ongoing RCT investigating partner-assisted interventions for insomnia. We identified partner accommodating behavior using a 14-item self-report questionnaire adapted from the Family Accommodation Scale for OCD.
Results: Over three-quarters (78%) of bed partners encouraged earlier bedtimes and later wake times, and half adjusted their own sleep. Over half of bed partners (56%) reported their partner becomes distressed when they do not provide assistance in relation to their insomnia. Thirty-nine percent adjusted their family routine, and half modified their leisure activities in response to their partners' insomnia. Seventeen percent modified their work schedule, and 11% encouraged their partner to take sleep medication or alcohol to improve sleep.
Conclusion: Results indicate bed partners of individuals with insomnia engage in a range of behaviors geared towards accommodating insomnia. Some of these occur at high rates and are contrary to CBTI treatment recommendations (e.g., encouraging earlier bedtimes and later wake times). Thus, despite what are likely good intentions, bed partners may contribute to the perpetuation of insomnia. Findings also indicate bed partners make accommodations that affect their own functioning, including their sleep and life outside of work. Taken together, insomnia interventions may better benefit patients and their partners by proactively assessing and addressing bed partner behaviors in treatment. It will be important to further investigate the impact of partner accommodation on insomnia symptoms.
Support (If Any): NHMRC Project Grant #APP1105458.

0383

SLEEP DEFICITS CAN BE EFFICIENTLY TREATED USING E-THERAPY AND A SMARTPHONE

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Introduction: Sleep deficiencies, such as insomnia are prevalent. They are known to affect mood, performance and wellbeing and were even linked to increased morbidity. Mobile technology and the growing availability of wearable devices open new opportunities for self-help for sleep disorders. We present a novel mobile e-therapy service, SleepRate, that combines: (1) sleep evaluation based on reported and subjective data; (2) quantified sleep architecture measurement derived from Heart Rate Variability; (3) Cognitive Behavioral Therapy (CBT).
Methods: 297 users have started the sleep improvement e-therapy, over a period of 15 months, and adhered with the program for at least 20 days. The night sleep was characterized using the following parameters: total sleep time, sleep efficiency, sleep latency and wake after sleep onset (WASO). Each of these parameters had a subjective and objective value. In addition, the users reported their sleep satisfaction and daily sleepiness. The first 6 nights (assessment stage) were compared with the 15th-20th nights (during CBT stage) using paired t-test with p&lt0.05 as the criterion for statistical significance.

Results: Average perceived sleep latency improved significantly with e-therapy from 23.5+/-1.3 minute (mean+/-SE) to 20.6+/-1.1 minutes. Objective WASO improved significantly from 50.6+/-1.0 minute to 48.8+/-0.9 minutes. In addition, the subjective sleep satisfaction increased significantly from 45.7+/-0.7 to 47.1+/-0.7 while the reported daytime sleepiness decreased significantly from 21.5+/-1.1 to 18.3+/-1, demonstrating the positive impact e-therapy has on sleep.
Conclusion: The availability of devices that are capable of evaluating objectively sleep duration, structure and quality allows having a deeper understanding of sleep in the natural sleep environment. The findings indicate that after 20 days of adherence with the program, there was significant improvement in several sleep variables. In addition, they show that while the service was efficient, the main barriers were users' engagement and the availability of accurate and minimally intrusive wearables. These barriers are likely to diminish with the improvement of wearable technology.
Support (If Any):

0384

FEASIBILITY AND EFFECTIVENESS OF JUST-IN-TIME ADAPTIVE INTERVENTION (JITAI) IN BEHAVIORAL INSOMNIA TREATMENT

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Introduction: Behavioral treatments for insomnia require a personalized, time-varying approach whereby treatment is adapted over time in response to the changing needs and evolving condition of the patient. Mobile technologies allow for this treatment adjustment performed in real-time, called Just-in-Time Adaptive Intervention (JITAI). The purpose of this pilot study was to evaluate the effects of a JITAI approach on insomnia treatment response and remission.
Methods: A cross-platform mobile health (mHealth) solution was developed for the purpose of delivering the JITAI. This solution consists of 1) a smartphone application; 2) a Web-based clinician portal that allows therapists to monitor patients and provide personalized treatment recommendations, assess adherence and progress; and 3) a secure communication system between the patient and clinician. Twenty-two military veterans with chronic insomnia received a 4-week behavioral insomnia treatment through the JITAI mHealth solution. All completed the Insomnia Severity Index (ISI) a baseline and 2 weeks post-treatment. Rates of treatment response and remission with the new mHealth JITAI solution were compared with rates previously reported in military veterans with chronic insomnia who completed a traditional 4-week in-person behavioral treatment. Treatment response was defined as a reduction of 8 points or more on the ISI. Remission was defined as meeting the definition for response and a final ISI score lower than 7.
Results: The rates of treatment response (84.21%) and remission (68.42%) were slightly higher in the mHealth JITAI group compared to the in-person condition (76.47% and 52.94%, respectively). Response and remission rates were not different between the delivery methods (χ^2= 0.34, p>0.05 and χ^2< 0.91, p>0.05 for response and remission, respectively).
Conclusion: mHealth JITAI solution is a promising insomnia treatment delivery mode. Results suggest that mHealth JITAI is non-inferior to an in-person brief behavioral treatment. mHealth JITAI is scalable and has a high potential for cost-effectiveness.
Support (If Any):

0385

A CONTINUOUS RELEASE ION POWERED PUMP MELATONIN DELIVERY SYSTEM

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Introduction: Several modified release formulations of melatonin have been developed with the goal of providing exogenous melatonin profiles that mimic normal endogenous levels (Mesa Wave-shaped plasma pharmacokinetic profile) for sleep; however, these formulations have not been successful. IPP-melatonin (ion powered pump melatonin delivery system; REMfresh), a novel patented product designed for optimized continuous release, was developed to overcome the limitations of previous modified release formulations.
Methods: The melatonin was encapsulated in a polymer matrix that maintains a solubility-enhancing pH environment, providing a favorable counter-ion environment local to the melatonin in the GI tract and optimizing absorption. IPP-melatonin has been designed as a hydro-gel matrix tablet. There is rapid release of the melatonin from the surface of the tablet, as the hydrogel release controlling matrix is setting up in the acidic environment (pH of 1 to 3.5) in the stomach. As the tablet moves into the higher pH (5.5 to 6.5) environment of the small-intestine, which is above the pKa of melatonin (~4.0), the acidic moiety in the tablet maintains the pH within the tablet below 4.0 for 7+ hours. The hydrogel matrix, after proper hydration, allows continuous release of the active and acidic moiety into the lumen. The association of the active and acidic moiety facilitates delivery of the active to the brush border of the epithelial layers of the small and large intestines for uptake into the bloodstream.
Results: The IPP-melatonin delivery technology allows burst release and absorption of approximately 50% of the melatonin within the first 3 hours, facilitating sleep onset, coupled with sustained release and absorption of approximately 50% of the remaining melatonin within the next 4 hours to optimize sleep maintenance.
Conclusion: The patented IPP-melatonin provides successful melatonin release and also optimizes absorption for up to 7 hours.
Support (If Any): This study was funded by Physician's Seal LLC.

0386

TO DRUG OR NOT TO DRUG? A DISCRETE CHOICE EXPERIMENT EXPLORING PATIENT PREFERENCES FOR MANAGING INSOMNIA

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Introduction: Patient preferences play a critical role in influencing treatment outcomes for insomnia. Despite available pharmacological and non-pharmacological treatments, a mismatch exists between patient preferences and clinician recommendations and treatment preference does not necessarily exist as mutually exclusive categories. A limited understanding of how patients deliberate between the two treatment options may perpetuate the current clinician-patient divide.

Therefore, this study aims to empirically quantify patient preferences for treatment attributes that are common to both pharmacological and non-pharmacological insomnia treatments.

Methods: A Discrete Choice Experiment (DCE) was conducted among a community population with self-reported insomnia and an Insomnia Severity Index score ≥ 14. A mixed multinomial logit model was used to investigate the influence of five key attributes on patient treatment preferences: time required for treatment use, treatment onset of action, maintenance of sleep benefits, length of treatment course and monthly out-of-pocket treatment costs.

Results: 205 online DCE questionnaires were completed. Treatments were preferentially viewed if they conferred long-term sleep benefits, had ongoing, as opposed to a predefined (i.e. 3 to 5 months), duration of treatment, required some, as opposed to no additional time commitment and had lower monthly out-of-pocket treatment costs. Treatment onset of action displayed a positive trend but did not reach statistical significance. Overall, onset of action and treatment length were the least prioritized attributes in our participants' treatment decision-making. Age, concession beneficiary status, fatigue severity, and help-seeking status were the only patient characteristics to exert a statistically significant influence on treatment preference.

Conclusion: Participants' prioritization of the five treatment attributes suggests a stronger inclination towards non-pharmacological treatment. Importantly, emphasis on investing time in treatment defies the current assumption that patients prefer a 'quick-fix' for managing insomnia. Implications for CBT-I dissemination and uptake are discussed.

Support (If Any): The first author is a recipient of an Australian Postgraduate Award (APA) scholarship and has received seed funding to conduct part of this research from the National Health and Medical Research Council (NHMRC) Centre for Integrated Research and Understanding of Sleep (CIRUS), (Grant Number: 571421).

0387

SPECIALTY DIFFERENCES IN PRESCRIBING SEDATIVE HYPNOTICS

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Introduction: Insomnia is a pervasive complaint in outpatient medicine. Sedative hypnotic medications are an approved treatment option, but are often prescribed by providers lacking knowledge regarding indications, appropriate dosing and adverse effects. In 2013 the Food and Drug Administration recommended that women be started at the lowest possible dose of zolpidem due to gender differences in pharmacokinetics. We analyzed prescription trends for non-benzodiazepine sedative hypnotics in a regional military healthcare network, focusing on the clinics with the highest rates (Family Medicine, Internal medicine, Psychiatry, and Sleep).

Methods: We performed a retrospective review of regional prescription data for eszopiclone, zolpidem, and zaleplon from September 1, 2015 through August 31, 2016. Trends in prescribing practices based on clinic of origin, patient gender, and age. Association between dosage levels of Zolpidem and remaining nominal variables was conducting using chi-square test of independence. Alpha was set at .05 for all analyses.

Results: Of the 27,340 zolpidem prescriptions in the region, 14,223 (52%) were for women. Among these, 7,362 (52%) were for elevated doses (zolpidem IR 10 mg or zolpidem CR 12.5 mg). Among women receiving elevated doses, 1,779 (24%) were for women over 65 years old. Family Medicine, Internal Medicine, and Psychiatry clinics prescribed zolpidem preferentially (71%, 69%, and 58% of total sleep aid prescriptions respectively) while the Sleep clinic prescribed eszopiclone (52%) most frequently. Zaleplon prescriptions were inconsequential (1.75%). Female patients were more likely to receive elevated doses of zolpidem in Family Medicine (OR 2.7, 95% CI 1.6–4.6), Psychiatry (OR 2.7, 95% CI 1.8–4.3), and Internal Medicine (OR 1.4, 95% CI 0.89–2.1) clinics compared to the Sleep medicine clinic.

Conclusion: Among the clinics analyzed there was variability in sedative hypnotic choice and dose preference among female patients. While elevated doses of zolpidem are appropriate in some cases, the proportion of prescriptions for higher doses in women, particularly the elderly, is concerning given the slower pharmacodynamics in this population. Monitoring regional prescribing patterns is important in the setting of frequent FDA updates and can facilitate interventions to improve appropriate prescribing practices.

Support (If Any): N/A

0388

CLINICAL EVALUATION OF THE ION POWERED PUMP (IPP) MELATONIN DELIVERY SYSTEM

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Introduction: Melatonin levels decline with age, which leads to poor quality sleep among older people. Melatonin supplementation has been shown to promote and maintain sleep in older populations. A prolonged-release (PR) melatonin marketed internationally demonstrated statistically significant improvements in sleep quality, morning alertness, sleep latency and quality of life in patients aged 55 years and older; however, a lower than anticipated plateau time for PR melatonin (4.4. hrs) resulted from lower absorption in the intestines. Building upon the body of evidence from PR-melatonin studies, the patented IPP-melatonin delivery system (REMfresh) was designed to overcome the challenges of absorption in the intestines and thereby extend the plateau time (known as the Mesa-Wave) to approximate the target of 7 hours and improve sleep maintenance.

Methods: The REM Sleep Absorption Kinetics Trial (REMSAKT) evaluated the PK properties of IPP-melatonin (5 mg) in healthy non-smoking adults. Blood samples were taken pre-dose and at 0.25, 0.5, 0.75, 1, 2, 3, 4, 5, 6, 8 and 12 hours following administration of IPP-melatonin. PK parameters, including C_{max}, T_{max} and plateau time for melatonin were determined. Adverse events and vital signs were assessed throughout the study.

Results: Ten Caucasian (4 males, 6 female) subjects aged 18 to 40 years completed the study. The median time it took melatonin levels to exceed the initial threshold level of 100 pg/mL was 0.131 hours for IPP-melatonin. The median C_{max} was 4,690pg/mL for IPP-melatonin and the median time to reach this concentration (T_{max}) was 1.5 hours. Melatonin levels showed a median plateau time of 6.7 hours. There were no treatment emergent adverse events seen with IPP-melatonin.

Conclusion: IPP-melatonin shows a profile similar to PR-melatonin while extending the median plateau from 4.4 hours to 6.7 hours. The longer plateau time may improve sleep maintenance and morning alertness in patients.

Support (If Any): This study was funded by Physician's Seal LLC.

0389

USE OF A CLOSED-LOOP ACOUSTIC STIMULATION NEUROTECHNOLOGY IMPROVES SYMPTOMS OF MODERATE TO SEVERE INSOMNIA: RESULTS OF A PLACEBO-CONTROLLED TRIAL

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Introduction: High-resolution, relational, resonance-based, electroencephalic mirroring (HIRREM®) is a closed-loop, allostatic, acoustic stimulation neurotechnology that uses software-guided algorithmic analysis to identify and translate selected brain frequencies into audible tones to support real-time self-optimization of brain activity. Preliminary data show that its use is associated with sleep improvements in heterogeneous populations, and reductions in temporal lobe high frequency amplitudes suggesting decreased neurophysiological hyperarousal.

Methods: Among 694 subjects screened, 122 with Insomnia Severity Index (ISI) scores of ≥15 were enrolled in this IRB-approved study, and randomized to receive either ten, 90 minute sessions of HIRREM plus current care (HCC), or placebo (random audible tones) plus current care (PCC), over 1–2 weeks. Measures were obtained at enrollment (V1), 1–2 weeks (V2), and 2 (V3) and 4 months (V4) after completion of intervention, with a daily sleep diary from V1-V3. The primary outcome was differential change in ISI scores from V1 to V3. Subjects were asked to guess their group assignment after the fourth session. Changes in autonomic cardiovascular regulation are reported elsewhere.

Results: Twenty one subjects became ineligible prior to receiving intervention, or dropped out. 101 completed the intervention (52 HCC, 49 PCC; mean age 53.3 +/- 14.6, 69 women). 65% (HCC) and 68% (PCC) guessed that they were in the HCC group. Initial analysis (n=101) adjusted for baseline ISI score shows a mean reduction of ISI score in the PCC group of 5.01 (SE 0.73), with an additional, statistically significant reduction of 2.12 points in the HCC group [total ISI score reduction of 7.13 (SE 0.71), p=0.0419]. No adverse events were reported.

Conclusion: Preliminary analysis of the primary outcome from this placebo controlled trial suggests clinically significant reduction of insomnia symptoms associated with use of HIRREM, and an additional benefit compared to placebo. Final results will be presented.

Support (If Any): The Susanne Marcus Collins Foundation, Inc.

0390

MEASURING ACTIVITY BY ACTIGRAPHY - ARE WE USING THE RIGHT METHODS?

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Introduction: Actigraphy is commonly used in research to provide an objective measure of sleep. Many attempts to evaluate activity using this measure have been undertaken. These tend to involve day/night activity averages which disregards the variability of the hour-by-hour data and variability. To our knowledge, there have been no attempts to aggregate minute-by-minute activity data into hour-by-hour bins which may provide for a better description of any activity changes across the diurnal day. The present analysis focuses on this data aggregation approach.

Methods: 15 patients (Mean Age=42.9±10.4; f=12) with chronic pain (non-malignant neck or back pain) who received 8-session CBT-I were evaluated by 7-day actigraphy at baseline and post-treatment (only 10 subjects completed actigraphy at both time-points). Daytime activity averages were computed for baseline and post-tx. Daytime activity averages were evaluated using paired sample t-test. Hour-by-hour activity averages were computed for an average 24-hr period using activity count from minute-by-minute epochs over the 7-days. Mixed models were utilized to evaluate the difference between baseline to post-tx (phase) over the 24-hr period (time). Model included main effect for phase and time along with a phase*time interaction.

Results: Weekly activity averages showed no difference in average activity throughout the day between baseline and post-tx (Baseline Activity=376, Post-tx Activity=408.6, p=0.26). However, mixed models assessing the daily activity hour-by-hour revealed a significant main effect for time-of-day (p<0.001) and for phase (p=0.001). While the phase*time-of-day was not significant (p=0.25), descriptive data suggest marked improvement post CBT-I especially in the morning (6-11AM).

Conclusion: Utilizing daily activity averages may result in a failure to resolve findings that are evident when assessing activity on an hour-by-hour basis. Further, arraying data in this manner may allow for an appreciation of how activity patterns across the diurnal phase of the 24-hr day.

Support (If Any): Supported by: NINR NR5R21NR009080-02.

0391

UNTREATED SLEEP APNEA MASKED BY SLEEPING PILLS UNDERMINES EFFICACY OF INSOMNIA THERAPY

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Introduction: Chronic insomnia is treated with sleeping pills or cognitive behavioral therapy for insomnia (CBTI). Unrefreshing sleep and frequent nocturnal awakenings also commonly occur in obstructive sleep apnea (OSA). The high incidence of comorbid OSA may be overlooked and can undermine the efficacy of insomnia treatment.

Methods: A retrospective chart review was performed on 199 patients presenting with chronic insomnia from October 2013 to November 2016 who enrolled in CBTI with a sleep physician at a community-based clinic. Self-reported sleep logs were used to track sleep measures. CBTI failure was defined as final sleep efficiency <80%. Patients with symptoms and signs of OSA were encouraged to undergo diagnostic sleep studies (home sleep apnea testing or diagnostic polysomnography) and those with apnea-hypopnea indices (AHI) >5 were identified.

Results: The population consisted of 63% women (125 subjects) and 37% men (74 subjects). The average age was 60.7 years (ranging from 12 to 90 years). The average body mass index (BMI) was 26.7. The average Epworth sleepiness scale score at presentation was 6.0. Sleeping pills were used at baseline in 77.4% (154 subjects). Improvements were seen from baseline to program conclusion in averaged measures of sleep: sleep-onset latency (45.19 to 22.15 minutes), wakefulness after sleep onset (46.07 to 27.30 minutes), total sleep time (6.23 to 6.33 hours), and sleep efficiency (75.56% to 84.95%). OSA was present by testing in 73.9% of the population (147 subjects). Recommended testing based on clinical suspicion was deferred in 16.1% (32 subjects). Only 10.1% (20 subjects) had a negative sleep study. Compared to successful controls, CBTI failure was associated

with a stable sleep efficiency (71.3% to 72.3% compared to 75.3% to 89.0%) and a higher overall incidence of sleep apnea (80% vs. 71.5%).
Conclusion: Obstructive sleep apnea is extremely common among patients presenting for CBTI, many of whom take sleeping pills that may mask the symptoms. Though CBTI may be effective, treatment failure is associated with an even higher incidence of sleep apnea. Resolution of insomnia may depend on identification and treatment of comorbid sleep apnea, which could have further impacts on long-term health.
Support (If Any): None.

0392

PREDICTORS OF ADHERENCE TO PSYCHOLOGICAL TREATMENT FOR INSOMNIA AND PAIN: ANALYSIS FROM A RANDOMIZED TRIAL

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Introduction: Poor adherence to psychological treatment for insomnia is common and greatly limits treatment gains. Very little is known about predictors of adherence among patients with chronic pain, although adherence is theorized to be more challenging for these patients. Pain coping responses and beliefs about pain and sleep, as well as medical and mental health comorbidities, may lead to greater dropout from treatment for this high risk patient group. This secondary data analysis examines predictors of drop-out and therapy non-attendance in an osteoarthritis population receiving psychological treatment for insomnia and pain.
Methods: Data were analyzed from the "Lifestyles" trial, a randomized controlled trial of a six-week group cognitive-behavioral pain coping skills intervention (CBT-P), group cognitive behavioral therapy for pain and insomnia (CBT-PI), and an education only attention control group (EOC). The current analysis focuses on 122 participants randomized to CBT-PI from 6 primary care clinics. Measures of treatment acceptability, demographics, medical variables, and symptoms (sleep, pain, depression, anxiety) were collected at baseline. Factor analysis was used to clarify the boundaries of these domains, and hierarchical regression was used to examine the incremental predictive power of these domains on therapy attendance and drop-out.
Results: Ratings of treatment acceptability were distinct from demographic and medical variables and baseline symptoms. Treatment acceptability was significantly related to session attendance and drop-out and was also the strongest predictor of session attendance ($\beta = .23$, $p < .05$), followed by opioid use ($\beta = -.19$, $p < .05$).
Conclusion: Treatment acceptability is a promising target to enhance adherence to psychological treatment for insomnia and pain among patients with chronic pain. This work represents an important step towards understanding how to optimize sleep treatments for this patient population and informs broader efforts to increase the perceived value of psychological sleep treatment among all patients with insomnia.
Support (If Any): This study was supported by NIH grant R01-AG031126 (MVV, SMMc and MVK - Multiple Principal Investigators). This material is the result of work supported with resources and the use of facilities at the Minneapolis VA Health Care System, Minneapolis, MN.

0393

COGNITIVE BEHAVIOR THERAPY FOR INSOMNIA ADMINISTERED BY PRACTICE NURSES IN RURAL NEW SOUTH WALES AUSTRALIA

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Introduction: Insomnia is a common sleep complaint seen by Family Physicians (FP). Pharmacotherapy is most commonly used, even though Cognitive Behavioural Therapy for insomnia (CBT-i) has long term efficacy challenging ineffective behaviours/faulty sleep beliefs. Access to professionals providing these interventions is almost absent in rural communities in Australia. Training Practice Nurses to undertake a CBT-i intervention may provide an easily accessible and deliverable treatment. Practice Nurses play a key role in rural communities, enabling treatment adherence through education and support.
Methods: This pilot randomised wait-list controlled trial selected individuals attending their FP practices with an Insomnia Severity Score (ISI) of >14 randomising them to either an active or weight listed (delayed) intervention arm. Six Practice Nurses were trained to deliver CBT-i at 3 clinics in the Primary Healthcare Network of New England (NSW) with full support from the FP's in that practice. Patients were seen individually over 4 sessions, facilitated by slides and a matching manual. All sessions were audio recorded and later evaluated by 2 assessors for accuracy of presentation. The ISI (primary outcome), mood and other questionnaire data were collected at 2, 4 & 6-months.
Results: N=26 were randomised (data available for 21 to date). There were no differences between the active and delayed groups at baseline for mood and sleep. At 2-months, CBT-i led to a significant fall in ISI (CBT-i vs Control -6.9, 95% CI -11.9 to -1.8, p=0.01). The Delayed group showed a similar fall in ISI after commencement of CBT-i. The effect appears sustained in both groups at 4-months post intervention. Assessment of the taped interviews/sessions suggests a high level of skill in these health professions who expressed considerable satisfaction in the intervention delivery.
Conclusion: This is the first full CBT-i intervention run by Practice Nurses compared with other studies using predominantly behavioural measures.This training appears to be an essential step in opening up CBT training to more rural communities.
Support (If Any): This pilot study was supported by seed funding from the Centre for Integrated Research and the Understanding of Sleep (CIRUS).

0394

EFFECT OF BACKGROUND NOISE ON SLEEP QUALITY

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Introduction: Indoor and outdoor noise are major causes of sleep disruption in western countries. Previous research has shown that administration of constant white noise may improve sleep quality by increasing the acoustic arousal threshold. Small trials and anecdotal findings suggest that white noise may also influence the brain electrical activity and improve sleep quality by reducing sleep onset latency and promoting a deeper sleep.

Methods: In an ongoing trial, eight healthy subjects were studied with two clinical polysomnographies approximately one week apart. They were exposed in random order to normal environmental noise (40.9 ± 0.9 dB) or to a louder (45.3 ± 1.2 dB, p<0.001) constant filtered white noise provided by 4 speakers (Nightingale® system Cambridge Sound Management, MA). A model of transient insomnia was determined by the sleep anticipation in 90 minutes from usual bedtime. The subjects were allowed to sleep for the same amount of time on both nights. The sleep studies were analyzed by an experienced sleep technician blinded to the treatment allocation.
Results: When exposed to filtered white noise, the subjects showed a strong trend for a shorter sleep onset latency measured as the first epoch of non-REM stage 2 sleep (20.9 ± 16.7 vs. 45.4 ± 64.2 mins, p=0.078; mean 38% reduction). Total sleep time was unchanged between white noise and control nights (448 ± 62 vs. 451 ± 90 mins, respectively, p>0.5) as well as sleep efficiency (84 ± 7 vs. 83 ± 13 % time in bed, p>0.5) and sleep architecture (p>0.5).
Conclusion: In an experimental model of transient insomnia, there was a trend for a reduction in the sleep onset latency by ~40% when subjects slept with a background of filtered white noise compared to normal environmental noise. If confirmed at study completion, these findings will suggest that filtered white noise can be used to minimize sleep-onset insomnia.
Support (If Any): N/A

0395

CLINICAL PRACTICE GUIDELINE FOR THE PHARMACOLOGIC TREATMENT OF CHRONIC INSOMNIA IN ADULTS: AN AMERICAN ACADEMY OF SLEEP MEDICINE CLINICAL PRACTICE GUIDELINE

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Introduction: The American Academy of Sleep Medicine commissioned a task force of experts in sleep medicine to develop clinical practice recommendations based on a systematic review of the literature.
Methods:
Results: 1. We suggest that clinicians use suvorexant as a treatment for sleep maintenance insomnia (versus no treatment) in adults. (WEAK)2. We suggest that clinicians use eszopiclone as a treatment for sleep onset and sleep maintenance insomnia (versus no treatment) in adults. (WEAK)
3. We suggest that clinicians use zaleplon as a treatment for sleep onset insomnia (versus no treatment) in adults. (WEAK)
4. We suggest that clinicians use zolpidem as a treatment for sleep onset and sleep maintenance insomnia (versus no treatment) in adults. (WEAK)
5. We suggest that clinicians use triazolam as a treatment for sleep onset insomnia (versus no treatment) in adults. (WEAK)
6. We suggest that clinicians use temazepam as a treatment for sleep onset and sleep maintenance insomnia (versus no treatment) in adults. (WEAK)
7. We suggest that clinicians use doxepin as a treatment for sleep maintenance insomnia (versus no treatment) in adults. (WEAK)
8. We suggest that clinicians use ramelteon as a treatment for sleep onset insomnia (versus no treatment) in adults. (WEAK)
9. We suggest that clinicians not use trazodone as a treatment for sleep onset or sleep maintenance insomnia (versus no treatment) in adults. (WEAK)
10. We suggest that clinicians not use tiagabine as a treatment for sleep onset or sleep maintenance insomnia (versus no treatment) in adults. (WEAK)
11. We suggest that clinicians not use diphenhydramine as a treatment for sleep onset and sleep maintenance insomnia (versus no treatment) in adults. (WEAK)
12. We suggest that clinicians not use melatonin as a treatment for sleep onset or sleep maintenance insomnia (versus no treatment) in adults. (WEAK)
13. We suggest that clinicians not use tryptophan as a treatment for sleep onset or sleep maintenance insomnia (versus no treatment) in adults. (WEAK)
14. We suggest that clinicians not use valerian as a treatment for sleep onset or sleep maintenance insomnia (versus no treatment) in adults. (WEAK)
Conclusion:
Support (If Any):

0396

REM ABSORPTION KINETICS TRIAL: A RANDOMIZED, CROSSOVER, CLINICAL PHARMACOKINETICS EVALUATION OF AN ION POWERED PUMP MELATONIN DELIVERY SYSTEM IN HEALTHY NON-SMOKING ADULTS

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Introduction: Immediate release (IR) melatonin formulations help promote sleep onset, but poor gastrointestinal absorption prevents them from providing adequate sleep maintenance. The IPP-melatonin (ion powered pump melatonin delivery system; REMfresh) was developed to provide an exogenous melatonin pharmacokinetic (PK) profile that mimics normal endogenous patterns through novel technology which optimizes gastrointestinal absorption.
Methods: The REM Absorption Kinetics Trial (REMAKT), a randomized, crossover, clinical PK evaluation compared IPP-melatonin (5 mg) with a leading marketed melatonin fast dissolve (5 mg) in healthy non-smoking adults. Blood was taken pre-dose and at 0.25, 0.5, 0.75, 1, 2, 3, 4, 5, 6, 8 and 12 hours following administration and was assayed for melatonin by a validated LC-MS/MS method. PK parameters, including C_{max} and T_{max} for melatonin were determined by inspection. Time to reach initial threshold (100 pg/mL), target (1000 pg/mL) hypothesized maintenance threshold concentrations, and duration of time above the target threshold levels for melatonin were determined by interpolation. Assessment of adverse events was adjudicated by the Medical Monitor Dr Lassiter.
Results: 10 healthy volunteer subjects completed the study. The median C_{max} was 4,690 pg/mL for IPP-melatonin and 23,352 pg/mL for the fast dissolve melatonin. Melatonin levels exceeded the hypothesized target maintenance threshold level of 1000 pg/mL for a median of 6.7 hours for IPP-melatonin, compared to 3.7 hours for melatonin fast dissolve. All 5 of the treatment emergent adverse events (TEAE) occurred with the fast dissolve melatonin. There were no TEAEs associated with IPP melatonin.
Conclusion: The top-selling IR melatonin formulation spiked 20X higher than clinically-proven minimum levels of exogenous melatonin for sleep onset; this same formulation also had a rapid decline that did not allow melatonin levels to be maintained for 7 hours. IPP-melatonin, a patented novel melatonin formulation, was shown to achieve both quick release of melatonin to induce sleep and continuous release with optimized absorption of melatonin to maintain sleep over 7 hours.
Support (If Any): This study was funded by Physician's Seal LLC.

0397

REPETITIVE SLEEP DISRUPTION, AN EXPERIMENTAL MODEL OF INSOMNIA, LEADS TO INCREASED SYMPATHETIC ACTIVITY

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Introduction: Sympathetic over-activity is an important feature of hypertension and might be the underlying mechanism of the link between insomnia with reduced total sleep time and hypertension. The normalized low frequency component of heart rate variability (HRV) spectra is considered a quantitative index of sympathetic activation. Thus, we investigated autonomic modulation via HRV in response to a novel repetitive sleep disruption protocol, an experimental model of insomnia.
Methods: Eight healthy participants (age 28 ± 2 yrs; BMI 23 ± 1 kg/m^2) completed a 19-day in-hospital protocol. Following 3 nights of consolidated sleep (8h/night from 2300-0700), participants were exposed to three nights of sleep disruption (40 min sleep opportunity and 20 min experimental awakening monitored by staff, repeated between midnight and 6am) followed by one night 8h recovery sleep. This sleep disruption protocol *repeated three times*, followed by three additional nights of recovery sleep at the end of the study. Two-lead electrocardiography was recorded during 5min controlled breathing (15 breaths/min) in the morning at baseline, each sleep disruption block and recovery. Lomb-scargle periodogram algorithm was performed to generate the power spectrum analysis of R-R interval. Spectral power of LF (0.04–0.15 Hz) was analyzed in normalized units (nu; LF/[total power- very LF component]) as indicator of sympathetic modulation.
Results: There was a significant intervention effect (p=0.045) on normalized LF measured during controlled breathing. Specifically, normalized LF showed a trend towards an increase over baseline (14 ± 8 nu, p=0.094) following the first block of sleep disruption, and significantly increased during the second (22 ± 8 nu, p=0.009) and third (21 ± 8 nu, p=0.015) blocks of sleep disruption. Furthermore, normalized LF was still elevated after two nights of recovery sleep (23 ± 8 nu, p=0.009) compared to baseline.
Conclusion: Sympathetic activity was exacerbated by repetitive experimental sleep disruption and was still elevated following two nights of recovery sleep. Our preliminary results indicate a disrupted autonomic function due to repetitive exposure to sleep disruption, an experimental model of insomnia.
Support (If Any): NIH/NINDS (NS-091177); NIH/UL1 RR02758 and M01-RR-01032 from the National Center for Research Resources to the Harvard Clinical and Translational Science Center.

0398

ARE CLINICAL TRIAL PARTICIPANTS REPRESENTATIVE FOR PATIENTS WITH INSOMNIA?

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Introduction: It is vital to conduct clinical trials that test new medication in the intended patient population. However, given the often stringent inclusion and exclusion criteria of clinical trials, it can be debated whether the recruited patients are representative for the average patient with insomnia.
Methods: Via advertisements in newspapers and consultation of sleep centers, N=79 patients with insomnia were recruited to participate in a clinical trial to examine next morning effects of hypnotic drugs on driving performance and cognitive performance. The current analysis examined recruitment failures of this clinical trial.
Results: During initial screening, N=25 (31.6%) patients were excluded for practical issues and baseline demographics. Of them, N=8 were excluded because they either did not answer the phone, or had no further interest, or time to participate. N=2 were excluded because they did not speak Dutch. N=6 subject were either too young or too old, and N=6 did not meet the pre-set driving experience criteria. Another 3 subjects were not willing to stop driving for the duration of the study. Another N=49 (62%) patients were excluded for medical reasons: N=2 patients did not meet the criteria of insomnia, N=7 were engaged in shift work, N=2 reported having other sleep disturbances, and N=6 reported a sleep latency of more than 60 minutes. N=17 were excluded because they had comorbid psychiatric disease for which most of them received treatment (N=12) or had other health related issues (N=5). The other N=14 patients were not willing to stop their current treatment with hypnotic drugs. Of the N=5 subjects that were scheduled for screening, N=2 did not show up and were lost to follow up. N=3 subjects were scheduled for a single-blind 1-week placebo run-in week. These subjects failed due to a placebo response, i.e. they had a change in subjective sleep latency greater than 20 minutes.
Conclusion: Of N=79 patients that were recruited, N=0 (0%) were included in the study. This data illustrates that patient's which are selected for participating in clinical trial are not always representative for patients in real life.
Support (If Any): The analyses were funded by Utrecht University.

0399

DYSFUNCTIONAL SLEEP BELIEFS IN CANCER-RELATED INSOMNIA

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Introduction: Dysfunctional beliefs about sleep have been found to be an important factor in chronic insomnia and cancer-related insomnia (CRI). Treatment effect of cognitive behavioral therapy for insomnia in CRI was found to be associated with reduction in dysfunctional sleep beliefs. Previous studies however used a general questionnaire to assess the dysfunctional sleep beliefs in CRI. The current study aims to: 1) identify dysfunctional sleep beliefs specifically related to cancer; 2) examine whether these beliefs play a more important role in CRI.
Methods: A 26-item cancer-related sleep belief questionnaire (CRSBQ) was constructed by interviewing 32 cancer patients (female: male=20:12; average age=54.6yo) with comorbid insomnia and three experts in sleep medicine and psycho-oncology. The CRSBQ was then administered, along with the Dysfunctional Beliefs and Attitude about Sleep, 16-item version (DBAS-16), Insomnia Severity Index (ISI), and a questionnaire for sleep history, to 82 patients with comorbid cancer and insomnia (female: male=72:10; average age =48.6yo). The participants were divided to two groups based on whether the onset of insomnia was before (pre-cancer group) or after (post-cancer group) the diagnosis of cancer for further comparisons.

Results: Participants' average rating on CRSBQ was higher than average rating on DBAS-16 (t=33.11, p<.001). Both CRSBQ and DBAS-16 scores correlated with ISI (r=.265, p<.05 and .322, p<.005, respectively). There was no significant difference on all the scales between pre-cancer and post-cancer groups.
Conclusion: Insomnia patients comorbid with cancer do have specific cancer-related sleep beliefs. However, these beliefs do not have a higher association with their sleep disturbance, whether the insomnia was a premorbid condition or not.
Support (If Any): The study is supported by the Ministry of Science and Techonology, Taiwan.

0400

COGNITIVE BIAS PHENOMENON IN INSOMNIA PATIENTS

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Introduction: Current study aimed to investigate cognitive bias on words stimuli in insomnia patients. Also by diversifying words stimuli, we investigated which types of words insomnia patients show cognitive bias most likely to.
Methods: Twenty-four insomnia patients based on DSM-IV criteria and 21 healthy controls were enrolled. Three types of words including 39 sleep-related, 40 neutral, and 40 negative words were used as experimental stimuli. In the subjective emotional rating tasks, all the participants were asked to rate the emotional intensity of randomly presented list of different types of words on a 7-point Likert scale (-3 = most negative and +3 = most positive). Subsequently, participants were asked to indicate whether each word stimulus was related to sleep or not.
Results: There were no significant differences in self-rated valence on 3 categories of words between two groups, but only simple main effect of types of words (p = 0.000). Also, there were significant differences in the number of responses whether each stimulus is related to sleep in neutral category (p = 0.047). Insomnia patients responded to neutral stimuli as sleep-related more frequently compared to control group (7.810±10.829 vs 2.714±2.432).
Conclusion: Current results support the presence of a cognitive bias towards neutral stimuli among insomnia patients. The cognitive bias may contribute to underlying mechanism of primary insomnia.
Support (If Any): This research was supported by Basic Science Research Program through the National Research Foundation of Korea funded by the Ministry of Science, ICT and Future planning (Study No.: NRF-2015R1C1A2A01054060).

0401

DREAM INCORPORATION OF INSOMNIA SUFFERERS AND GOOD SLEEPERS IN AN EXPERIMENTAL SETTING

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Introduction: Dream incorporation in laboratory setting manifests itself by direct (ex: experimenter, electrodes, etc) or indirect (ex: participating in an experiment) presence of elements referencing to the experimental setting. The presence of increased cortical activation during sleep and wakefulness in insomnia sufferers (INS) is well documented and is often reflected through enhanced information processing. This latter could increase awareness of sleeping environments and lead to dream incorporation of the experimental settings. The objective of the present study is to compare INS and good sleepers (GS) regarding dream incorporation for laboratory settings.
Methods: PSG was recorded in 12 INS and 12 GS (aged 30 to 45) for five consecutive nights (N1 to N5). On N3 and N5, participants were awoken during REM periods for dream collection. Dream incorporation of the laboratory setting was targeted with the following categories: environment (bed, electrodes, etc.) staff and experience (being awakened, report dreams, etc.). Dream elements referring to sleep but not related to laboratory settings were also quantified.
Results: Independent sample T tests were used to assess between groups differences in regards to 1) Environment 2) Staff 3) Experience and 4) Sleep dream incorporation. Two participants were excluded due to extreme data. Results showed a significant difference between INS and GS for environmental dream incorporation (p=.001), INS reporting more environmental elements. No significant difference were found for Staff (p=.483), Experience (p=.289) and Sleep (p=.283).
Conclusion: Because a greater number of elements from the laboratory environment is observed in INS' dreams, it might suggest that INS are more hyperaroused at sleep onset and display enhanced information processing. Results also suggest that INS appeared more mindful of their surroundings since the immediate, concrete, external elements of the environment are more prone to be treated and so, incorporated in dreams.
Support (If Any): CIHR (86571).

0402

ALTERED PERCEPTION OF TIRED FACES IN INSOMNIA: A STUDY COMPARING NORMAL AND POOR SLEEPERS

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Introduction: Insomnia is associated with reduced emotion intensity ratings for facial expressions of sadness and fear. Considering tired faces are often rated as appearing sad, individuals with insomnia may show reduced intensity ratings for expressions of tiredness. As a first step in exploring this possibility, we compared normal and poor-sleepers in their ratings for the expression intensity of tiredness and alertness whilst observing sleep-related and neutral faces.
Methods: Fifty-six normal-sleepers (NS:26.95±9.32yrs, 68% female) scoring <8 on the Insomnia Severity Index (ISI; 3.73±2.12) and 58 poor-sleepers (PS:26.19±9.16yrs, 86% female) scoring ≥8 on the ISI (13.14±3.94), observed 98 facial photographs (49 neutral; 49 sleep-related). Between 0–100, participants were required to rate the extent to which each face appeared as tired and alert. 0 indicated not at all, 100 indicated very much so. Sleep-related faces were created by manipulating neutral photographs to include previously identified facial tiredness cues: depressed eyelids, increased pretarsal show, bags under eyes, drooped corners of mouth. Mean ratings were compared between-groups.
Results: All participants rated sleep-related faces as more tired and less alert relative to neutral photographs, F(1,112)=70.91,P=.001. A mixed ANOVA demonstrated a significant group x face (neutral vs. sleep-related) x rating (tired vs. alert) interaction F(1,112)=8.03,P=.005: revealing that compared to normal-sleepers (63.80±13.04), poor-sleepers (56.61±14.39) showed lower ratings for the expression of tiredness, but not alertness (NS:34.69±14.91; PS:37.09±12.23), whilst observing the sleep-related faces. Ratings of tiredness (NS:36.39±12.55; PS:34.98±13.12) and alertness (NS:57.86±11.42; PS:54.10±12.92) did not differ between groups whilst observing neutral faces.
Conclusion: The present study, using normal and poor-sleepers, provides suggestive evidence that insomnia is associated with reduced ratings of expression intensity for sleep-related facial photographs displaying tiredness. Previous research from our group confirms individuals with insomnia misperceive their own, but not other peoples, facial appearance as more tired than they are. As such, the current results

provide further understanding of mechanisms involved concerning the perception of tiredness in insomnia.
Support (If Any): n/a

0403

DREAM CONTENT AND CORTICAL ACTIVITY DURING REM SLEEP IN INSOMNIA INDIVIDUALS

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Introduction: Current models of insomnia suggest that cortical hyperarousal is one of its core feature. Greater activation in beta and alpha frequencies during the night and greater negative dream content in insomnia sufferers (INS) than in good sleeper (GS) have been found. However, it remains unknown if there is a relationship between cortical activation and oneiric content. Thus, we aim at: 1) comparing negative, positive and active elements in INS and GS' dreams, 2) measuring cortical activity in REM in both groups and 3) examining the link between cortical arousal and dream content across successive REM periods.
Methods: PSG was recorded in 12 INS (mean age 37.5 years, SD=4.3) and 12 GS (mean age 37.3 years, SD=4.7) for five consecutive nights (N1 to N5). On N3 and N5, participants were awoken in REM sleep for dream collection. The Hall & Van de Castle scale was used for dream content analysis. PSA was conducted on the 5 minutes period before the awakening for dream collection.
Results: Generalized linear mixed regression model showed no significant effect for group, REM periods and interaction on negative and positive elements of dream content ($p>0.05$). However, a significant interaction of group and REM periods on activity elements of dreams ($p=0.04$) was found, GS presenting more activity elements at the end of the night than INS. No significant group effects on cortical activation were found ($p\geq0.05$). Nonetheless, a significant effect of REM period was observed, both beta and alpha activity decreasing throughout the night ($p<0,001$). Finally, no link between cortical activity and dream content was observed.
Conclusion: The absence of beta and alpha increases in INS might suggest that spectral analysis is not optimal to study hyperarousal in INS during REM sleep. However, because cortical activation is already very high during REM, more activity in high frequencies can be linked to awakening or sleep fragmentation. Because a greater number of elements of activity is observed in dreams of GS, it might suggest that INS are more focused on negative elements in their dreams than GS.
Support (If Any): Fonds de recherche du Québec - Santé (FRSQ).

0404

DIURNAL PATTERNS OF INSOMNIA INTERNET SEARCH QUERIES: AN ANALYSIS OF GOOGLE TRENDS DATA

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Introduction: Patients frequently use the Internet as a source of information regarding their symptoms or health conditions. As a result, timing of search engine query data has been used to investigate patterns of illness symptomatology. Since insomnia typically occurs at night and may be exacerbated by environmental conditions such as light emitted from computing screens, search queries for insomnia may reflect both patterns of symptoms as well as a factor that perpetuates insomnia complaints.
Methods: Hourly normalized search volume (NSV) for the search term "insomnia" was acquired utilizing Google Trends over a one-week interval from 11/21/16 to 11/28/16, the largest output for which hourly NSV is available. Diurnal patterns in NSV were examined for the United States, as well as separately in highly populated states spanning different time zones. Diurnal patterns for insomnia search queries were also examined in other representative countries with high search volumes for convergent validity. ANOVA was utilized to examine effects of time (hour of day) for insomnia NSV. Timing of peak insomnia NSV (normalized to clock time for each location) was examined for each state/country. Additional data from 11/28/16 to 12/05/16 and 12/05/16 to 12/12/16 were utilized to confirm findings through replication.
Results: Highly significant differences in insomnia NSV times across the 24-hour day were observed for all countries and states examined (all $p<0.0001$). Insomnia NSV demonstrated a robust diurnal pattern, with peaks in search volumes occurring between 02:00 and 04:00 in all locations. Results were confirmed in replicative analyses.
Conclusion: Peaks in insomnia search queries during the middle of the night suggest patients are utilizing the Internet at the time they are experiencing symptoms. Future research that examines the impact of Internet use on insomnia symptoms, and how timing of Internet use may impact outcomes of Internet-based insomnia therapies are warranted.
Support (If Any): N/A

0405

WORK STRESS AND INSOMNIA: WORK-LIFE BALANCE AS A MEDIATOR

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Introduction: The 24-hour day in human beings is composed by three major elements: work, personal life and sleep. Increased work stress might disrupt the balance between work and life, and further interfere with nighttime sleep. The current study therefore aims to explore the mediating role of work-life balance on the association between work stress and insomnia.
Methods: Participants included 369 full-time employees (158 males and 184 females from age 23 to 62; Mean= 36.11, SD=7.34) recruited from technology and insurance industries in Taiwan. They completed a set of questionnaires, including Job Stress Questionnaire (JSQ), Insomnia Severity Inventory (ISI), and Work-Life Balance Questionnaire (WLBQ).
Results: The model that the Work Interference with Personal Life (WIPL) dimension of the WIPL as a mediator between work stress and sleep disturbances was examined using Bootstrap Method. After controlling age, sex and BMI, the results show that JSQ total score could predict ISI ($\beta=.206$, $t=6.131$, $p<.001$) and WIPL ($\beta=.497$, $t=13.718$, $p<.001$). Furthermore, WIPL could predict ISI score ($\beta=.180$, $t=3.72$, $p<.001$). After controlling the score of WIPL, the predictive power of JSQ total score toward ISI is decreased significantly but remains significant ($\beta=.117$, $t=2.860$, $p<.01$). The results suggest that WIPL has a partial mediating effect on the association between work stress and severity of insomnia.
Conclusion: The findings support that work stress could lead to insomnia partially through the disruption of work-life balance. Strategies to prevent work demand from interfere with personal life, such as setting clear work-life boundary, could probably decrease the risk of insomnia in employee who are under high work stress.
Support (If Any):

0406

RELATIONSHIP BETWEEN BOTHERSOME SELF-REPORTED HOT FLASHES AND SLEEP QUALITY IN MIDLIFE WOMEN WITH AND WITHOUT INSOMNIA

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Introduction: The prevalence of insomnia increases as women approach menopause, partly in association with the emergence of sleep-disruptive hot flashes. Here, we aimed to investigate relationships between self-reported hot flashes and sleep quality in midlife women with and without insomnia. We also evaluated attitudes and beliefs about sleep.
Methods: 47 women in the menopausal transition (MT) or post-menopause (age range: 49 - 58) who reported having at least one hot flash during an overnight laboratory visit completed the Dysfunctional Beliefs and Attitudes about Sleep scale (DBAS, a validated measure of 16 items of sleep-disruptive cognitions), presleep arousal scale, and evaluated their sleep quality, severity and bother of hot flashes, and mood following one night in the sleep laboratory.
Results: Women with insomnia had higher total DBAS scores, reflecting more disruptive sleep-related cognitions ($p<0.001$), and higher levels of pre-sleep cognitive arousal ($p<0.01$) than women without insomnia. Women with, compared to those without, insomnia reported longer sleep onset latencies and felt less refreshed, less alert, and had a poorer mood, on waking ($p<0.05$). Both groups reported similar levels of severity and bother of nocturnal hot flashes and more bothersome hot flashes were associated with poorer sleep quality ($p <0.01$).
Conclusion: Similar to insomnia sufferers at other stages of life, midlife women with insomnia in the context of menopause have more dysfunctional beliefs about sleep than those without, which should be a target for treatment. Hot flashes, particularly when bothersome, are associated with a poorer sleep quality regardless of the presence of an insomnia diagnosis. However, the combination of bothersome hot flashes and faulty cognitions about sleep in women with insomnia may lead to greater impact on daily functioning and mood.
Support (If Any): Funding: Grant HL103688 (FCB).

0407

INSOMNIA AND ACADEMIC RETENTION IN STUDENT VETERANS

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Introduction: To date, empirical research has focused on many risk factors known to contribute to academic functioning, such as lack of social support, depression, posttraumatic stress, and suicidality, to name a few. When focusing on student veterans, there has been a lack of research on insomnia in general. The presence of such disturbances alone may impair several domains of functioning, such as emotional well-being, physical health, relationships, and academics. The purpose of this study is to determine if higher rates of insomnia increase the risk for academic distress and dropout in this population.
Methods: The sample focused on 193 veterans enrolled at a Gulf Coast university (M = 32.43 years old, SD = 9.15). Participants completed a questionnaire consisting of four items assessing academic retention on a four-point Likert scale (i.e., "How confident are you that this university is right for you?" [very confident - very unconfident], "How much thought have you given to stopping your education?" [very little thought - a lot of thought], "How likely is it that you will re-enroll?" [very likely - very unlikely], and "How likely will you earn a degree?" [very likely - very unlikely]), and the Insomnia Severity Index (ISI). Four multiple regression models were conducted to determine if insomnia predicted retention after controlling for age, ethnicity, and gender.
Results: Correlation analyses demonstrated that ISI positively associated with retention question one ($r = .18$, $p = .013$), retention question two ($r = .19$, $p = .008$), and retention question three ($r = .17$, $p = .019$). Regression results indicated that ISI significantly predicted retention question two ($F(4,178) = 3.18$, $p = .015$, $R^2 = .07$), retention question three ($F(4,180) = 4.10$, $p = .003$, $R^2 = .08$), and retention question four ($F(4,180) = 5.66$, $p < .001$, $R^2 = .11$).
Conclusion: The results highlight the importance of considering insomnia as a barrier to successful post-secondary matriculation for Gulf Coast veterans. Data support the notion that the inability to obtain restful sleep may influence the decision to discontinue education.
Support (If Any): N/A

0408

GRAY MATTER VOLUME REDUCTIONS IN THE THALAMUS AND NUCLEUS ACCUMBENS FOLLOWING ACUTE SLEEP CONTINUITY DISRUPTION

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Introduction: Insufficient sleep has been negatively associated with reductions in psychological and cognitive functioning and can lead to excessive daytime sleepiness. However, the effect of acute sleep loss on regional gray matter volume (GMV) changes is poorly understood. Limited evidence suggests that thalamic GMV is susceptible to alterations in normal sleep patterns. In addition, prior work in our lab has revealed that sleep continuity disruption (SCD) reduces positive affect and increases impulsivity, suggesting the mesolimbic dopaminergic reward system may be altered by sleep loss. We hypothesized that a night of SCD would produce regional GMV reductions in the thalamus and nucleus accumbens (NAc), which would be correlated with higher ratings of daytime sleepiness.
Methods: Twenty healthy, good sleepers underwent a randomized, within-subject crossover study in which the effects of SCD via forced awakenings (FA) were compared to uninterrupted sleep (US). Following a single night of FA or US, subjects rated their sleepiness (Stanford Sleepiness Scale (SSS)) and completed a magnetic resonance imaging session. T1-weighted scans were preprocessed and mean values for region of interest (ROI) were calculated using CAT12 and SPM.
Results: Whole brain analysis revealed total GMV increased following FA, however, this was not associated to any specific region. There were significant reductions in GMV in the left thalamus ($p<0.005$, cluster corrected) and left NAc ($p=0.032$, FWE small volume corrected) following FA. Additionally, increased daytime sleepiness was negatively correlated with GMV reductions in the thalamus and NAc ($p<0.05$).
Conclusion: A single night of SCD produced an increase in total GMV, and regional GMV reductions in the thalamus and the NAc. While the thalamus has previously been implicated, to our knowledge, this is the first occurrence of reduced NAc GMV, as well as its

correlation to excessive daytime sleepiness. Despite these findings, the mechanisms associated with reduced GMV selectively affecting these regions requires additional research.
Support (If Any): NIH T32 NS7020110 (BR); NIH K23 DA035915 and NIH P30 NR014131 (PHF); NIH R01 DA0329922 (MRI, MTS).

0409

INSOMNIA PREDICTS MULTIPLE DIMENSIONS OF SUICIDAL IDEATION AMONG ARMY SERVICEMEMBERS

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Introduction: Previous research has demonstrated a link between insomnia and suicidal ideation. Most of these studies, however, have treated suicidal ideation as a single construct. Recently, it has been suggested that ideation be considered dimensionally (i.e., in terms of passivity, intent, plan, and willingness to communicate intent and plan). In the present study, the association of insomnia with suicidality was assessed in terms of five different measures of ideation.
Methods: An archival analysis was conducted using a national database of army service members (Army STARRS), 2,617 of whom had been assessed for insomnia and suicidality. Insomnia was defined as difficulties initiating and/or maintaining sleep within the last 30 days. Depression was assessed by whether or not the participant met criteria for a depressive episode during the past 30 days. Suicidal ideation was assessed for the last 30 days in terms of: thoughts of death (i.e., wishing one was dead), thoughts of suicide (i.e., thoughts of killing self), suicidal plan (i.e., thoughts of how to kill self), suicidal intent (i.e., intention to kill self), and suicidal communication (i.e., telling someone about the suicidal thoughts). Stepwise logistic regressions were used to determine the association of insomnia with the dimensional measures of suicidality.
Results: When controlling for depression, insomnia emerged as a significant predictor for suicidal communication [OR = 2.59, $p < .01$], thoughts of death [OR = 2.36, $p < .001$], suicidal plan [OR = 1.88, $p < .01$], and thoughts of suicide [OR = 1.66, $p < .01$]. Suicidal intent was not found to be significantly associated with insomnia.
Conclusion: The present findings suggest that insomnia may be differentially associated with dimensional aspects of suicidal ideation. A more refined delineation of suicidality may serve to clarify the nature of the association between insomnia and suicidal ideation, and potentially offer some clues as to the mechanisms behind this association.
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0410

ONLINE CASE-BASED EDUCATION IMPROVES HEALTHCARE PROVIDER KNOWLEDGE AND COMPETENCY IN CARE OF PATIENTS WITH INSOMNIA

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Introduction: Many healthcare providers are challenged by the evidence-based diagnosis and management of insomnia. The current study was undertaken to determine whether an online, case-based intervention could effectively improve knowledge and competence in both primary care physicians (PCPs) and psychiatrists regarding the diagnosis and management of insomnia.
Methods: The educational intervention was an online, interactive, text-based CME activity comprised of 2 patient case scenarios requiring clinicians to apply evidence-based recommendations. Educational effect was evaluated through a linked pre- vs post-assessment of responses of individual learners, allowing each learner to act as his/her own control. A paired 2-tailed t-test evaluated whether the mean pre- and post-assessment scores significantly differed from one another and Pearson's $\chi 2$ test measured changes in paired responses to individual questions. Cramer's V was used to calculate the effect size of the intervention. Data from the educational intervention were collected between March 23, 2016 and May 18, 2016.
Results: Comparison of responses to questions before and after education demonstrated statistically significant improvements and a large effect for both PCPs (n=1148; V =.552; P <.05) and psychiatrists (n=981; V =.492; P <.05). Significant increases in knowledge and competence were observed in several specific areas for both PCPs and psychiatrists (P <.05 for all comparisons): diagnosis of insomnia disorder using the DSM 5 criteria, initial hypnotic choice in a patient with both sleep onset and maintenance difficulties, competence in choosing a non-GABA-targeted hypnotic, and knowledge of the mechanism of action of non-GABA-targeted hypnotics.
Conclusion: This study demonstrated the success of a targeted, online, interactive, case-based educational intervention on improving the knowledge and competence of both PCPs and psychiatrists regarding the accurate diagnosis and appropriate treatment of insomnia. There is a need for additional education on the diagnosis and management of insomnia to reinforce the improvements demonstrated by this intervention.
Support (If Any): An unrestricted educational grant from Merck & Co, Inc.

0411

INSOMNIA SYMPTOMS AND TIME-USE IN THE WORKING POPULATION: AN EXPLORATIVE STUDY USING DIARY DATA

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Introduction: Insomnia symptoms in the working population might be related to insufficient time for recovery between workdays. The aim of the present study was to investigate differences in time-use pattern during a workweek between employees with insomnia symptoms and employees considered to be good sleepers.
Methods: Participants (N=579; 76% women) were full-time workers within the public sector in Sweden. Data were collected during one week through questionnaires and diaries. Time-use was reported through 13 different activity categories every half hour daily between 06:00 am and 01:00 am the next night. Differences in the amount of paid work (including overtime), non-paid work (including domestic work, care for children and care for others) and free-time/recovery activities were explored on workdays and days off separately.
Results: Among participants, 22% were classified as suffering from insomnia according to the Karolinska Sleep Questionnaire. During workdays, employees suffering from insomnia spent on average 7:59 hours (h) on paid work, 1:46 h on non-paid work and 5:58 h on free-time/recovery activities. For good sleepers the corresponding time-use was 8:03 h for paid work, 1:34 h on non-paid work and 6:02 h on free-time/recovery activities. Analyses of variance showed that time-use patterns did not differ significantly between the groups, even when

adjusting for gender and age. On days off, there were similarly no significant differences between the groups.
Conclusion: Insomnia symptoms do not seem to be related to time-use among full-time workers in the public sector in Sweden.
Support (If Any):

0412

UNITED BY SLEEP ARCHITECTURE, DIVIDED BY METABOLISM: METABOLOMICS OF MILD INSOMNIA

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Introduction: Insomnia remains one of the top causes of neuropsychiatric disorders. The disease is associated with a number of negative consequences including daytime fatigue, impaired emotional and cognitive regulation and decreased quality of life. Despite being common in occurrence, very little is known about pathophysiology of the disease. Strikingly, objective measurements of sleep often fail to distinguish insomniacs from healthy controls. We investigated the metabolic profiles of insomnia patients using NMR spectroscopy based metabolomics to gain insights of the disease at a molecular level.
Methods: Insomnia patients (n=15) and healthy controls (matched by age and sex, n=15) were recruited for the study. The individuals were subjected to blood draw every 2 hours for 48 hours and one night of polysomnography. Blood serum samples were extracted and analyzed by high resolution NMR spectroscopy. Spectral data was analyzed and compared using multivariate statistical tools and time series analysis.
Results: Insomnia patients have distinct metabotypes from matched controls in spite of comparable sleep architecture. Metabotypes of insomnia patients were significantly different from the controls across all time points and temporally in nighttime samples. Energy, sugar, and branched chain amino acid (BCAA) metabolism were found to be distinctly altered. In addition, circadian oscillations of metabolites were impacted in insomnia patients. Specifically, we observed an imbalance of anabolic and catabolic activity in insomnia. Bedtime catabolic activity was found to be increased, as suggested by temporal buildup of catabolic products of energy substrates.
Conclusion: Despite similar sleep architecture, metabolic profiles of participants with insomnia are highly distinct from control individuals. Obvious differences in the energy metabolism and BCAA metabolism may have a mechanistic connection with incidental metabolic disorders in chronic insomnia.
Support (If Any): This work was supported by an investigator-initiated research grant from Merck, Inc.

0413

UNEMPLOYED INDIVIDUALS REPORTING HINDRANCE-RELATED WORK STRESS ON PREVIOUS JOB HAVE INCREASED LIKELIHOOD OF INSOMNIA DISORDER

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Introduction: Research investigating the challenge-hindrance framework of work stress supports that challenge-related work stressors (e.g. job demands, time pressures), are associated with positive outcomes (e.g., job satisfaction) while hindrance-related stressors (e.g. job insecurity, organizational politics), are associated with negative outcomes. Both burnout and unemployment are associated with disturbances in sleep. However, surprisingly few studies have examined previous work stress in unemployed individuals, including whether previous work stress is associated with later Insomnia Disorder.
Methods: Initial, cross-sectional data were gathered as part of the ongoing, prospective Assessing Daily Activity Patterns through occupational Transitions (ADAPT) study. Thirty-eight recently unemployed individuals (< 90 days, N = 23 female, 61%; M age = 43.56 years; SD = 10.77 years) completed the Cavanaugh et al. (2000) self-reported work stress scale about their previous job. They also participated in the Duke Sleep Interview, a semi-structured interview assessing symptoms of ICSD sleep disorders, including Insomnia Disorder (Chronic and Short Term).
Results: A total of 23 participants (61%) met ICSD criteria for a current, post-job loss Insomnia Disorder (n = 9, 24% Chronic; n = 14, 37% Short-term). Challenge and hindrance-related work stress scores were normally distributed. Logistic regression results indicated that only hindrance-related work stress increased the likelihood of Insomnia Disorder (B = .24, SE = .11, p = .04); challenge-related work stress did not increase the likelihood of Insomnia Disorder (B = -.03, SE = .08, p = .71). Neither hindrance nor challenge-related work stress predicted Chronic Insomnia. A nonsignificant trend indicated that hindrance-stress increased the likelihood of Short-Term Insomnia (< 3 months, B = .18, SE = .10, p = .06); no one item carried this effect.
Conclusion: The results from this ongoing study suggest that hindrance-related work stress increases the likelihood of Insomnia Disorder above and beyond challenge-related work stress. These findings suggest that hindrance-related work stress prior to job loss may have continued effects on sleep after job loss. They also support the promotion of occupational wellness programs and management training to address hindrance-related work stress as one way of improving sleep health.
Support (If Any): National Heart, Lung, and Blood Institute #1R01HL117995-01A1.

0414

INDIVIDUAL AND PSYCHOSOCIAL WORK FACTORS RELATED TO INSOMNIA IN MUSICIANS

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Introduction: We recently reported that Norwegian musicians have a higher prevalence of insomnia symptoms compared to a representative community sample (Prevalence Difference 6.9, 95% Confidence Interval 3.9–10.0). Further, musicians and artists generally report higher mental and work related stress compared to the regular workforce. Still, few studies have investigated interactions between musicians´ work and individual life and insomnia. In the present study, we investigate how personality traits and psychosocial work variables were related to insomnia among musicians.
Methods: All members of the Norwegian Musician's Union who were eligible (n= 4168) were invited to participate in the online questionnaire study. A total of 2121 individuals (51%) participated. Of these, 656 (30.9%) worked full time as professional performing musicians and constitute the study sample in the present study. Insomnia was measured with the Bergen Insomnia Scale. We used hierarchical multiple regression analyses to examine how age, work hours per week, personality traits, demands, control, efforts, support, rewards and work-family conflict were related to insomnia scores.

Results: The variables investigated explained 22% of the variance in insomnia among musicians (F=(11,532)=13.961, p=.000). In the full model, extraversion, neuroticism and high demands were significantly, positively related to insomnia, while social support was negatively related to insomnia. Age, work hours per week, openness, agreeableness, conscientiousness, control or work-family conflict were not related to insomnia score.
Conclusion: Although we cannot conclude about causality, our results support that personality traits of musicians partly may explain their insomnia symptoms. Work conditions and psychosocial variables may be difficult to measure for musicians because of large differences in work context, but high levels of demands and low social support may contribute to developing insomnia symptoms among full-time musicians.
Support (If Any): The Norwegian ExtraFoundation for Health and Rehabilitation and Statistics Norway.

0415

USEFULNESS OF WRIST ACTIGRAPHY SLEEP MEASURES IN PREDICTING FATIGUE IN INSOMNIA DISORDER

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Introduction: Fatigue is a prevalent health and safety risk, leading to reduced productivity and increased accidents, that is frequently associated with poor sleep quantity and/or quality. While wrist actigraphy has been validated for the objective assessment of sleep and wake states, little is known about the ability of actigraphy-based sleep measures to predict next-day levels of fatigue.
Methods: In an ongoing study with currently N=25 participants, N=15 insomnia disorder based on DSM-V criteria (ID: 2 males, ages 18–49) and N=10 healthy controls (HC: 3 males, ages 18–47) participants wore a Respironics Actiwatch and reported fatigue levels on a scale of 0–10, with higher scores indicating greater fatigue, daily across seven days using the REDCap electronic data capturing system. Daily Actiwatch measures for total sleep time (TST), sleep efficiency (SE), number of awakenings, and wake after sleep onset (WASO) were used to predict fatigue ratings the following day using linear regression analysis.
Results: ID reported more fatigue (ID: 4.68±.28; HC: 1.9±.20; p<0.001) over the study week and had longer total WASO than HC (ID: 42±3.2min; HC: 30±3.2min; p<0.05). TST, SE, and number of awakenings did not differ significantly between groups. More minutes of WASO the night before predicted higher next day subjective ratings of fatigue in ID but not HC.
Conclusion: Time spent awake during the sleep period, rather than total hours of sleep or number of awakenings, appears to contribute to next day fatigue in ID, suggesting that certain sleep measures assessed by actigraphy may be useful for predicting daytime fatigue in ID. Further analyzes will investigate the relationship between other actigraphy-based sleep measures (e.g., daily mobility measures, sleep/wake bout length) and fatigue in insomnia disorder and in health controls.
Support (If Any): Investigator-initiated grant from Merck Inc., NIH/UL1 RR02758 and M01-RR-01032 from the National Center for Research Resources to the Harvard Clinical and Translational Science Center.

0416

INSOMNIA IDENTITY RELATION TO THE BIG FIVE PERSONALITY TRAITS AND TRAIT EMOTIONAL INTELLIGENCE

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Introduction: Individuals may endorse an "Insomnia Identity", described as believing that one has insomnia, which can be measured independently of other sleep parameters or a diagnosis of insomnia disorder. Pathologizing sleep concerns, as may be done with endorsement of insomnia identity even in the presence of a normal sleep pattern, may be linked to other maladaptive thoughts and behaviors. This in turn could alter one's mood and ability to recognize emotions. We evaluated the relation of insomnia identity status to Big Five personality traits (BFP) and Trait Emotional Intelligence (TEI).
Methods: 538 participants (124 males, *M* age = 18.8 years; *SD* = 1.7), completed questionnaires about personality traits (BFP, 5 subscales) and TEI. Participants also answered a question on insomnia identity, "I am an Insomniac" (1 = strongly disagree to 5 = strongly agree).
Results: Insomnia identity was dichotomized into endorsement and non-endorsement, excluding values from the "undecided" category. A multivariate T-test of insomnia identity on the Big Five personality traits and TEI revealed a significant effect, Wilks' $\Lambda = .95$, $p < .01$. Univariate follow-up testing revealed significant differences on Neuroticism ($p < .001$) and TEI ($p < .001$). Neuroticism was significantly higher for those who endorsed insomnia identity ($t = -3.61$, $p < .001$) and TEI was lower for those who endorse insomnia identity ($t = 3.59$, $p < .01$).
Conclusion: Individuals who endorsed an insomnia identity reported higher traits of neuroticism and lower TEI scores. Those who believe they have insomnia may have more neurotic tendencies and perceive their own emotional abilities as less favorable than those who do not endorse this sleep pathology. Prior research has shown that insomnia identity consequences are unrelated to disturbed sleep, suggesting insomnia identity is a meaningful clinical target.
Support (If Any): None.

0417

ITALIAN VALIDATION OF THE INSOMNIA CATASTROPHIZING SCALE: AN INSTRUMENT TO ASSESS INSOMNIA-SPECIFIC CATASTROPHIZING THOUGHTS

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Introduction: Several instruments have been developed and validated to investigate insomnia-specific cognitions. The Insomnia Catastrophizing Scale (ICS) is a self-report questionnaire evaluating catastrophizing thoughts related to nighttime symptoms (ICS-N) and daytime impairment (ICS-D) of insomnia. The aim of the present study was to assess the psychometric properties of the Italian version of the ICS.
Methods: An Italian sample of 435 university students (Mean age=23.5±4.68; %F=76.5) completed the ICS together with the Insomnia Severity Index (ISI). Confirmatory factor analyses (CFA) of the ICS-N and the ICS-D were conducted using MPLUS7 software. Model parameters were estimated using the maximum likelihood (ML) estimation method, and the quality of the measurement model was visually examined through the fit indices estimates of Tucker-Lewis index (TLI), comparative fit index (CFI), and standardized root mean square residual (SRMR). Cronbach's alpha coefficient for each scale was estimated to evaluate the internal consistency of items. Finally, correlations with ISI were performed to evaluate convergent validity of ICS scales.

Results: The CFA showed that the one-factor model fit the data well both for the ICS-N ($\chi^2_{(44)}$=366.349, p<.001; CFI=.901, SRMR=.048) and the ICS-D ($\chi^2_{(9)}$=81.688, p<.001; CFI=.906; SRMR=.022). In both cases, the items loaded significantly on their latent factor (>.65). Chronbach's alpha was .93 for the ICS-N and .94 for ICS-D. Both ICS-N and ICS-D correlated with ISI (r=.717, p=.001 for ICS-N and r=.615, p=.001 for ICS-D).
Conclusion: CFA confirmed the presence of one-factor structure for both the ICS-N and the ICS-D. The two scales also showed to be reliable at a satisfactory level. Finally, both the scales correlated with insomnia severity, supporting the concurrent validity of the two scales.
Support (If Any): None to report.

0418

IMPROVING ACTIGRAPHY-BASED SLEEP EFFICIENCY ESTIMATES

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Introduction: Sleep efficiency (SE) is the guiding index of cognitive behavioral therapy for insomnia (CBT-I), but it is typically estimated from patient self-reports of questionable validity. Actigraphy (ACT) should enhance CBT-I by providing objective estimates of sleep efficiency; however, only two studies have validated actigraphy-based estimates of sleep efficiency (ACT-SE) in sleep-disordered patients studied at home. Both found ACT-SE to correspond poorly with PSG-based SE (PSG-SE). The current study assessed the validity of ACT-SE in a third sleep-disordered sample studied at home and piloted a simple method of improving ACT-based estimates of sleep efficiency.
Methods: Participants with panic disorder, posttraumatic stress disorder, or comorbid posttraumatic stress and panic disorder, and controls without sleep complaints, underwent in-home recording of sleep using concurrent ambulatory PSG and actigraphy. Synchronized PSG and proportional integral mode (PIM) ACT recordings were obtained from 41 participants. Sleep efficiency was scored using conventional methods from both ACT and PSG, and ACT-SE/PSG-SE concordance examined. ACT data were then resampled to 30-second epochs and rescaled on a per-participant basis to yield optimized concordance between PSG- and ACT-based sleep efficiency estimates.
Results: The correlation between ACT-SE and PSG-SE across participants was statistically significant ($r = 0.35$, $p < 0.025$); though ACT-SE failed to replicate a main effect of diagnosis. Individualized calibration of ACT against a night of PSG yielded a significantly higher correlation between ACT-SE and PSG-SE ($r = 0.65$, $p < 0.001$; $z = 1.692$, $p = 0.0452$, one-tailed) and a significant main effect of diagnosis that was highly correspondent with the effect on PSG-SE.
Conclusion: Actigraphic estimation of sleep efficiency in sleep-disordered patients tested at home can be significantly improved by calibration against a single night of concurrent PSG. This improvement must rely on amplification/attenuation of non-zero epochs of ACT. Modern actigraphs provide the temporal and amplitude resolution needed for re-calibration.
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0419

HEMISPHERIC AND MORPHOLOGICAL CHARACTERISTICS OF SLEEP SPINDLES IN PRIMARY INSOMNIA AND GOOD SLEEPERS

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Introduction: Sleep spindles are implicated in memory consolidation and possibly altered in psychopathology. However, little is known about quantitative and morphological abnormalities in Primary Insomnia (PI). We explored differences in sleep spindle characteristics between PI and Good Sleepers (GS).
Methods: Following an acclimation night, 23 PI (16 female, Age: M=21.3, SD=14.3yrs) and 19 GS (14 female, Age: M=32.6, SD=14.9yrs) completed consecutive nights of home sleep monitoring (psg-2 and psg-3) prior to a fear conditioning and extinction task. Signal processing of artifact free scalp EEG was accomplished using co-author S.P's open source C/C++ program (http://zzz.bwh.harvard.edu). Canonical (13.5Hz), fast (15Hz), and slow (11Hz), spindles were detected from bilateral central (C3, C4; canonical and fast) and frontal (F3, F4; slow) derivations using wavelet analysis with adaptive thresholds. Spindle Amplitude, Density and Duration were calculated for detected spindles. For canonical, fast and slow spindle frequency types, two-group (PI vs. GS) x 2 Night (psg-2 vs. psg-3) x 2 Hemisphere (left vs. right) ANOVAs for Amplitude, Density and Duration were conducted independently for stages N2 and N3.
Results: For canonical spindles, we observed a Hemisphere main effect for N2 Density (left > right, $F(1,20) = 6.750$, $p = .017$), a main effect trend of Night for N2 Amplitude (night 3>night2, $F(1,20)=3.803$, $p=.065$) and Hemisphere for N3 Amplitude (left>right, $F(1,20)=4.325$, $p=.052$), and a trend for a Night x Hemisphere interaction for N3 Duration ($F(1,20)=3.458$, $p = .078$). For fast spindles, we observed a main effect of Night for N2 Amplitude (psg 3>psg 2, $F(1,20)=6.272$, $p = .021$), Group for N3 Duration (PI>GS, $F(1,20)=6.107$, $p=.024$), and a Night x Hemisphere interaction trend for Duration ($F(1,20)=3.510$, $p = .077$). For slow spindles, we observed a main effect of Group for N2 Duration (PI>GS, $F(1,20)=6.460$, $p=.019$) and main effect trend of night for N2 Amplitude (psg3>psg2, $F(1,20)=3.258$, $p=.085$) and group for N3 duration (PI>GS, $F(1,20)=3.542$, $p=.075$).
Conclusion: Hemispheric differences in N2 canonical spindle density is conserved in both PI and GS. N2 fast spindles' Amplitude increased from psg-2 to psg-3, possibly influenced by task-related learning. Compared to GS, PI demonstrated greater spindle duration for fast spindles in N3 and slow spindles in N2, offering a possible signature for the condition.
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0420

WHO ARE THE PARTNERS? A SLEEP PROFILE OF PARTNERS OF INDIVIDUALS SEEKING TREATMENT FOR INSOMNIA

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Introduction: Sleep has typically been investigated as an individual phenomenon. However, recent research suggests sleep is largely a dyadic process: An individual's sleep is influenced by his/her bed partner, and sleep problems in one partner can precipitate sleep disorders in the other partner. There is qualitative suggestion that partners of individuals with insomnia are good sleepers, as those with insomnia report feeling envious of their partners' healthy sleep. Currently, there is a lack of data supporting or refuting this notion. The present study provides an initial report on sleep patterns of bed partners of individuals with insomnia.
Methods: Analyses examine data from 18 partners (9 female, aged 19–75 years) of individuals seeking treatment for insomnia in an ongoing RCT investigating partner-assisted interventions for insomnia. Baseline measures include the Insomnia Severity Index (ISI), STOPBang, Epworth Sleepiness Scale (ESS), PROMIS Sleep Related Impairment, Duke Structured Interview for Sleep Disorders, and sleep diary data.
Results: Overall, partners reported healthy sleep characteristics. One partner reported a previous sleep disorder diagnosis (OSA), which was effectively managed at the time of data collection. Seventeen out of 18 partners reported ISI within healthy ranges (< 10; M = 3.56), 15 reported ESS < 10 (M = 5.94), and 16 were low risk for OSA (STOPBang < 5; M = 2.15). Partners' sleep diary data indicated an average total sleep time of 6.8 ± 1.2hr, sleep latency 17.2 ± 15.1min, and sleep efficiency 87.5%±8.1%. More than 75% reported healthy levels of sleep-related daytime functioning.
Conclusion: Results indicate that the majority of insomnia bed partners experienced normal sleep, supporting the common rhetoric that bed partners are good sleepers. These preliminary findings suggest insomnia may not be "contagious" within couples. It will be important for future research to examine other factors such as length and severity of insomnia and to compare this population directly to healthy sleepers' partners.
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0421

WHO ENVIRONMENTAL NOISE GUIDELINES: SYSTEMATIC REVIEW ON ENVIRONMENTAL NOISE AND EFFECTS ON SLEEP

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Introduction: As the auditory system perceives and evaluates noise even while asleep, noise disturbs and fragments sleep and impairs recuperation. The World Health Organization (WHO) is in the process of preparing new Environmental Noise Guidelines for the European Region. To evaluate the strength of the available evidence on the effects of environmental noise exposure on sleep, a systematic literature review was conducted.
Methods: 74 studies predominately conducted between 2000 and 2015 were included in the review. A meta-analysis of surveys linking road, rail, and aircraft noise exposure to self-reports of difficulty falling asleep, awakening during the night, and sleep disturbance was conducted. A pooled analysis of polysomnographic studies on the acute effects of transportation noise on sleep was also performed. Due to a limited number of studies and the use of different outcome measures, a narrative review only was conducted on the effect of transportation noise on motility, cardiac and blood pressure outcomes, and on children's sleep. The effect of wind turbine and hospital noise on sleep was also assessed.
Results: For self-reported measures that asked how noise affects sleep, the unadjusted odds ratio for the percent highly sleep disturbed for a 10 dB increase in the average nighttime noise level was significant for aircraft (1.936; 95% CI 1.608–2.332), road (2.126; 95% CI 1.820–2.483), and rail (3.058; 95% CI 2.378–3.933) noise. For polysomnographically measured sleep, the unadjusted odds ratio for the probability of awakening for a 10 dB increase in the indoor maximum noise level was also significant for aircraft (1.351; 95% CI 1.218–1.499), road (1.360; 95% CI 1.192–1.550), and rail (1.354; 95% CI 1.209–1.515) noise.
Conclusion: Transportation noise was found to affect objectively measured sleep physiology and subjectively assessed sleep disturbance in adults. For the other outcome measures and noise sources examined the evidence was conflicting or only emerging.
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0422

EVALUATING THE ASSOCIATION BETWEEN INSOMNIA SUBTYPES AND SUICIDAL IDEATION AMONG ARMY SERVICEMEMBERS

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Introduction: Past studies support an association between insomnia and suicidal ideation. Few studies, however, have parsed insomnia into its respective subtypes (i.e., early, middle, and late insomnia), to assess if one of the subtypes confers more risk for suicidal ideation than the others. To assess this possibility, the present study assessed associations between suicidal ideation (globally construed) and early, middle, and late insomnia, as well as the phenomenon of frequent awakenings.
Methods: The sample consisted of 2,617 servicemembers that participated in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS), a large epidemiological study examining the risk factors for suicidality. Insomnia variables included measures of early, middle, and late insomnia and frequent nocturnal awakenings. Depression was determined by whether or not the participant met criteria for a depressive episode during the past 30 days. Suicidal ideation was determined by whether or not participants endorsed any form of suicidal ideation during the same time frame. To determine the independent effect of each insomnia variable on suicidal ideation, a stepwise logistic regression was conducted. Insomnia and depression variables were entered as independent variables in the model, and suicidal ideation was entered as the dependent variable.
Results: When controlling for depression [OR = 7.05, $p < .001$], only early insomnia [OR = 1.13, $p = .02$] and frequent awakenings [OR = 1.23, $p < .001$] emerged as significant predictors of suicidal ideation.

Conclusion: The present data provide some insight into the specific nature of the relationship between insomnia and suicidal ideation, in that early insomnia (i.e., difficulty initiating sleep) and frequent awakenings were distinctly associated with a global measure of suicidal ideation. If these results are found to be reliable (over subsequent studies with similar and/or different populations and/or using prospective measures) such data may serve to focus future investigations on how insomnia confers risk for suicidality.
Support (If Any): Army STARRS was funded by the US Department of Health and Human Services, National Institutes of Health, National Institute of Mental Health (NIH/NIMH; U01MH087981).

0423

TYPE-SPECIFIC EFFECTS OF CHILDHOOD MALTREATMENT ON ADULT SLEEP PROBLEMS

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Introduction: Childhood maltreatment (CM) is a highly important but often overlooked predictor of adult sleep problems. Given approximately 40% of individuals experience CM, characterisation of the relationship between CM and adult sleep problems could be particularly useful for identification and early intervention of individuals at risk of developing insomnia.
Methods: 1219 individuals from the Netherlands Sleep Registry (age 19-89years, 915 females, 633 insomnia) completed the Insomnia Severity Index (ISI), Childhood Trauma Questionnaire and Hospital Anxiety and Depression Scale. First, we quantified the risk of developing insomnia following CM. Then using a partial least squares analysis, we examined the CM-subtype specific effects on adult insomnia symptoms (ISI components), as well as the moderating effects of age, gender, depressive symptoms and anxiety symptoms.
Results: CM was related to a 1.54 fold increase in the risk of developing insomnia. Childhood physical neglect was associated with worse sleep patterns (ISI-4, β=0.19, 0.008<μ<0.377) and noticeability of sleep-related problems (ISI-5, β=0.19, 0.008<μ<0.375). Childhood sexual abuse, partially mediated by anxiety symptoms, was associated with greater distress concerning sleep patterns (ISI-4, β=0.11, 0.001<μ<0.207). Additionally, we found that the impact of childhood emotional abuse on sleep maintenance (ISI-2, β=-0.11, -0.198<μ<-0.013), early awakenings (ISI-3, β=-0.10, -0.194<μ<-0.001) and daytime dysfunction (ISI-7, β=-0.10, -0.192<μ<-0.007) decreased with age.
Conclusion: The present study highlights the importance of screening for CM in adults reporting with sleep problems. These findings should be used to inform risk assessment and for the development of individualised treatment plans, such as anxiety management for individuals with a history of childhood sexual abuse.
Support (If Any):

0424

MODERATE OBSTRUCTIVE SLEEP APNEA IS ASSOCIATED WITH INCIDENT DIABETES: A LONGITUDINAL, POPULATION-BASED STUDY

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Introduction: Mild-to-moderate obstructive sleep apnea (OSA) is highly prevalent in the general population, but with minimal symptoms. In cross-sectional studies, it has been shown that OSA in its severe form is associated with insulin resistance, glucose intolerance, and type 2 diabetes independent of the confounding effects of obesity. However, findings on the association between mild-to-moderate OSA and diabetes from longitudinal studies are limited and inconsistent. The purpose of this study was to examine the association between mild and moderate OSA with incident diabetes in a large random sample of the general population over a long follow-up period.
Methods: The Penn State Adult Cohort is a random general population sample of 1,741 adults who underwent 8h polysomnography and was provided a detailed medical history interview at baseline. After 10.1 years, those with apnea/hypopnea index (AHI)<30 and no diabetes at baseline (n=1250) were followed up. Mild and moderate OSA were defined as AHI=5–14.9 and AHI=15–29.9, respectively. The presence of diabetes at baseline and follow-up was defined by a self-report of receiving treatment for diabetes and/or history of a diabetes diagnosis.
Results: The incidence of diabetes was 10.2%. After adjusting for sex, race, baseline age, BMI, hormone replacement therapy, smoking, alcohol drinking, fasting blood glucose, and length of follow-up, moderate OSA was significantly associated with increased odds for developing diabetes (OR= 2.78, CI=1.17–6.63). Mild OSA was not associated with incident diabetes (OR= 0.47, CI=0.18- 1.19). When the model was further adjusted for ΔBMI, the results remained similar.
Conclusion: Moderate OSA, even when asymptomatic, is associated with increased risk for the development of diabetes. Future studies should examine the potential of biomarkers to improve clinicians' abilities to detect who, among patients with asymptomatic moderate OSA, are at increased risk for adverse cardiometabolic sequelae in the future.
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0425

ASSOCIATION BETWEEN TONGUE VOLUME AND TONGUE FORCE IN OBSTRUCTIVE SLEEP APNEA

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Introduction: The tongue is the primary pharyngeal dilator muscle that influences upper airway patency. We have previously shown that patients with obstructive sleep apnea have increased tongue volumes and increased tongue fat deposition. However, the relationship between tongue volume and tongue force has not been studied. We hypothesized that increased tongue volume would be associated with decreased tongue force in apneics and controls, and that this effect would be mediated by tongue fat.
Methods: 132 Apneics (AHI ≥ 15 events/hr) and 42 non-apneics (AHI ≤ 10 events/hr) with a BMI greater than 30kg/m^2 were recruited from the University of Pennsylvania's Sleep Center. The non-apneic controls had a mean AHI of 5.6 ± 5.3 events/ hour and BMI of 34.6 ± 5.8 kg/m^2 while apneics had a mean AHI of 39.3 ± 29.7 events/hour and BMI of 41.2 ± 9.79 kg/m^2. For each subject, polysomnography, tongue force (kPa), and tongue volume (mm^3) and tongue fat by spein echo and Dixon MRI, respectively, were measured. Tongue force was recorded using Northwest and Iowa Oral Performance Instruments with the highest of three measures recorded as the maximum. Polysomnography was performed on all subjects and scored using the AASM Chicago Criteria. To measure the total tongue volume (mm^3), subjects underwent axial and sagittal upper airway MRI analysis. Linear regression was used for statistical analysis.
Results: There was no relationship between tongue volume (mean: 80560 ± 13510mm^3) and tongue force (mean: 81.6 ± 14.0kPa) in non-apneic controls with and without controlling for tongue fat ($p = 0.63$ and $p = 0.59$, respectively). However, increased tongue volume (mean: 96824 ± 19472mm^3) was significantly associated with increased tongue force (mean: 77.1 ± 16.8kPa) ($p < 0.001$, $r=0.24$) in apneics, and this effect remained after controlling for tongue fat ($p < 0.001$, $r=0.24$).
Conclusion: In apneics but not controls increased volume of the tongue was associated with increased tongue force. Tongue fat did not mediate the relationship between tongue volume and tongue force in apneics and non-apneic controls. Out results suggest that increased tongue EMG activity (which has been shown to be increased in apneics during wake and sleep) may explain the increased tongue force.
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0426

MILD-TO-MODERATE OBSTRUCTIVE SLEEP APNEA IS ASSOCIATED WITH INCIDENT HYPERTENSION: A LONGITUDINAL, POPULATION-BASED STUDY

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Introduction: Mild-to-moderate obstructive sleep apnea (OSA) is highly prevalent in the general population, but with minimal symptoms. It has been shown that OSA in its severe form is associated with cardiovascular disorders, such as hypertension. However, the findings of the association between mild-to-moderate OSA and hypertension from longitudinal studies are limited and inconsistent. The purpose of this study was to examine the association between mild and moderate OSA and incident hypertension in a large random sample of the general population over 10-year follow-up.
Methods: The Penn State Adult Cohort is a random general population sample of 1,741 adults who underwent 8h polysomnography and was provided a detailed medical history interview at baseline. After 10.1 years, those with apnea/hypopnea index (AHI)<30 and no hypertension at baseline (n=787) were followed up. Mild and moderate OSA were defined as AHI=5–14.9 and AHI=15–29.9, respectively. The presence of hypertension at baseline and follow-up was defined by a self-report of receiving treatment for hypertension and/or history of a hypertension diagnosis.
Results: The incidence of hypertension was 25.2%. After adjusting for sex, race, baseline age, BMI, hormone replacement therapy, smoking, alcohol drinking, MAP, apnea therapy and length

of follow-up, mild (OR=4.35, CI=2.25–8.39) and moderate OSA (OR= 3.80, CI=1.41–10.30) were significantly associated with increased ORs for developing hypertension, respectively. The association between OSA and hypertension was significantly stronger in younger adults than elderly (OSA × age interaction p=0.01). Furthermore, when the model was adjusted for ΔBMI, the results remained similar.

Conclusion: Mild-to-moderate OSA, even when asymptomatic, is associated with increased risk for the development of hypertension. Moreover, this risk is significantly decreased in older individuals. Future studies should examine the potential of biomarkers to improve clinicians' abilities to predict who, among asymptomatic patients with mild-to-moderate OSA, are at increased risk of adverse cardiometabolic sequelae in the future.

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0427

EXPERIMENTAL FRAGMENTATION MODELING LOW-LEVEL OSA DOES NOT ALTER PERCEIVED PRESSURE-PAIN THRESHOLD OR TOLERANCE

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Introduction: Patients with untreated obstructive sleep apnea (OSA) have fragmented sleep and perceive thermal nociceptive stimuli as more painful. Sleep restriction and deprivation worsen pain, but the impact of fragmentation alone has not been established. We systematically interrupted sleep using ambulatory blood pressure inflation (at 5min intervals) to determine whether fragmentation seen in mild apnea-hypopnea index increased pressure-pain.

Methods: After PSG screening for sleep disorders (baseline), 12 females, 18-30yrs, spent two nights in-lab for sham and fragmentation (randomized order, separated by two nights at home for washout). Induced sleep interruptions (arousals of ≥3sec) occurring within 10sec of cuff inflation were scored blind to condition and cuff activity. An hour after awakening, participants' pressure-pain was assessed. Participants indicated the duration after which weight on each of the ring and middle fingers became painful (threshold) and intolerable (tolerance; 3min max). Threshold and tolerance were compared across nights (baseline, sham, and fragmentation) based on non-dominant or dominant hand (with or without blood pressure cuff, respectively).

Results: Average sleep at home (7hr44m; SD=39m) was preserved in-lab (per actigraphy). Baseline, fragmentation, and sham did not differ on N1%, N3%, or REM%. N2% was higher on fragmentation night than sham (p=0.037). Cuff-induced interruption occurred 5.2 (SD=1.3) times/hr, with higher interruption frequency during N2 (6.7 times/hr, SD=1.7). Although pain threshold and tolerance were lower on the non-dominant (cuff) hand (main effect, p=0.005 and p=0.002, respectively), there was neither a main effect of study night (p=0.293 and p=0.121, respectively) nor an interaction (p=0.233 and p=0.398 condition*hand, respectively).

Conclusion: The fragmentation protocol interrupted sleep 5.2 times/hr (N2 6.7 times/hr), but did not affect finger-applied pressure-pain threshold or tolerance. Results suggest that pressure-related nociceptive processing is preserved with sleep fragmentation at a frequency consistent with clinical-threshold OSA and that OSA-related pain effects are due to hypoxia and/or more severe fragmentation.

Support (If Any): West Virginia University Office of Academic Affairs Doctoral Student Research Program and Department of Psychology Graduate Student Research Fund.

0428

DEPRESSION IS ASSOCIATED WITH DECREASED SLEEP QUALITY RATHER THAN RESPIRATORY DISTURBANCE OR HYPOXIA DURING SLEEP IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea is known to be associated with depression, but which changes in OSA patients are responsible for the depression is still controversial. This study was conducted to examine which factors, including the severity of OSA, are associated with the depressive symptoms and excessive daytime sleepiness in OSA patients.

Methods: We reviewed retrospectively the data of 1200 subjects (872 men; mean age 48.7 years) who completed self-report questionnaire and performed polysomnography in the center for sleep and chronobiology of SNUH. We compared Beck Depression Inventory (BDI) and Epworth Sleepiness Scale (ESS) score between control and OSA groups. The analyses for OSA subgroups classified by severity and partial correlation were performed.

Results: The BDI score was significantly higher in OSA group than control group (12.3 ± 7.6 vs. 10.4 ± 6.2, p=0.002). There was significant difference in ESS score among mild, moderate and severe OSA subgroups (7.1 ± 4.8 vs. 8.1 ± 4.5 vs. 10.1 ± 4.5, p<0.001), but not in BDI score (13.4 ± 7.8 vs. 12.3 ± 8.1 vs. 11.5 ± 6.9, p=0.236). After adjusting for age, sex and BMI, BDI score in OSA group was significantly correlated with total sleep time (TST), sleep efficiency (SE), wake after sleep onset (WASO), and sleep latency (SL), but not with apnea-hypopnea index (AHI) and average O2 (r=-0.116, p<0.00; r=-0.001, p=0.001; r=0.077, p=0.014; r=0.127, p<0.001; r=-0.027, p=0.387; r=0.019, p=0.542, respectively). The ESS score in the OSA group was significantly correlated with TST, SE, WASO, SL, AHI and average O2 (r=0.114, p<0.001; r=0.109, p=0<0.001; r=-0.081, p=0.01; r=-0.138, p<0.001 and r=-0.134, p<0.001, respectively).

Conclusion: In current study, patients with OSA showed higher depressive symptoms than those without OSA. Daytime sleepiness in OSA patients was associated with the severity of OSA as well as sleep architectures. However, depressive symptom was associated with only sleep architectures, but not with the severity of OSA. Depression in OSA patients may be explained better by sleep quality rather than respiratory disturbance or hypoxia during sleep.

Support (If Any):

0429

EVOLUTION OF GRAY MATTER VOLUME IN MILD AND MODERATE OBSTRUCTIVE SLEEP APNEA

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Introduction: Cerebral gray matter changes were reported in individuals with obstructive sleep apnea (OSA). However, the evolution of these gray matter changes over time is unknown. Considering that over 50% of individuals aged 55 and older who present mild to moderate OSA (apnea-hypopnea index [AHI] between 5 and 30) remain untreated, it is particularly important to better understand the evolution

of gray matter changes in this subgroup. Our objective was to investigate the evolution of the gray matter volume in this subgroup using voxel-based morphometry (VBM) and magnetic resonance imaging.
Methods: Twelve control subjects (age: 63.8 ± 7.2 yo; AHI: 1.9 ± 1.5) and 18 individuals with untreated mild to moderate OSA (age: 63.9 ± 5.2 yo; AHI: 12.1 ± 6.5) were evaluated twice using a magnetic resonance imaging with an 18-month delay between visits. The VBM method with paired t-tests was used to compare gray matter volumes between visits in each group separately ($p<0.05$ FWE cluster level).
Results: After 18 months, we observed a decreased volume in the caudate nuclei, the right putamen and the globus pallidus in the untreated OSA group. However, the control group showed reduced volume of the right cerebellum and the inferior temporal gyrus after 18 months.
Conclusion: Distinct patterns of changes in gray matter volume were observed in the OSA versus the control group. The atrophy found in the control subjects were previously reported with normal aging. Decreased volume in the basal ganglia was specific to the OSA group and could be explained by the chronic exposure to hypoxia, excitotoxicity and changes in regional cerebral blood flow. Our results suggest that even mild or moderate OSA causes gray matter damages different from normal aging over time.
Support (If Any):

0430

CENTRAL PERIODIC BREATHING IN ACUTE STROKE

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Introduction: Central periodic breathing (CPB) is frequently observed in acute stroke patients. There have been controversies about the association with the location and size of stroke and its effect on the outcome of stroke. Our hypothesis is that it is a manifestation of autonomic instability responding to acute stroke.
Methods: We investigated patients who were admitted with acute ischemic stroke and received nocturnal polysomnography. We collected data on symptoms suggesting sleep disordered breathing during the month preceding the onset of stroke and and parameters associated with respiratory events in polysomnography. Stroke data including demographics, risk factors, etiologic subtypes, initial vital sign and clinical course were also collected. We compared the clinical characteristics between those with and without CPB.
Results: Among 94 patients, 20 showed CPB in polysomnography. None of 15 patients with small vessel occlusion had CPB. Diastolic blood pressure at visit tends to be higher in those with CPB (p=0.06). NIHSS was not significantly associated with CPB. Incidence of early neurological deterioration and modified Rankin Scale at three months were not different between groups.
Conclusion: CPB occurs in strokes other than small vessel disease. Elevation of blood pressure and CPB coincide in acute stroke. This suggests that autonomic instability is the possible mechanism of CPB occurring in acute stroke.
Support (If Any):

0431

PATHOPHYSIOLOGIC ASPECTS OF SLEEP DISORDERED BREATHING AND PAROXYSMAL ATRIAL FIBRILLATION

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Introduction: Although associations of sleep disordered breathing (SDB) and continuous atrial fibrillation (AF) have been well-characterized, the relationship of SDB and paroxysmal AF (PAF), an earlier stage in the AF evolution, is not well understood. We sought to examine the association of SDB and its attendant pathophysiologic attributes in relation to PAF.
Methods: We leverage a case control study designed to examine the underlying mechanisms of SDB and PAF: the Sleep Apnea and Atrial Fibrillation Biomarkers and Electrophysiological Atrial Triggers (SAFEBEAT, NCT02576587). Cases were >18 years with PAF1:1 matched to controls without AF by age (±5 years), sex, race and body mass index (BMI±5kg/m^2) who underwent 16-channel research-grade polysomnography. SDB was defined by apnea hypopnea (>3% desaturation) index (AHI), central apnea index (CAI), percentage sleep time <90% oxygen saturation (TST<90) and arousal index (AI). Conditional logistic regression models were used to assess relationships of SDB measures and PAF. Multivariable models were further adjusted for hypertension, diabetes, myocardial infarction history, dyslipidemia and depression (odds ratio and 95% confidence intervals presented).
Results: The analytic sample was comprised of 300 participants (n=150 cases, n=150 controls): age 61.9 ± 11.9 years, 63.3% male, and BMI 31.4 ± 6.7kg/m^2. Unadjusted analyses demonstrate a statistically significant inverse association of AHI and PAF (OR=0.95, 95%CI: 0.93–0.97) which persisted in the multivariable model (OR=0.95, 95%CI: 0.93–0.98). High blood pressure had a significant association with PAF (OR= 1.97, 95%CI: 1.013–3.82). No significant associations were observed for CAI, AI and TST<90 relative to PAF.
Conclusion: The current findings demonstrate a 5% decreased odds of PAF per single unit increase in AHI consistent with an unanticipated inverse association. Given existing data showing increased risk of mainly continuous AF in SDB, it is possible that SDB may exert variable influences (beneficial versus detrimental) depending upon the extent of cardiac remodeling and stage of AF evolution.
Support (If Any): NHLBI RO1 1 R01 HL 109493, Clinical and Translational Science Collaborative of Cleveland,UL1TR000439 from the National Center for Advancing Translational Sciences (NCATS) component of the National Institutes of Health and NIH roadmap for Medical Research.

0432

CRP IS A BETTER PREDICTOR OF HYPERTENSION AND HYPERGLYCEMIA THAN APNEA/HYPOPNEA INDEX IN MILD-TO-MODERATE OBSTRUCTIVE SLEEP APNEA

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Introduction: The guidelines for when and how to treat mild-to-moderate obstructive sleep apnea (OSA) are a clinically gray area, particularly when patients are asymptomatic. We examined the relative utility of

apnea/hypopnea index (AHI) vs. C-reactive protein (CRP) in predicting hypertension and hyperglycemia in adults with mild-to-moderate OSA.
Methods: 60 middle-aged, relatively non-obese men and post-menopausal women (55.0% male, 55.1 ± 0.7y, mean BMI 29.2 ± 0.5) underwent an 8h polysomnography study. Mild-to-moderate OSA was defined as 5≤AHI<30. Blood pressure (BP) was assessed in the evening before bed. A blood draw was taken upon awakening for measures of CRP and fasting glucose. Hypertension was defined as systolic BP ≥140 mmHg, diastolic BP ≥90 mmHg, and/or use of antihypertensive medication; hyperglycemia was defined as blood glucose ≥100 mg/dL. We generated area under the receiver-operating characteristics (ROC) curves (AUCs) to compare the accuracy of AHI vs. CRP in predicting hypertension and hyperglycemia, with demographics (age, sex, and BMI) as additional predictors.
Results: Hypertension and hyperglycemia were present in n=29 and n=18 participants, respectively, with mild-to-moderate OSA. CRP was a stronger predictor of hypertension (OR=1.42, p=0.086) and hyperglycemia (OR=1.83, p=0.01) than AHI (OR=1.01, p=0.81; OR=1.09, p=0.12, respectively). In terms of predicting hypertension, the AUC for the model including demographics only (age, sex, BMI) was 0.667. Incorporating AHI into the model yielded an AUC of 0.670; adding CRP increased the AUC to 0.721. In terms of predicting hyperglycemia, the AUC for the model including demographics was 0.648. Incorporating AHI into the model yielded an AUC of 0.698; adding CRP increased the AUC to 0.813.
Conclusion: Incorporating a measure of systemic inflammation greatly improves the ability for clinicians to detect cases of mild-to-moderate OSA with true cardiometabolic risk and, thus, warrant treatment. These findings have implications in improving prognosis and treatment options for patients with OSA in the mild-to-moderate range.
Support (If Any): *NIH R01 HL64415.*

0433

IMPACT OF PULMONARY PHYSIOLOGIC AND METABOLIC FACTORS ON ARTERIAL CARBON DIOXIDE LEVELS IN OBESITY HYPOVENTILATION SYNDROME

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Introduction: Although the relationship of respiratory physiology and arterial pCO2 (PaCO2) has been characterized in sleep disordered breathing (SDB), less is known about factors affecting PaCO2 levels in the obesity-hypoventilation syndrome (OHS). We hypothesized that metabolic and mechanical factors would be positively associated with PaCO2 levels in OHS whereas SDB variables would not.
Methods: In this retrospective study involving adult patients without neuromuscular disease or sedative use, the following variables were collected: 1) SDB - Apnea/hypopnea index (AHI), percent sleep time <90% (PSAT<90), nocturnal SaO2 (nSaO2); 2) Metabolic - bicarbonate (HCO3), fasting blood glucose (FBS), creatinine, body surface area (BSA), metabolic syndrome, chronic kidney disease (CKD); and 3) Mechanical factors - body mass index (BMI), neck circumference, forced vital capacity (FVC), forced expiratory volume in first second (FEV1) and pulmonary disease.
Results: The final sample included 81 patients with mean[±SD] age of 62 ± 11 years, 53% female, median[IQR] BMI 39.7kg/m^2[34.7,45.5], BSA 2.3m2[2.1,2.5], 95% with OHS and PaCO2 50.0 ± 4mmHg. Median AHI was 28.1[16.8,64.4], PSAT<90% 18.1[3.3,52.2], nSaO2 91.0%[89.0,93.2], HCO3 28.5meq/L[25.0,32.0] and FBS 111.5mg/dl[97.0,165.5]. Metabolic syndrome and pulmonary disease were present in 48.8% and 56.3% respectively. Mean FVC was 65.8 ± 20.9% and FEV1/FVC 73.6 ± 11.2% of predicted. Univariate linear regression showed that pulmonary disease (coefficient, 95%CI) (3.49,0.77-6.22), metabolic syndrome (2.92,0.18-5.65), BMI (0.15,0.03-0.28), HCO3 (0.31,0.07-0.56) and FBS (0.04,0.01-0.06) were positively associated with PaCO2 at p<0.05. Nocturnal SaO2 (-0.35,-0.63 - -0.08) was negatively associated while AHI (-0.01,-0.06-0.03) and PSAT<90% (0.04,-0.01–0.09) were not associated with PaCO2.
Conclusion: Presence of pulmonary disease, metabolic syndrome, higher BMI, bicarbonate and FBS were positively associated with PaCO2 in OHS patients with concomitant OSA. In contrast, SDB variables were negatively associated or not associated at all. These results highlight the greater importance of underlying pulmonary-metabolic factors, relative to SDB factors, in the development of hypercapnia in OHS patient with OSA.
Support (If Any):

0434

THE ASSOCIATION OF TRAFFIC-RELATED AIR POLLUTION WITH SLEEP APNEA AND INFLAMMATORY BIOMARKERS

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Introduction: Obstructive sleep apnea (OSA) is associated with inflammatory biomarkers which may predispose to premature cardiovascular disease. Air pollution is also associated with systemic inflammation, and may therefore also be associated with worsening OSA. Our objective was to assess whether traffic-related pollution (TRAP) is associated with OSA severity or systemic inflammation.
Methods: 1858 consenting patients who had a polysomnography (PSG) for suspected OSA were recruited between 2007 and 2013 into a research database. Information from a detailed questionnaire, BMI, and PSG were included. In a subset (n=494), serum was collected the morning after PSG, and levels of inflammatory biomarkers (e-selectin, intracellular adhesion molecule, vascular cell adhesion molecule, interleukin 6, interleukin 8) were measured using Luminex. For each patient, residential 6-digit postal code (corresponding to ~ 1 block face) was used to estimate each subject's TRAP exposure (nitrogen oxides, black carbon and fine particulate matter) using land-use regression, with mean nitrogen dioxide concentration of 16.2 ± 5.6 ppb (Vancouver, BC). SAS 9.4 used for analysis.
Results: 1339 participants (69.6% male, mean and SD age: 57.6 ± 12.2 years, AHI: 22.5 ± 22.1/hr) had a postal code within the air pollution model domain. 255 patients had no OSA (AHI <5/hr); 390 had mild OSA (AHI 5–15/hr); 336 had moderate OSA (AHI 15–30/hr); and 358 had severe OSA (AHI >30/hr). Pollution measures were not significantly correlated with AHI (Pearson correlation coefficients -0.005 to -0.061, p>0.1 for all variables) or with OSA severity using categorical variables by ANOVA; the lack of association persisted after controlling for age and gender. None of the inflammatory biomarkers were associated with pollution levels.
Conclusion: In our cohort, we did not find an association between air pollution exposure and either OSA severity or inflammatory biomarkers.

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0435

INTERETHNIC COMPARISON OF INTER-MANDIBULAR AND SOFT TISSUE VOLUMES AMONG NATIVE CHINESE, ICELANDIC CAUCASIAN AND AFRICAN-AMERICAN APNEICS

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Introduction: Anatomical risk factors associated with obstructive sleep apnea (OSA) include obesity, enlarged upper airway soft tissue structures, and craniofacial abnormalities. Research has shown that Chinese apneics have smaller airways, soft tissue structures and craniofacial structures when compared to Caucasian and African-American apneics. However, neither total intra-mandibular volume (IMV) nor the relationship between IMV and soft tissue volumes have been assessed by ethnicity. Oour study objectives were to compare the IMV and the ratio of soft tissue volumes to IMV between native Chinese, Icelandic Caucasian, and African-American apneics. We hypothesize that, given similar severity of OSA, IMVs will be smaller and ratio of soft tissue volumes to IMV will be larger in Chinese compared to Caucasians and African-Americans.

Methods: 25 Chinese, 25 Caucasian, and 25 African-American apneics (AHI≥15 events/hour) were recruited from outpatient sleep clinics in China, Iceland, and Philadelphia, USA. Subjects tended to be middle-aged (53 ± 10.2 years), overweight (BMI 32 ± 6.5 kg/m^2), male (64%), and have severe apnea (AHI 39 ± 22.3 events/hour). Subjects were matched on gender and AHI within 5 events/hour. Subjects underwent upper airway MRI (1.5T field strength) and volumetric analysis of upper airway structures was conducted using Amira software.

Results: Chinese trended towards smaller mean IMV values compared to African-Americans (169127.8 ± 37941.2mm^3 vs. 190203.9 ± 27667.8mm^3, p=0.082), though significant differences were not seen compared to Caucasians (169276.7 ± 30667.8mm^3). Chinese subjects exhibited significantly smaller tongue volume to IMV ratio (0.17 ± 0.08) than both Caucasians (0.45 ± 0.04, p<0.001) and African-Americans (0.46 ± 0.03, p<0.001). Conversely, Chinese subjects had significantly larger lateral wall volume to IMV ratio (0.10 ± 0.04) than both Caucasians (0.07 ± 0.01, p<0.001) and African-Americans (0.07 ± 0.02, p<0.001). No differences were seen in soft palate volume to IMV ratio. Caucasians and African-Americans showed no differences in soft tissue volume to IMV ratios.

Conclusion: Differential anatomic risk factors contribute to OSA across ethnic groups. Chinese displayed smaller total IMV and tongue volume to IMV ratios, but larger lateral wall volume to IMV ratios, compared to Caucasians and African-Americans. These results may suggest that the ratio of lateral wall volume to IMV plays an important role in the causal effects of OSA for Chinese patients.

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0436

THE ASSOCIATION BETWEEN GESTATIONAL DIABETES MELLITUS AND SLEEP-DISORDERED BREATHING

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Introduction: An estimated 4.6–9.2% of pregnancies are complicated by GDM which is an important public concern due to its association with maternal and fetal complications. Data on sleep disturbances including sleep-disordered breathing (SDB) in GDM is controversial. Evidence investigating the associations between GDM and SDB using objective measures is limited. This study aimed to determine if SDB is associated with an increased risk of GDM.

Methods: Women with GDM (n=38) and healthy pregnant women (n=33) matched for race, maternal age (32.2 ± 3.9 yrs vs 31.8 ± 4.3 yrs, respectively) and parity underwent a full lab-polysomnography after being screened for GDM (24–36 wks pregnancy). They also completed questionnaires including Sleep Apnea Symptom Score (SASS) from the Multivariable Apnea Prediction index. Bivariate and multivariable logistic regression analyses were performed to determine the clinical characteristics that were significantly associated with GDM. Using GDM diagnosis as the dependent variable, sleep and demographic variables having a P<0.2 in a bivariate analysis were reevaluated in full regression models as independent variables.

Results: Subjects' characteristics were similar between the two groups including pre-pregnancy BMI (mean BMI, 30.5 ± 8.5 vs 30.5 ± 7.2, p=0.98). SASS, objective and subjective-measured sleep duration and sleep quality, habitual snoring, mean oxygen saturation were not different between the two groups. However, women with GDM had higher apnea hypopnea index (AHI) compared with matched controls (mean AHI±SD; 3.5 ± 5.8 vs 1.2 ± 1.6, p=0.027, respectively). The diagnosis of OSA by PSG and AHI were significantly associated with GDM diagnosis (OR 16.60; 95% CI, 1.41 -196 vs OR 1.30; 95% Cl, 1.02–1.63, respectively), after adjustment for pregnancy BMI, education, marital status, smoking and family history. Further analysis demonstrated that the different models, ODI3 and ODI4 (the number of oxygen desaturations >3% and >4% per hour), were significantly linked with GDM diagnosis (OR 1.20; 95% CI, 1.02–1.41 vs OR 1.40; 95% CI, 1.02–1.92, respectively), adjusting the same variables mentioned above.

Conclusion: This study indicates that PSG-confirmed OSA diagnosis and oxygen desaturations were associated with the occurrence of GDM. The clinical significance of these associations needs to be investigated in a future study with larger sample size.

Support (If Any): R00NR013187.

0437

THE CLINICAL UTILITY OF SUBJECTIVE VS. OBJECTIVE TESTS OF EXCESSIVE DAYTIME SLEEPINESS IN THE ASSESSMENT OF PATIENTS WITH SLEEP APNEA

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Introduction: Excessive daytime sleepiness (EDS) is highly prevalent in obstructive sleep apnea (OSA). In clinical practice, EDS is

assessed subjectively with the Epworth Sleepiness Scale (ESS), whereas Multiple Sleep Latency Test (MSLT) is the standard test for the objective assessment of EDS. Psychomotor vigilance task (PVT) has been suggested as a convenient, simpler method than MSLT to assess EDS. In this study, we examined the association between these three methods and their possible utility as predictors of cardiovascular morbidity by examining their association with preclinical markers of metabolic risk, i.e. the proinflammatory cytokine interleukin-6 (IL-6).
Methods: We studied 58 OSA patients (53.7 ± 7.0y, 63.8% male) who underwent 8-hour in-lab polysomnography for 4 consecutive nights. Four trials of MSLT and PVT were administered on the 4th day every 2 hours. PVT was performed an hour before MSLT. PVT variables included number of lapses, mean reciprocal of the fastest 10% and slowest 10% reaction times (RTs), and median of 1/RT. ESS was assessed on day 1 of the study. Twenty-four-hour profiles of IL-6 levels were assessed on the 4th day.
Results: Lower MSLT values were associated with significantly elevated 24-hour (β=-0.34, p=0.01), daytime (β=-0.30, p=0.02) and nighttime (β=-0.38, p<0.01) IL-6 levels. Higher ESS scores were significantly associated with greater number of lapses (β=0.34, p=0.021) and lower values of slowest 10% (β=-0.30, p=0.04) and 1/RT (β=-0.36, p=0.01) but not with IL-6 levels. No significant associations were found between PVT performance, and IL-6 levels or PVT and MSLT.
Conclusion: Our findings suggest that in OSA, MSLT is associated with low-grade inflammation whereas ESS is associated with impaired sustained attention/vigilance as measured by PVT. It appears that MSLT is a good predictor for cardiovascular morbidity whereas ESS predicts impaired performance in OSA patients.
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0438

SNORE SOUND ANALYSIS: WITHIN AND BEYOND HUMAN HEARING RANGE

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Introduction: Maximum hearing range experienced by the young child is 20Hz-20 kHz. Average middle aged adults can only hear the sounds of frequencies up to 15 kHz. Snoring is considered as a hallmark of an OSA disease. The acoustic analysis of snoring sounds has been developed as a promising tool in order to objectively evaluate snoring sounds. This study explores snore sounds from 4Hz to 35 kHz and in particular focuses on the non-human hearing component, i.e.15–35 kHz band. During an apnea event when Upper airways (UA) are fully collapsed, a large pressure difference can generate at the site of the collapse. Mechanical resistance of UA muscles may add some delay to the process of reopening of UA. The generated large pressure difference squeezes air through the narrow opening of UA. We hypothesise that the sound produced during such a condition covers broad spectrum possibly going beyond human hearing range.
Methods: The snore sound data were recorded from six (Apnea Hypopnea Index range= 4.1 - 122.2) subjects undergoing polysomnography (PSG) test. Snore sound data were acquired with a free-field, condenser microphone. We explored the time domain response of snore sounds in multiple frequency bands covering the range 4Hz to 35 kHz. The response of snore sounds during various respiratory events was analysed by synchronising 15–35 kHz band of snore sound data with the flow and nasal pressure channels from the PSG data.
Results: We analysed time domain response of 600–3000 snore episodes from each subject. The results of this analysis suggest that post-apneic/hypopneic snore episodes covers broad frequency range and show better existence beyond 15 kHz compared to non-apneic, pre-apneic and hypopneic snore episodes. Snore sounds analysis during respiratory events like breathing, flow limitation, hypopnea and apnea suggest that with an increase in the level of obstruction in the UA, causes airflow and nasal pressure to drop and showing the better existence of snore sounds in 15–35 kHz.
Conclusion: This study shows that snore sounds of obstructive sleep apnea subjects exist outside the human hearing range.
Support (If Any): None.

0439

UNTREATED OBSTRUCTIVE SLEEP APNEA IS ASSOCIATED WITH REDUCED EXERCISE CAPACITY: A META-ANALYSIS

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Introduction: Obstructive sleep apnea (OSA) is linked to adverse cardiovascular events. However, the pathophysiologic mechanisms underlying reduced cardiopulmonary fitness associated with OSA remain unclear.
Methods: Pubmed, Scopus, Web of Science, Cochrane Registry of Trials, and bibliographies of relevant original articles and reviews were systematically searched from inception to April 2016 for studies evaluating exercise capacity in OSA, without language restriction. The primary outcome of interest was maximal/peak oxygen consumption (VO2). To explore mechanisms of exercise limitation, several ventilatory and cardiovascular parameters measured during cardiopulmonary exercise testing were assessed, as well as 6-minute walk distance (6MWD). Studies involving subjects treated with positive airway pressure, systolic heart failure, and those lacking a control group were excluded.
Results: Forty five studies with 5,379 unique subjects met inclusion criteria. Using a random effects model, the pooled mean difference in VO2 among study participants with OSA (n=741) compared to controls (n=659) was -3.096 ml/kg/min (95% CI -4.335 to -1.856). This finding was robust in sensitivity analyses, including evaluations by study sample size and whether controls were matched appropriately. Difference in workload was -16.928 watts (95% CI -23.883 to -9.974). There were no differences in ventilatory parameters (e.g., maximal ventilation, ventilatory efficiency, breathing reserve), O2 pulse, or anaerobic threshold. Difference in maximal heart rate (HR) was -8.423 beats/min (95% CI -11.077 to -5.770) and heart rate recovery in 1 minute (HRR-1) was -5.246 beats/min (95% CI -7.107 to -3.385). Maximal diastolic but not systolic blood pressure was associated with OSA. Using meta-regression, mean difference in VO2 did not appear confounded by intra-study differences in body mass index (BMI) or age between subjects and controls, or by OSA severity measured by apnea hypnopnea index (AHI). Difference in BMI (p<0.001) and AHI (p=0.006) did influence difference in HRR-1. However, both VO2 and HRR-1 also appeared independently associated with untreated OSA. There was a trend toward reduced 6MWD by -25.936 meters (p=0.056).
Conclusion: Untreated OSA appears independently associated with reduced exercise capacity. This limitation appears related to cardiac autonomic system and baroreflex sensitivity impairments, as evident by reduced HR and HRR-1, rather than ventilatory deficiencies.
Support (If Any):

0440

A NOVEL CLINICAL SIGN OF OBSTRUCTIVE SLEEP APNEA HYPOPNEA SYNDROME: EK SIGN

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Introduction: Diagnosis of obstructive sleep apnea and hypopnea syndrome (OSAHS) is suspected in the presence of symptoms such as snoring, early daytime sleepiness, nocturnal polyuria and cognitive deficits. Classifications or grading systems were reported in the past using palatal and tongue positions, tonsil size and BMI to evaluate the success of surgery. We defined EK sign (El Chater and Koka sign) as the presence of horizontal wrinkling of soft palate and uvula and we tried to evaluate it's predictive value for OSAHS in snoring patients.
Methods: We reviewed the clinical data of 69 snoring patients presented between 2012 and 2014 at Sleep laboratory, Medical Centre, Aubervilliers, France. All patients underwent clinical examination including clinical history, ESS, age, sex, BMI, and oropharyngeal examination for the presence of EK sign. A polygraphy was carried out in all patients.
Results: Forty two patients were male and 27 patients were female; age ranging from 22 to 74 yrs. The BMI ranged between 21 and 48. The ESS was 4 to 14 (median 10). There was no significant correlation between age, sex, and EK sign (p>0,05). EK sign was positive in 0% in snorers without OSAHS, 12% in mild, 47% in moderate, 64% in severe OSAHS. EK sign significantly correlated with the severity of OSAHS (7% if AHI<15; 58% if AHI≥15, p<0.01). EK sign was positive in 25 patients and all 25 are apneic; positive predictive value is 100%; specificity of 100%. Negative predictive value and sensitivity were 27% and 44% respectively. Of 25 EK sign positive patients, 2 had MAD and 23 had CPAP treatment; the latter with a mean follow-up of 34,6 months. The adherence to CPAP was 3 to 8,9 hours per day (median 5hours). EK sign persisted despite CPAP treatment.
Conclusion: Wrinkling of uvula and soft palate (EK sign) is a strong clinical predictor of OSAHS with a positive predictive value of 100%. Histological changes such as muscle atrophy, increased collagen and elastic fibers in extracellular matrix in the soft palate in apneic individuals were reported. These histological changes may result in morphological alterations of soft palate.
Support (If Any): None.

0441

IS UPPER AIRWAY RESISTANCE SYNDROME A PRECURSOR OF OBSTRUCTIVE SLEEP APNEA?

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Introduction: Upper airway resistance syndrome (UARS) was firstly described in 1993 to address patients with symptoms very similar to those presented by patients with obstructive sleep apnea (OSA) but that did not meet the criteria of this syndrome. As consequence, some researchers proposed that OSAS and UARS are part of the same disease, in different stages of evolution, while others thought that they are two different pathologies. This abstract tackles this unsolved question, evaluating the progression of the patients with UARS after eight years of follow-up.
Methods: 714 subjects from the original EPISONO cohort (Sao Paulo, Brazil) were reassessed after eight years with questionnaires and a full night polysomnography. OSAS was classified according to the third edition of the International Classification of Sleep Disorders and UARS as AHI < 5 events/h, peripheric oxygen saturation ≥ 92% and percentage of time with airflow limitation ≥ 5%, associated with daytime sleepiness and/or fatigue.
Results: From the 714 subjects, 103 were considered control and 74 UARS. Within the last group, 36.5% developed OSAS in 2015. About the same proportion (37.9%) of the subjects from the control group also presented OSAS in the follow-up study. However, the risk of presenting daytime sleepiness was 49% (CI95%OR: 1.13–1.96) higher in subjects from the UARS in comparison with the control group.
Conclusion: The percentage of new cases of OSAS from the control group was similar to the UARS group, suggesting that UARS is not an important risk factor for the development of OSAS and, therefore, weakening the theory that these two disorders are part of the same pathology in different stages of evolution. Nevertheless, UARS has been proven to be a risk factor for the development of daytime sleepiness, encouraging more studies to be made in order to elucidate this disorder.
Support (If Any): This work was suported by Associação Fundo de Incentivo à Pesquisa (AFIP) and the Sao Paulo Research Foundation (grant #2014/15259-2).

0442

ADULT SHORT LINGUAL FRENULUM < AND > OBSTRUCTIVE-SLEEP-APNEA LINGUAL FRENULUM & OBSTRUCTIVE-SLEEP-APNEALINGUAL FRENULUM & OBSTRUCTIVE-SLEEP-APNEALINGUAL FRENULUM AND OBSTRUCTIVE-SLEEP-APNEA

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Introduction: Short lingual frenulum is associated with sucking, swallowing, speech difficulties and sleep-disordered-breathing in children. Relationship between presence of short lingual frenulum and obstructive-sleep-apnea was evaluated
Methods: 229 adults successively referred for suspicion of OSA and clinically evaluated by the same individual during a 3 months period with determination of presence of abnormal or normal lingual frenulum. Frenulum normalcy was determined with measurement of the "free-tongue" between upper frenulum and tip of tongue and determination of the "Tongue-range-in-motion-ratio" [normal if less than 50% difference with tongue flat in mouth and with tongue tip reaching the incisive papillae]. All subjects had polysomnogram with determination of apnea-hypopnea-index, flow limitation and oxygen saturation drops. Syndromes and patients with major psychiatric problems were eliminated from the investigation.
Results: All subjects [mean age 55.35 ± 17.13years] presented OSA based on clinical evaluation and nocturnal polysomnography with 42.4% been women. There were 105 subjects with short lingual frenulum that had been never diagnosed/treated. Statistical analyses show that compared to patients with OSA and normal lingual frenulum, short lingual frenulum subjects presented similar Epworth-sleepiness-scores, no significant difference in gender distribution, body-mass-index, mean age, clinical symptoms disrupted sleep, daytime sleepiness, headache, daytime fatigue, cognition problems, enlarged inferior nasal turbinates, tonsil size when present. But they had significantly higher frequency of deviated septum (0.001); high and narrow palatal vault (0.0001), maxillary cross-bite (0.001), small mandible (0.0001), overbite (0.001): patients with short frenulum had clear impairment of both maxilla and mandible. Polysomnography showed that subjects with normal frenulum had a significantly higher apnea-hypopnea index (0.045) and lower nadir of oxygen saturation (0.05)

Conclusion: Short lingual frenulum restrict tongue motility early in life and lead to abnormal development of oral cavity, with clear impact on maxillary and secondary mandibular growth, as already observed during childhood Morphologic changes occur slowly during childhood, lead to small upper-airway that favors collapse of upper-airway during sleep and development of obstructive-sleep-apnea at later date. Short lingual frenulum has been reported as a phenotype for pediatric-sleep-apnea Recognition and treatment early in life would avoid occurrence of the syndrome and its co-morbidities.
Support (If Any): none.

0443

THE EFFECT OF WEIGHT LOSS ON MAXIMAL TONGUE FORCE IN OBSTRUCTIVE SLEEP APNEA (OSA)

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Introduction: The tongue is thought to be the most important upper airway dilator muscle and it has been shown that there is a high percentage of fat in the tongue in OSA. Weight loss is a known treatment for OSA; however, the effect of weight loss on tongue force in apneics has not been studied. We hypothesized that apneics would have an increase in tongue force after weight loss due to a reduction in fat-infiltration of the tongue.
Methods: We recruited 19 apneics (AHI > 15 events/hour) with a BMI greater than 30 kg/m^2 (41.3 ± 10.9) from the Penn Center for Sleep and Circadian Neurobiology. MRI, polysomnography, and tongue force measurements were performed on the subjects (58% men; age 45.4 ± 14.9 years) pre and post-weight loss (> 5% change). Tongue force measurements (kPa) were recorded using the Iowa Oral Performance Instrument as described by Solomon & Robin (2005). Axial and sagittal MR images using a fast spin echo and three-point Dixon protocol were analyzed for tongue and tongue fat volume (mm^3). Relationships between measures were determined using paired t-tests and linear regression.
Results: There were significant reductions in tongue (-6900 ± 12191 mm^3, p = 0.022) and tongue fat volume (-5765 ± 6878 mm^3, p=0.005) post-weight loss, as well as a significant decrease in AHI (-32 ± 27 events/hour, p < 0.001). Reduction in tongue fat was correlated with a reduction in tongue force in a linear model (p = 0.016). A positive correlation between tongue force and tongue volume trended towards significance (p = 0.081), and tongue volume was positively correlated with tongue fat (p = 0.043).
Conclusion: Our data indicate that tongue force is reduced with weight loss secondary to a reduction in tongue size. This suggests that tongue EMG activity may be reduced with weight loss.
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0444

NASAL CYCLE DURING SLEEP

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Introduction: The phenomena of periodic cycles of vascular engorgement on the nasal cavity mucosa that alternate between right and left sides are termed the "nasal cycle(NC)." We have already reported that nasal cycle duration during sleep is longer than in wakefulness (Kimura et al. Laryngoscope, 123:20502055, 2013). And it is speculated that nasal cycle is influenced by postural change, change of autonomic nerve activity and sleep stage. Purpose of this study is to clarify the mechanism of nasal cycle during sleep using Polysomnography(PSG).
Methods: We utilized PSG and portable rhinoflowmeter (Rhinocycle, Rhinometrics, Lynge, Denmark), measuring airflow independently through each nostril during sleep on 29 healthy subjects.
Results: 1, NC was found in 24 of 29 patients during PSG. 2, In 5 of 29 cases, NC with the postural change was found. As for one, NC with the postural change was found in awake state, 3 during light sleep(Stage 1,2) and another one during REM sleep. 3, In 29 all cases which we found NC during sleep, 21/29 was found during REM sleep, 7/29 during light sleep and 1/29 during wake, however, there was no case in slow wave sleep. 4, The NC tended to be found in REM sleep for the sleep latter half, and, furthermore, in REM sleep which duration showed longest.
Conclusion: We speculated that the NC was associated with a function of the REM sleep. Further study needed to clarify the relationship between nasal cycle and brain function during sleep.
Support (If Any): nothing.

0445

SNORING FREQUENCY AND INTENSITY IN PREGNANT WOMEN AND ASSOCIATION WITH TIME TO DELIVERY

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Introduction: Sleep disordered-breathing (SDB) is associated with several adverse pregnancy outcomes, particularly maternal hypertension and diabetes and possibly fetal growth restriction. However, little is known about SDB association with time-to-delivery, a clinically important outcomes, as earlier deliveries contributes to maternal-infant morbidity and mortality. We examined the association of snoring frequency and intensity and time-to-delivery among a cohort of pregnant women.
Methods: Pregnant women in their third trimester, without hypertension or diabetes, recruited from prenatal clinics of a large medical center, completed a questionnaire about their sleep characteristics. Demographic, risk factor, and delivery information was abstracted from medical charts. Women were classified into four groups based on their snoring status: non-snorers, infrequent-quiet, frequent-quiet, or frequent-loud snorers. Cox Proportional Hazard Regression Models were used to investigate the association between snoring frequency and intensity and time-to-delivery, adjusting for education, race, pre-pregnancy BMI, smoking, parity, weight gain rate and induction.
Results: Of 904 non-hypertensive, non-diabetic women, half were non-snorers. Among snorers, 42% and 52% were infrequent or frequent-quiet snorers, respectively. Frequent-loud snoring was reported by 6% of women. Earlier deliveries were more common in the frequent-loud group than all other groups; the median time-to-delivery was 38.8 and 39.4 weeks' gestation for frequent-loud snorers and controls respectively; while the first quartile time-to-delivery was 37.1 and 38.6 for frequent-loud snorers and controls respectively. We observed an increased hazard ratio for delivery among frequent-loud snorers, compared with controls and adjusted for pre-pregnancy, pregnancy and delivery characteristics; [HR=1.81,(95% CI 1.18,2.78)]. Similar time-to-delivery was observed among non-snorers and infrequent- or frequent-quiet snorers.

Conclusion: Our findings suggest that healthy pregnant women, absent of key comorbidities, with loud-frequent snoring are at-risk for earlier deliveries. The combination of snoring frequency and intensity may be a clinically useful marker to identify otherwise low-risk women who are likely to deliver earlier.
Support (If Any): Gilmore Fund for Sleep Research, University of Michigan Institute for Clinical and Health Research (MICHR) grant UL1TR000433 MICHR seed pilot grant F021024 National Heart, Lung, and Blood Institute (HL089918)

0446

CARDIOVASCULAR CONSEQUENCES OF OBSTRUCTIVE SLEEP APNEA IN WOMEN: A CLINICAL COHORT STUDY

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Introduction: Previously, we reported that obstructive sleep apnea (OSA) increased the risk for cardiovascular (CV) events in a longitudinal cohort, but had insufficient power to examine for differential effects by sex. The current study investigates sex differences in this relationship.
Methods: Clinical data on adults referred with suspected OSA who underwent a diagnostic sleep study at a large urban academic hospital (Toronto, Canada) between 1994 and 2010 were linked to provincial health administrative data from 1991 to 2015. Cox regression was fit to investigate the association between OSA and a composite CV outcome (hospitalization due to myocardial infarction, stroke, heart failure, atrial fibrillation, or death from any cause) controlling for traditional risk factors.
Results: In total, 10,149 subjects were included: median age 49, 38% women, median apnea-hypopnea index (AHI) 16 events per hour. At baseline, women were more likely to report waking unrefreshed, morning headaches and restless legs; men were more likely to report snoring and witnessed apnea. Women tended to have a milder REM-predominant OSA; men were more likely to have severe position-dependent OSA given similar age and BMI. Over a median follow-up of 9.4 years, 1,719 participants (516 women) developed the composite outcome.

Controlling for known risk factors, having >30% vs. ≤30% of total sleep time spent with SaO2<90% was associated with the composite CV outcome in both women (HR = 1.50; 95% CI: 1.08–2.08) and men (HR = 1.32; 1.07–1.63); however, the effect was significantly stronger in women (p = 0.04 for interaction).
Conclusion: In a large clinical cohort with suspected OSA, severity of OSA, as measured by the degree of nocturnal hypoxemia, was associated with long-term CV consequences in both men and women. However, the association was stronger for women than for men. These findings have potential implications for risk stratification and treatment of OSA patients.
Support (If Any): 2015 CHEST Foundation Research Grant in Women's Lung Health; Canadian Respiratory Research Network fellowship training award; Institute for Clinical Evaluative Sciences, which is funded by an annual grant from the Ontario Ministry of Health and Long-term Care.

0447

AGE AND SEX MODIFY THE ASSOCIATION BETWEEN OSA AND TRADITIONAL AND NOVEL CARDIOVASCULAR RISK FACTORS: THE MULTI-ETHNIC STUDY OF ATHEROSCLEROSIS (MESA)

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Introduction: The associations of obstructive sleep apnea (OSA) with risk of cardiovascular diseases (CVD) vary by age and sex, but the role of traditional and novel CVD risk factors in these differences is poorly understood. We hypothesized that OSA severity is associated with traditional and newer cardiovascular risk factors, with stronger associations in men and younger individuals.
Methods: Participants in MESA Exam 5 (2010–2013) underwent standardized assessments for CVD risk factors and OSA using overnight in-home polysomnography. Primary analysis assessed associations between traditional risk factors (diabetes, hypertension, dyslipidemia) as well as white blood cell (WBC) count and Cystatin C level with the apnea hypopnea index (AHI) (log transformed) as outcome (n=1344). Secondary analysis assessed associations with hsCRP, ICAM-1, Fibrinogen, and D-Dimer levels (n=228). Multiple regression models were used to adjust for age, sex, race/ethnicity, smoking and body mass index (BMI), testing for age and sex interactions.
Results: Participants were mean age of 68±9y, mean BMI of 29±5kg/m^2; 47% were men, and 14% had severe OSA (AHI≥30). Diabetes, hypertension, triglyceride, HDL-cholesterol, glucose, systolic and diastolic blood pressures (BP), WBC count and Cystatin C level each were associated with OSA severity in multivariate adjusted models that did not include BMI; with BMI adjustment, only HDL and diastolic BP remained significantly associated with AHI. Age interactions were identified, with stronger associations observed in BMI-adjusted models for WBC and glucose with AHI for participants <65y (p_{int}= 0.004 and 0.019, respectively). hsCRP tended to be associated with AHI, but only in younger (<65y) individuals (p_{int}=0.086). Triglyceride level showed a significant interaction with sex, with stronger associations with AHI in men (p_{int}=0.007).
Conclusion: Some risk factors are more strongly associated with OSA in middle-aged compared to older individuals, suggesting differences in pathophysiology and phenotypes that may explain population variations in CVD-OSA relationships.
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0448

CLINICAL VALIDATION OF A DIAGNOSTIC PATCH FOR THE DETECTION OF SLEEP APNEA

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Introduction: Portable home sleep monitors are being increasingly utilized in clinical practice for diagnosing sleep apnea. However, most

type III home monitors are difficult for patients to set up and wearing the monitors is disruptive to patient's typical sleep pattern. The diagnostic value of an inexpensive easy-to-use light-weight flexible skin-adhesive patch (SomnaPatch) that minimally affects sleep was evaluated in this study.

Methods: Simultaneous polysomnography (PSG) and the diagnostic patch recordings were made in 179 subjects (mean age 54.0 ± 13.6 y, 55% male) selected from the databases of patients previously tested with PSG to ensure even representation of the clinically important apnea-hypopnea index (AHI) ranges. The skin-adhesive diagnostic patch weighs less than one ounce and records nasal pressure, blood oxygen saturation, pulse rate, respiratory effort, sleep time and body position ($S_3C_4O_2P_2E_3R_2$ category). To compare the apnea-hypopnea index of the diagnostic patch with polysomnography, all recordings were auto-scored with the Somnolyzer software (Respironics). Bland-Altman analysis was performed. Sensitivity, specificity and accuracy were calculated and receiver operating characteristic (ROC) curves were constructed for six AHI thresholds (5, 10, 15, 20, 25 and 30 events per hour). The rate of clinical agreement and positive likelihood ratio were calculated.

Results: Overnight recordings from 174 subjects were included in the final analysis. All six ROC curves had area under the curve of over 0.9. Sensitivity, specificity and accuracy for the optimal threshold of AHI≥15 were 0.86, 0.83 and 0.85 respectively. Positive likelihood ratio (LR+) was 7.4. Bland-Altman analysis showed that the bias was 0.9 events per hour and the limits of agreement were 18.1 and -16.1. The rate of clinical agreement between recordings with PSG AHI≥30 and patch AHI≥30 and was 85%. The rate of clinical agreement between recordings with PSG AHI<30 and the patch AHI within (PSG AHI ±10) was 89%. The total rate of clinical agreement was 87.4% with 95% confidence interval of 81.4%-91.9%.

Conclusion: The new diagnostic patch offers excellent clinical value for detecting sleep apnea across all severity levels as compared with standard in-lab polysomnography.

Support (If Any): Research was supported by NIH grant R44 HL123196.

0449

EVALUATION OF SLEEP DISORDERED BREATHING IN HYPERMOBILE PATIENTS

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Introduction: Hypermobility syndromes can be an important risk factor for Sleep Disordered Breathing (SDB). The risk factors for SDB, such as obesity, male gender, or post-menopausal status, are frequently absent in hypermobile populations, yet the impact of SDB on the quality of these patients' lives can be profound.

Methods: Charts of 49 consecutive patients with a Beighton hypermobility score ≥5 from a Neurology Institute were retrospectively reviewed. All ± values reflect the standard error of the mean.

Results: Eighty-four percent of these patients had sleep complaints. Thirty underwent Polysomnography (PSG), though PSG was requested for all. Five were denied by insurance, and 6 refused PSG. PSGs demonstrated SDB in 29 patients: 19 had Obstructive Sleep Apnea (G47.33) and 10 had Sleep Apnea - Unspecified (Upper Airway Resistance Syndrome) (G47.30). The average age was 33.4 ± 2.3 years, the average BMI was 26.9 ± 1.6, and the average Epworth Sleepiness Scale Score was 12.1 ± 0.98. Twenty-one of these 30 patients received an MRI of the cervical spine for symptoms and signs of cervical radiculopathy. On a T1-weighted, mid-sagittal section, the following measurements were made of the narrowest dimensions in centimeters: Retropalatal (0.47 ± 0.06), Retrolingual (0.86 ± 0.05), and Retroepiglottal (0.47 ± 0.04), and Epiglottal length (2.22 ± 0.06). These measurements did not differ significantly from five patients with hypermobility without sleep complaints who also received an MRI of the cervical spine.

Conclusion: 1. SDB is prevalent in hypermobile patients.2. Most patients in this series with sleep complaints were female (88%), with an age well below that of typical menopause, and a BMI well below that generally considered at risk for SDB.

3. Airway measurements in patients with sleep complaints did not differ significantly from those in hypermobile patients without sleep complaints.

4. These results warrant further investigation into the underlying causes of SDB in hypermobile patients. These causes could include physiological sleep-related changes, as well as anatomical obstruction.

5. All patients with hypermobility with sleep complaints should be studied with PSG, though abnormalities frequently fall outside the parameters that justify a formal diagnosis of OSA, and will require the more sensitive measures of attended PSG to diagnose their SDB.

Support (If Any):

0450

ROLE OF OXYGEN SATURATION DURING SLEEP IN IDENTIFYING OBESITY HYPOVENTILATION SYNDROME AND ITS CORRELATION WITH SUPINE WAKE END-TIDAL PCO_2

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Introduction: Obesity Hypoventilation Syndrome (OHS) remains under-diagnosed due to lack of appropriate predictors which establish a concrete association with daytime hypercapnia. There have been very few studies suggesting higher serum bicarbonate levels and oxygen saturation (SpO_2) nadir may be relevant predictors of OHS but none of the studies to date have shown a definite relationship. Our goal is to further explore these relationships to establish strong predictors for diagnosing OHS.

Methods: We performed a retrospective study of consecutive obese (BMI ≥ 30 kg/m^2) adult patients undergoing nocturnal polysomnography (NPSG) (November 2015-October 2016); categorized as Group A (with OHS) and Group B (without OHS). Data included demographics, end-tidal pCO_2, SpO_2 nadir, mean sleep SpO_2, NPSG variables: using 2016 AASM Version 2.3 option 1A criteria [total respiratory disturbance index (tRDI)] and option 1B criteria [apnea hypopnea index (AHI)], co-morbidities, serum bicarbonate and thyroid stimulating hormone. Patients with chronic obstructive lung disease, uncontrolled hypothyroidism, chronic opiod use and neuromuscular diseases were excluded. Multiple regression analysis, Student's t-test and Chi-square test were used for statistical analysis.

Results: Out of 336 subjects: 60 had OHS (Group A), 247 were non-OHS (Group B) and 29 met exclusion criteria. Variables that were significantly different between Groups A and B [reported as median(quartile1,quartile3)] were: SpO_2 nadir: 79.5% (73%,85%) vs 84% (79%,88%) [p =0.0073], mean sleep SpO_2: 93% (89%,95%) vs 95% (93%,96%) [p=0.0002], sustained hypoxemia: 11.6% vs 1.6% [p =0.0002], sleep hypoventilation: 43.3% vs 3.6% [p <0.0001], AHI: 38.1 (12.2, 78) vs 17.6 (4, 40) [p=0.015], tRDI: 53.8 (32, 98.3) vs 38 (17, 74.6) [p=0.035]. Wake end-tidal pCO_2 was significantly associated with mean sleep SpO_2 [p=0.0007] and BMI [p=0.008]. To differentiate OHS from non-OHS: mean sleep SpO_2 <90% had the best positive predictive value (85%) and negative predictive values (85%) [p<0.0001];

SpO_2 nadir <80% had the best combination of positive predictive value (31%) and negative predictive value (86%) [p=0.0007].
Conclusion: Mean sleep SpO_2 <90% in NPSG indicates high risk of OHS, and SpO_2 nadir >80% suggests low risk of OHS.
Support (If Any): None.

0451

OVERLAP SYNDROME OF COPD AND OSA: METABOLIC RISK FACTORS AND SYSTEMIC INFLAMMATION

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Introduction: Chronic obstructive pulmonary disease (COPD) and obstructive sleep apnea (OSA) are common and their co-occurrence, known as the overlap syndrome, is estimated in at least 1% of the general population. However, further knowledge is needed to fully characterize the overlap syndrome.
Methods: We retrospectively studied 256 persons with stable COPD characterized in 2 previous physical activity studies. Body-mass index (BMI) was calculated from height and weight measured in the clinic. Participants were asked specifically if they had a diagnosis of OSA, hypertension (HTN), congestive heart failure (CHF), coronary artery disease (CAD), or diabetes mellitus (DM). CRP and IL-6 were determined using a high-sensitivity immunoturbidimetric assay with a sensitivity of 0.03 mg/L and 0.094 pg/mL, respectively. We compared characteristics between those with COPD-OSA (N=61) and those with COPD only (N=195) using unpaired T test, Wilcoxon rank sum test, or Chi square test, as appropriate. To assess the independent relationship between overlap syndrome and levels of CRP and IL-6, we used linear regression models (PROC GLM, SAS 9.4), adjusting for age, BMI, %predicted FEV_1, pack-years, and history of CAD.
Results: There was no difference between those with COPD-OSA and those with COPD only with respect to age (cohort mean 71 ± 8 years) and %predicted FEV_1 (cohort mean 58 ± 21 %predicted). BMI and the prevalence of HTN and DM were significantly higher in the COPD-OSA group compared to the COPD only group. Persons with COPD-OSA were more likely to report CV disease including CAD and CHF, compared to those with COPD only. Both CRP (P=0.02) and IL-6 levels (P=0.02) were significantly higher in persons with COPD-OSA compared to persons with COPD only, after controlling for age, BMI, %predicted FEV_1, pack-years, and history of CAD. Compared to COPD only, those with COPD-OSA had a 1.64 mg/L [95%CI: 1.09 to 2.48] increase in CRP and a 1.39 ng/mL [95%CI:1.06 to 1.81] increase in IL-6.
Conclusion: Persons with COPD-OSA have a significantly higher prevalence of metabolic risk factors including higher BMI, HTN, and DM, higher levels of inflammatory biomarkers, and are more likely to have CV comorbidities than persons with COPD only.
Support (If Any):

0452

THE INTERACTION BETWEEN OBSTRUCTIVE SLEEP APNEA (OSA) AND OBESITY ON SERUM LEVELS OF INFLAMMATORY ADHESION MOLECULES

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Introduction: Serum levels of adhesion molecules are associated with increased risk of cardiovascular disease (CVD). Obesity and OSA are associated with increased serum levels of adhesion molecules, but the interaction between them is unclear.
Methods: Patients referred to the UBC Sleep Laboratory for a polysomnogram (PSG) for suspected OSA were recruited and provided a morning blood sample after PSG.
Results: 494 patients participated; mean age was 49.7 yrs, 323 were male, and mean AHI was 22.6/hr. In unadjusted analyses (Spearman's coefficient), body mass index (BMI) was significantly associated with serum levels of the three adhesion molecules investigated (E-selectin, intracellular adhesion molecule ICAM, vascular cell adhesion molecule VCAM). AHI was significantly associated with E-selectin levels (Spearman's= <.01) but not sICAM (Spearman's= 0.31) or sVCAM (Spearman's= .40). The relationships between E-selectin and BMI/AHI were further explored using linear regression. After adjusting for previous heart disease, smoking status, gender and age, both AHI (p=.01) and BMI (p=<.01) remained significant predictors. A multiplicative interaction between AHI and BMI was not found (p=.33). However, patients with both severe sleep apnea (AHI>30) and a BMI above the median (32 kg/m2) had elevated levels of E-selectin (55.43 ng/ml) compared to individuals who had either condition alone (50.39 ng/ml and 52.10 ng/ml), and ANOVA results suggest a significant difference between groups (F=<.01).
Conclusion: BMI and AHI are significant predictors of E-selectin levels. Patients who were obese and had severe OSA had significantly higher E-selectin levels than those who had either condition alone. Further research is required to determine the clinical consequences of elevated levels of E-selectin associated with OSA and obesity.
Support (If Any): CIHR (Sleep Disordered Breathing Team Grant), VCHRI Scientist Award, BC Lung Association Operating Grant.

0453

CRANIOFACIAL PHOTOGRAPHIC MEASUREMENTS AND RELATIONSHIP TO OSA SEVERITY ACROSS FOUR ETHNIC GROUPS

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Introduction: Craniofacial morphology is a risk factor for Obstructive Sleep Apnea (OSA). Craniofacial phenotyping using simple digital photography has shown utility in predicting OSA. However, craniofacial structures that relate to OSA may vary by ethnicity. We hypothesized that the relationship between OSA severity and craniofacial photographic measurements would vary between four ethnic groups.
Methods: Front and profile craniofacial photographs were collected in clinical sleep centers within the Sleep Apnea Global Interdisciplinary

Consortium (SAGIC). Photographs of 2243 subjects from 5 continents were analyzed and divided into four ethnic groups: Caucasian (N=904), African-American (N=243), South American (N=660), and Asian (N=223). Relationships between AHI and both facial (width and lower height) and mandibular (width and length) dimensions were assessed by correlation and compared between ethnicities, controlling for age, gender, and BMI.

Results: Face width positively correlated with AHI in all ethnicities (p &lt 0.001). Adjusting for age, gender, and BMI, Asians had a stronger relationship between face width and AHI (β[95%CI]) = 4.5 [0.9–8.2]) than Caucasians (2.7[1.1–4.2]); the relationship was not statistically significant in African-Americans (3.3 [-1.5–7.1], p=0.09) or South Americans (0.2 [-1.3–1.7], p=0.8). Lower face height remained positively related to AHI for Asians (3.5 [0.04–6.9]), borderline in African-Americans (3.7 [-0.1–7.5], p=0.06), but associated in Caucasians or South Americans. There was a trend for a positive relationship between mandibular length and AHI to remain only in Asians post-adjustment (3.2 [-0.3–6.7]). Mandibular width related to AHI most strongly in Caucasians (4.5 [2.8–6.2], p &lt 0.0001), but was not evident in African-Americans.

Conclusion: Craniofacial photographic measurements relate to OSA severity independently of age, BMI, and gender; with significant ethnic differences. Asians showed strongest relationship with AHI and face width, lower face height, and mandibular length. Mandibular width most strongly related to AHI in Caucasians. African-Americans had fewer significant associations between AHI and facial dimensions, with lower face height most prominent in this group.

Support (If Any): N/A.

0454

CRANIOFACIAL MEASUREMENTS COMBINED WITH PROPORTIONS OF GENETIC ANCESTRY ARE USEFUL TO INFORM OSA SEVERITY

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Introduction: Craniofacial measurements have been shown to be important predictors of obstructive sleep apnea (OSA). Evidence indicates that these measures may inform OSA severity. Studies also suggest that genetic factors influence both the risk for OSA and craniofacial morphology. It is possible that underlying genetic architecture modifies the relationship between craniofacial morphology and OSA severity. We hypothesized that the proportion of genetic heterogeneity that is attributable to different ancestries would influence this relationship.

Methods: Craniofacial photographic measurements, in-lab sleep studies, and genome-wide genotyping data were collected from 454 admixed individuals that were ascertained via the population-based Sao Paulo Epidemiological Sleep Study (EPISONO) cohort. Ancestry proportions were calculated based on four major populations from the 1,000 Genomes Project. We then determined the correlation structure across these ancestry proportions, 40 craniofacial measurements, gender, age, body mass index (BMI), and neck circumference (NC). Additionally, we conducted unsupervised clustering on these data to determine if these traits could identify clinically-meaningful OSA subgroups.

Results: Genetic ancestry proportions were significantly correlated and predicted several craniofacial measurements, adjusted for age, gender, BMI and NC. Cluster analysis identified two main subgroups, distinguished by gender, NC, overall craniofacial dimensions, and proportions of genetic ancestry. Individuals in Cluster 1 (N=211) had increased apnea-hypopnea indices (AHI, β=7.6;95%CI=4.4–10.7), oxygen desaturation indices (β=7.4;95%CI=4.3–10.4) and more severe OSA, defined by AHI≥30 (OR=2.8;95%CI=1.7–4.9) compared to Cluster 2 (N=243). Increased lower anterior face volume and nose width, as well as decreased African and American ancestry proportions, were strong independent predictors of being assigned to the more severe OSA cluster.

Conclusion: Using craniofacial photographic measurements, genetic ancestry and anthropometric characteristics, we identified clinically-meaningful OSA subgroups. We expect that measurements of lower anterior face volume and nose width may be useful to inform severity of OSA, in lieu of polysomnography. Furthermore, population genetic structure potentially modifies the relationship of craniofacial morphology with OSA severity. We are currently analyzing genomic data to determine if specific variants are associated with the more severe OSA cluster.

Support (If Any): AFIP, CNPq and FAPESP (#2014/1259-2).

0455

PREVALENCE AND PREDICTORS OF SUBJECTIVE AND OBJECTIVE SLEEPINESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA (OSA)

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Introduction: Excessive daytime sleepiness (EDS) is frequently observed in patients with OSA. However, most studies assessing EDS in OSA have had small sample sizes and/or lacked objective means of assessment.

Methods: We assessed the prevalence and predictors of subjective sleepiness [Epworth sleepiness scale scores (ESS)>10] and objective sleepiness [mean sleep latency (MSL) on the maintenance of wakefulness test (MWT)<20 minutes] in the Apnea Positive Pressure Long-term Efficacy Study (APPLES) cohort.

Results: The mean baseline ESS of the participants (n=1105) was 10.4 ± 4.4 (range 0–22). In bivariate analyses, women (n=382) were significantly sleepier (ESS 10.9 ± 4.5 vs. 10.2 ± 4.3, P=0.006) than men (n=723). There was a trend towards those with severe OSA (AHI>30, n=611) to be sleepier than those with AHI≤30 (ESS 10.7 ± 4.5 vs. 10.2 ± 4.3, P=0.07). The ESS scores correlated directly with BMI, AHI, and Hamilton Rating Scale for Depression (HAMD) score, and inversely with age. Increased sleepiness (ESS > 10) was present in 543 participants (49.1%). Participants with depression and chronic pain had higher ESS scores and a higher proportion of participants who were sleepy (ESS > 10). A linear regression model revealed younger age, greater AHI and higher HAMD scores to be independently associated with higher ESS scores. Logistic regression showed higher odds of sleepiness in those with depression (HAMD≥8), (OR=1.4, P=0.03) and lower odds with increasing age.MSL of 20 minutes was seen in 521 participants (48%) and MSL<20 minutes in 565 participants (52%). Of those with ESS >10, 61.2% had MSL <20 minutes compared to only 43.2% in those with

ESS ≤10 (P<0.001). In a linear regression model, increasing age was associated with higher MSL values (less sleepiness), while higher HAMD scores and AHI were associated with lower MSL (more sleepiness). Logistic regression showed that younger age, presence of depression and AHI >30 were associated with higher odds of sleepiness (MSL <20 minutes).

Conclusion: Excessive sleepiness, as measured by ESS score >10 or a MSL <20 minutes on MWT, was present in almost half the patients with sleep apnea, and was associated with presence of depression, more severe sleep apnea and younger age.

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0456

SYMPTOM CLUSTERS IN OBSTRUCTIVE SLEEP APNEA IN AN ASIAN POPULATION

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Introduction: Asians have a craniofacial structure that predisposes them to developing obstructive sleep apnea (OSA) at a lower BMI compared to their Caucasian counterparts. However, there is little information on ethnic differences in symptom presentation. Recently, the Icelandic Sleep Apnea Cohort (ISAC) used daytime and nighttime symptoms and comorbidities to identify three distinct OSA subgroups: *excessively sleepy*, *minimally symptomatic*, and *disturbed sleep*. This study examines OSA subgroups within a population-based cohort of moderate-severe apneics in Korea.

Methods: Study subjects are participants in an ongoing population cohort study of middle-aged and older adults in Korea. Of the 2,918 participants, 422 new moderate to severe OSA cases [apnea/hypopnea index (AHI) ≥15 events/hour] were diagnosed by home sleep studies (Embletta X-100). All participants completed a detailed sleep-related symptom questionnaire that assessed daytime sleepiness, night-time sleep disturbances, snoring, and other symptoms. A latent class analysis was performed.

Results: When examining solutions between 2 and 10 clusters, the *a priori* 3-cluster solution was the optimal clustering solution based on BIC. Although there was a lower overall symptom burden in our population sample, the three cluster solution demonstrated subgroups similar to those identified in ISAC. The minimally symptomatic subgroup was most prevalent (55.7%), whereas the excessive sleepiness subgroup was most prevalent (42.6%) in the Icelandic cohort. Among the Korean subgroups, there were no differences in mean AHI and body-mass index, however, the disturbed sleep subgroup was oldest and had the most women.

Conclusion: These results suggest use of the three symptom cluster solution for classifying OSA patients may be widely applicable, irrespective of ethnicity or study population. Leveraging OSA subgroups may be the start of developing personalized care plans centered on differences in patient symptoms. Furthermore, understanding the biological mechanisms of each subgroup may not only improve patients' outcomes, but also lead to novel diagnostic tests.

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0457

COMORBIDITIES AND HEALTH-RELATED QUALITY OF LIFE AMONG PEOPLE WITH SLEEP APNEA WITH EXCESSIVE SLEEPINESS: FINDINGS FROM THE 2016 US NATIONAL HEALTH AND WELLNESS SURVEY

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Introduction: Few population-based studies have explored how excessive sleepiness (ES) contributes to burden of illness among patients with sleep apnea (SA).

Methods: Data were obtained from the 2016 US National Health and Wellness Survey, an annual, representative, cross-sectional, general health survey (N=97,503). Respondents self-reporting a SA diagnosis were categorized as having ES (Epworth Sleepiness Scale [ESS≥11]) or not having ES (ESS<11) and compared with a non-SA control group. Respondents reporting narcolepsy were excluded. Measures included comorbidities and health-related quality of life (HRQoL; using SF-36v2) via the mental component summary (MCS), physical component summary (PCS) and health utility scores (SF-6D). Outcomes were examined by three groups: SA w/ES, SA w/oES, and non-SA controls using one-way ANOVAs (continuous outcomes) and chi-squares (categorical outcomes). Generalized linear models controlling for covariates examined the effect of SA/ES status on HRQoL.

Results: Overall, SA w/ES was associated with higher comorbidities and lower HRQoL. The SA w/ES group (N=731) had a significantly higher proportion reporting depression (62.4% vs. 48.0%), unstable angina (6.4% vs. 4.1%), asthma (26.3% vs. 20.7%) and GERD (39.0% vs. 29.4%) compared to the SA w/oES group (N=1,452; all P<.05) and also compared to non-SA controls (N=86,961; P<.05). The SA w/ES group also had significantly lower HRQoL compared with the SA w/oES group and non-SA controls on MCS, PCS, and SF-6D (P<.05). After controlling for covariates, the burden of ES remained consistent as the SA w/ES group had significantly lower MCS (41.81 vs. 45.65 vs. 47.81), PCS (46.62 vs. 48.68 vs. 51.36), and SF-6D (0.65 vs. 0.69 vs.0.73) (all P<.001) compared with SA w/oES and non-SA controls.

Conclusion: These data provide support that ES is associated with a substantial increased burden to SA patients as demonstrated by increased comorbidities and reduced HRQoL compared to those without ES and non-SA controls.

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0458

ANTHROPOMETRIC DIFFERENCES IN OSA ACROSS FOUR ETHNIC GROUPS IN OSA ACROSS FOUR ETHNIC GROUPS

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Introduction: Obstructive Sleep Apnea (OSA) is a common sleep disorder with similar prevalence in different ethnic populations. Obesity is a major risk factor for OSA; however, the impact of obesity on OSA severity may vary with ethnicity due to differential disease etiology. We hypothesized that the association between Apnea-Hypopnea Index (AHI) and anthropometric measures of obesity will vary in strength between four ethnicities.

Methods: Anthropometry (BMI, neck circumference) and AHI data were collected by clinical sleep centers within the Sleep Apnea Global Interdisciplinary Consortium (SAGIC). Data from 2966 subjects on 5 continents were collected and divided into four ethnic groups: Caucasian, African-American, South American, and Asian. The relationship between AHI and anthropometry was examined within each ethnicity by Spearman's rank correlation and between ethnic groups using beta coefficients and interaction tests.

Results: AHI correlated with BMI (p &lt 0.0001) in all ethnicities (Caucasian: r=0.37, N=1325; African-American: r=0.25, N=330; Asian: r=0.41, N=265; South-American: r=0.47, N=769). While increased BMI was related to increased AHI, ethnicity influenced the strength of association (p &lt 0.0001). Asians were most susceptible, with each unit increase in BMI reflecting an expected 2.7 [2.1–3.3] (β[95% CI]) events/hour AHI increase. Impact of BMI was similar for Caucasians (1.2 [1.1–1.4]) and South Americans (1.5 [1.3–1.7]) with African-Americans showing only 0.8 [0.4–1.1] events/hour AHI change per BMI unit increase. Asians also showed the largest increase in AHI (3.5 [2.8–4.2]) per unit increase of neck circumference compared to African-Americans (2.3 [1.3–3.4]), Caucasians (1.9[1.7–2.2]), and South Americans (2.0 [1.7–2.3]).

Conclusion: Higher obesity relates to more severe OSA in the 4 ethnic groups studied, but ethnicity modifies the strength of this relationship. Asians had the strongest relationship between obesity and AHI, indicating weight gain in this population will contribute more to OSA severity than in other ethnicities. Overall obesity had less impact in African-Americans; fat deposition around the neck may be more relevant in this population.

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0459

GENERALIZABLE OSA CLINICAL SUBGROUPS IN AN INTERNATIONAL SLEEP CENTER POPULATION

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Introduction: A recent study of moderate-severe obstructive sleep apnea (OSA) in Iceland identified 3 disease subgroups related to clinical symptoms and comorbidities. Using an international sample of OSA patients, we sought to replicate this original result and examine whether the subgroups are generalizable to an ethnically diverse sample of patients.

Methods: Using data from 988 moderate-severe OSA patients (apnea-hypopnea index [AHI] ≥15 events/hour) recruited as part of the *Sleep Apnea Global Interdisciplinary Consortium (SAGIC)*, we performed a latent class analysis of 18 self-reported symptom variables, hypertension, cardiovascular disease and diabetes mellitus.

Results: The original three OSA subgroups of *minimally symptomatic, disturbed sleep* and *excessively sleepy* patients replicated within 215 SAGIC patients recruited from Iceland, independent from the Icelandic sample used in the original clustering analysis, as well as in the remaining 773 patients recruited from 5 other countries. We observed no differences in AHI among the 3 subgroups in either Iceland (p=0.781) or the international sample (p=0.872); thus, these clinical subgroups are not driven by OSA severity. Differences in age, gender or BMI among the 3 subgroups were generally small. Within the larger international sample, the three subgroups originally found in Iceland were extended to six optimal subgroups: 3 related to the combination of severe excessive sleepiness symptoms, disturbed sleep or both, 2 subgroups of less symptomatic patients with either moderate sleepiness or witness OSA events, and a relatively asymptomatic group. Among these subgroups, we observed significant differences in age, gender, BMI and ethnicity, as well AHI, although all subgroups were still middle-aged, obese and had severe disease on average.

Conclusion: These results both confirm and extend previously identified clinical subgroups of OSA with respect to symptoms and comorbidities. Leveraging these subgroups to move beyond a uniform approach to disease management and into more personalized care is an important future endeavor in Sleep Medicine.

Support (If Any):

0460

DEFINING OSA EXTREME PHENOTYPES ACROSS THE WORLD: A SLEEP APNEA GLOBAL INTERDISCIPLINARY CONSORTIUM EFFORT

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Introduction: Obstructive sleep apnea (OSA) is a common disorder with complex pathophysiology and heterogeneous clinical presentation, making it challenging to identify underlying biological factors. This study aims to characterize extreme phenotypes of OSA in a large sample of subjects from different sleep centers and ethnicities across the world.

Methods: This is a retrospective study in 81,592 individuals ≥18 years old from major cities in Brazil, United States, Taiwan and Australia, who underwent sleep studies from 2009 to 2014. Individuals were grouped according to self-reported ethnicity as: Asians (5.4%), African Americans (5.4%), Admixed (11.6%), Caucasian (74.8%) and Other (2.8%). Logistic regression was used to classify individuals as apnea-hypopnea index (AHI) ≥ 30 versus AHI < 5 on the basis of age, gender and body mass index (BMI) and all pairwise interactions for each ethnicity group separately. Extreme OSA cases were defined as those with AHI ≥ 30 but with predicted probabilities < 5th percentile and extreme controls were individuals with AHI < 5 but with predicted probabilities > 95th percentile.

Results: A total of 175 (0.21%) extreme controls (mean AHI 2.3[SD=1.4], age 56.6[15.7] years, mean BMI 45.1[19.5] kg/m2, and 88.6% male), and 745 (0.91%) extreme OSA cases (mean AHI 68.5[27.5], age 26.8[4.8] years, mean BMI 22.4[3.0] kg/m2 and 0.8% male) were identified across the ethnicity groups. Among extreme controls, Caucasians were the oldest (58.3[15.8] years), African Americans and Others showed highest BMI (48.2[9.5] and 48.7[13.5] kg/m2) and African Americans showed highest prevalence of males (100%). Among the extreme cases, Asians were the youngest (25.1[4.7] years), showed lowest BMI (20.8[2.6] kg/m2) and highest prevalence of males (10.5%).

Conclusion: We describe subgroups of patients that share unexpected patterns associated with the development or absence of severe OSA. These patterns also differ across ethnicities around the world. Although the prevalence of extreme OSA phenotypes is low, their characterization will help to guide molecular studies that may inform specific biological mechanisms for this disease.

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0461

BEYOND THE INDEX: QUANTITATIVE PHENOTYPING OF APNEA

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Introduction: Clinically, sleep apnea is characterized using metrics such as the Apnea-Hypopnea Index (AHI), a single rate averaged over the total sleep time. While clinically informative, it does not reflect either context or temporal distribution of the events. Thus, it is possible for patients with identical AHIs to present vastly different apnea phenotypes. Additionally, while descriptors relating factors such as sleep stage and position to apnea events can provide useful clinical information, current methods do not quantify the degree to which these factors contribute to the events. It is therefore crucial to develop phenotyping methods that can disambiguate differences in apnea event context, as well as in the relative contributions of different behavioral and physiological factors.

Methods: We develop a point process approach for quantifying the contributions of different polysomnographic (PSG) observations to the instantaneous respiratory event probability. A point process is any system that can be represented as a series of stochastic momentary events, which is governed by time-varying instantaneous rate or probability. We use a generalized linear model (GLM) framework to estimate the degree to which sleep stage, body position, and previous event timing predicts the instantaneous probability of an event occurring.

Results: We applied our point process framework to technician-scored PSGs from a cohort of subjects with severe disease (AHI>30). Models including only position and sleep stage were poor predictors of sleep apnea (Kolmogorov-Smirnov test on time rescaled events). However, by adding the timing of past apnea events to the model, we observed a marked improvement to the model goodness-of-fit. Moreover, the degree to which past events influenced future apnea probability showed heterogeneity and clustering across subjects.

Conclusion: These results indicate that past apnea history may be a major influencing factor on apnea probability. This suggests that a single apnea event, while mediated by other factors such as position and stage, may set off a cascade of subsequent respiratory events. Therefore, the structure of the history dependence may be a novel feature for apnea phenotyping and target for evaluating the effects of clinical intervention.

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0462

RECOGNITION AND TREATMENT OF OBSTRUCTIVE SLEEP APNEA AMONG MEDICARE BENEFICIARIES

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Introduction: Although a high proportion of older Americans are at-risk for obstructive sleep apnea (OSA), the magnitude of OSA under-diagnosis and under-treatment among this rapidly expanding population is unknown. The purpose of this study was to estimate the proportion of older Americans at risk for OSA among a large, representative sample of Medicare beneficiaries, and to assess for potential gaps in OSA recognition, diagnosis, and treatment among these at-risk individuals.

Methods: Data were obtained from Round 3 of the National Health and Aging Trends Study (NHATS), a nationally representative annual survey of community dwelling Medicare beneficiaries linked to Medicare fee-for-service claims. The NHATS 2013 survey included a "sleep module" about sleep disturbances and symptoms of sleep-disordered breathing, including items that map to key elements of the STOP-BANG questionnaire, a validated instrument to assess OSA risk. Respondents were considered at risk for OSA if ≥3 of these surrogate STOP-Bang items

were positive, consistent with the published STOP-Bang threshold. CPT, ICD-9 and HCPCS codes from linked claims were used to estimate the proportion of at-risk respondents who were evaluated with home sleep apnea testing or in-laboratory polysomnography, diagnosed with OSA, and prescribed positive airway pressure, respectively.
Results: The NHATS sample included 3,195 individuals, of which 1,052 were randomly selected to receive the sleep module. A total of 602 respondents (56%) were at risk for OSA, but only 8% of at-risk respondents had been tested for OSA. Among those tested, 94% had received a diagnosis of OSA, and 82% of those diagnosed were prescribed positive airway pressure therapy.
Conclusion: Evidence from this nationally representative sample of community-dwelling Medicare beneficiaries suggests that increased OSA risk is highly prevalent among older Americans, yet seldom investigated. When investigated, OSA is almost always confirmed, and usually treated.
Support (If Any): This work was supported by an American Sleep Medicine Foundation Strategic Research Award (PI: Braley 115-SR-15), NIHMD R01 MD008879 (Burke, Skolarus) and a T32 Grant from NINDS (NIH/NINDS T32 NS007222).

0463

PESTICIDE EXPOSURE AND SLEEP APNEA IN THE AGRICULTURAL LUNG HEALTH STUDY

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Introduction: Carbamate and organophosphate pesticides inhibit acetylcholinesterase, leading to respiratory depression at high exposure. Thus, involvement in sleep apnea is plausible, but there are no studies at lower levels of exposure.
Methods: To examine associations between pesticide exposure and sleep apnea, we analyzed data from 1,569 U.S. male pesticide applicators, mostly farmers, from an asthma case-control study nested within the prospective Agricultural Health Study. On questionnaires, participants reported use of specific pesticides and physician diagnosis plus prescribed treatments for sleep apnea. We used multivariable logistic regression to estimate the associations between ever-use of 63 pesticides and sleep apnea (234 cases, 1,335 non-cases).
Results: Among 1,569 male pesticide applicators, the mean age was 63 years, 98% were white, and 5% were current smokers. As expected, sleep apnea cases had substantially higher mean BMI than non-cases (mean of 34.5 versus 29.7 kg/m^2, respectively), and sleep apnea was more common among current asthma cases than noncases (prevalence 23.5% versus 10.8%, adjusted Odds Ratio (OR) = 2.47 [95% Confidence Interval (CI): 1.87–3.27]). The following numbers of sleep apnea cases reported use of each of the queried treatments: CPAP (n=215, 91.9%), "surgery" (n=16, 6.8%), "bi-level "(n=23, 9.8%), other oral device (n=22, 9.4%). Among 63 tested pesticides, four were associated with sleep apnea at $P<0.05$: two positively and two inversely. The most notable association was for carbofuran, a carbamate (100 exposed cases, OR= 1.83, 95% CI 1.34–2.51, P= 0.0002). Carbofuran use began before reported onset of sleep apnea in all cases and the P value for trend across increasing lifetime days of use was 0.003.
Conclusion: In a farming population, exposure to carbofuran was positively associated with sleep apnea. This result adds to the known adverse health outcomes of exposure to carbofuran, a pesticide cancelled in the US in 2009 for use in production of foods for human consumption although still used for this purpose in other countries.
Support (If Any): This study was funded by the National Institute of Environmental Health Science and the National Cancer Institute.

0464

OBSTRUCTIVE SLEEP APNEA AND RISK OF OCCUPATIONAL INJURY

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Introduction: To investigate whether patients with obstructive sleep apnea (OSA) are at increased risk of occupational injury (OI)
Methods: Patients referred to the University of British Columbia (BC) Hospital Sleep Laboratory for suspected OSA (May 2003 to July 2011) were recruited and those diagnosed with OSA using polysomnography (PSG) were included in the analyses. Information from patients with OSA (AHI greater than 5/hr) were linked with the workers' compensation claims database to identify OI resulting in at least one day off work in the five years prior to PSG. The odds of injury in each year was compared to a matched control group (by age, gender, industry type) taken from the general population of BC. Logistic regression was used to model the odds of a work-related injury over the five-year period.
Results: A total of 872 patients with OSA and 4360 controls were included in the study. There were 128 OI in the OSA patients (3.1% had a least one OI) and 791 OI in the control population (3.7% of controls had at least one OI). In the logistic regression model, OSA was not associated with an increased odds of OI (OR = 0.84, 95% CI = 0.68–1.03, p = 0.10). This association remained unchanged in the model adjusted for the confounding effects of age and gender (OR = 0.84, CI = 0.68–1.03, p= 0.10). In a secondary analysis restricted to injuries potentially associated with vigilance at work, patients with OSA had a similar rate of OI as matched controls (OR=1.00, CI=0.73–1.37, p= 0.99).
Conclusion: In this matched analysis, OSA was not associated with an increased risk of OI. Whether this is due to the lack of impact of OSA in the period prior to diagnoses, or other unknown confounders (e.g. work time, job descriptions) is open to discussion.
Support (If Any): CIHR Sleep Team Grant.

0465

PROFILE OF SINGAPOREAN PATIENTS WITH SLEEP DISORDERED BREATHING(SDB): THE IMPACT OF ETHNICITY

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Introduction: Singapore is a multi-ethnic society comprising ethnic Chinese (74.3%), Indians(9.1%), Malays(13.3%) and others. Our goals were to construct a profile of Singaporean patients diagnosed with Sleep Disordered Breathing(SDB) and find differences between the major ethnic groups.
Methods: Polysomnography(PSG) data of consecutive patients (n=659) who underwent level 1 study at our centre in the year 2015 were reviewed and analysed. Patients with SDB (Apnea-Hypopnea index, AHI of at least 5/hour) were included(n=567). PSG parameters included in our analysis were: Total AHI, Rapid Eye Movement(REM)-sleep AHI,Non-REM(NREM)-sleep AHI, and positional AHI (supine

and non-supine). Data collected from retrospective chart review were age,sex,race,body mass index (BMI in kg/m^2),neck circumference, Epworth Sleepiness Score (ESS) and documented history of hyperglycemia.SDB was stratified by AHI: Mild(AHI 5–15/hour), moderate (AHI 15–30/hour) and severe (AHI>30/hour).REM-SDB was defined as AHI in REM sleep > twice AHI in NREM sleep, and Positional SDB as supine AHI > twice non-supine AHI.

Results: 415/567 (73.2%) of SDB patients were males. Mean age was 47.9 years; Mean ESS was 7.11; Median BMI was 28 kg/m^2, mean neck circumference was 39.9 cm, and median AHI was 37.4/hour.382 (67.4%) had low ESS (</=10). Mild, moderate and severe SDB was seen in 124 (21.9%), 118(20.8%) and 325 (57.3%) patients respectively. Positional SDB was seen in 233(41.1%) patients and REM-related SDB in 146 (25.7%). 126 (22.2%) patients had history of hyperglycemia. There were 444(78.3%) Chinese, 64(11.3%) Indian, and 44(7.7%) Malay patients, with 15(2.6%) patients of other ethnicities. Malay patients had a significantly higher median BMI (Chinese:27; Indian:30.7; Malay:37.3;p<0.001). There were no significant differences between Chinese, Indian and Malay patients in remaining parameters.

Conclusion: Our patients were mainly non-sleepy middle-aged males, of which, more than half had severe SDB. Positional SDB was common. Malay patients had highest BMI. There were no other significant differences in the selected characteristics between the three ethnic groups. To our knowledge, our study is the first attempt to characterize the SDB features and elucidate the differences amongst the three ethnic groups in Singapore.

Support (If Any): Nothing to declare.

0466

PREDICTIVE ABILITY OF ANTHROPOMETRIC INDICES FOR ASIAN OBSTRUCTIVE SLEEP APNEA

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Introduction: Obesity is a major risk factor for obstructive sleep apnea syndrome (OSAS). However, it is unclear whether anthropometric cut-off values for screening OSAS should be adapted to Asian people who are less obese in comparison with Caucasians. This study aimed to formulate and validate anthropometric obesity indices for detecting moderate to severe Asian OSAS.

Methods: Patients were Japanese (no mixed heritage) individuals. Those with apnea-hypopnea indices (AHI) ≥15 events/h on polysomnography constituted the OSAS group. For the developmental analysis, logistic regression analysis was used to determine OSAS risk using age, BMI, neck circumference (NC), and waist circumference (WC). We determined the optimal values at cut-off AHI ≥15 events/h using receiver operating characteristic (ROC) curves. In the validation analysis, we assessed the efficacy of new objective anthropometric screening scores for OSAS in a separate validation group.

Results: We included 443 male patients (mean age: 48.8 ± 12.9 years). Age, BMI, NC, and WC were significant risk factors for OSAS. We therefore determined cut-off values for predicting OSAS as two or more of following: age ≥47 years, BMI ≥25.0 kg/m^2, NC ≥38.5 cm, and WC ≥90.0 cm. The sensitivity, specificity, and positive and negative predictive values in the validation were 80.3%, 56.0%, 71.4%, and 67.5%, respectively.

Conclusion: Age, BMI, NC, and WC were determined as significant risk factors for OSAS. Our objective anthropometric screening score is simple and accurate for determining the prevalence of moderate to severe OSAS in a Japanese population.

Support (If Any): It was supported in part by the Japan Society for the Promotion of Science (grant numbers 15K11463).

0467

THE ROLE OF OBSTRUCTIVE SLEEP APNEA AND OBESITY IN POSTOPERATIVE OUTCOMES: A POPULATION-BASED STUDY IN PATIENTS UNDERGOING OPEN COLECTOMIES

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Introduction: An increasing body of evidence demonstrates an association between obstructive sleep apnea (OSA) and adverse perioperative outcomes with national data existing on particularly orthopedic and bariatric surgery. However, large scale data is currently lacking on open colectomies: procedures associated with high opioid utilization and high complication rates. Moreover, the interaction between obesity and OSA in this setting remains undefined.

Methods: Patients undergoing open colectomies were identified using the national Premier Perspective claims-based database (2006–2014; n=275,064). Multilevel multivariable models measured the associations between an OSA*obesity interaction term and perioperative outcomes: length and cost of hospitalization, opioid utilization (in oral morphine equivalents), respiratory and cardiac complications, ICU admission, mechanical ventilation, and in-hospital mortality. Odds ratios (OR) and 95% confidence intervals (CI) are reported.

Results: Overall, 4.9% (n=13,383) of patients had a diagnosis code for OSA of which 46.5% (n=6,460) was classified as obese. When adjusted for relevant covariates, OSA (with and without obesity, respectively) was associated with 17.6% (CI 15.2–20.0%) and 5.4% (CI 3.4–7.4%) increased cost of hospitalization; this was 9.4% (CI 8.3–10.6%) for obesity without OSA (all P<0.0001). Interestingly, other perioperative outcomes followed this same pattern: highest risks for OSA/obesity combined, with obesity more important in this risk than OSA. The strongest effects were seen for respiratory complications: OR 2.51 (CI 2.35–2.68), OR 1.43 (CI 1.33–1.54), OR 1.52 (CI 1.45–1.58), for OSA with obesity, OSA without obesity, and obesity without OSA, respectively (all P<0.0001).

Conclusion: OSA is associated with adverse perioperative outcomes in patients undergoing open colectomies. However, obesity without OSA appears to exert a stronger risk than OSA without obesity, with a synergistic effect if both OSA and obesity are present. Given the high volume of open colectomies, and the large proportion of undetected OSA further research is warranted into not only risk stratification but also effectiveness of tailored interventions.

Support (If Any): N/A.

0468

SLEEP-DISORDERED BREATHING, COGNITIVE FUNCTION AND RISK OF COGNITIVE DECLINE: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Growing evidence suggests an association between sleep-disordered breathing (SDB) and cognitive decline in the elderly.

However, existing population-based studies have been conflicting and few have considered differential effect on cognitive domains. This meta-analysis aims to provide a quantitative synthesis of the relationship between SDB, cognitive function and risk of cognitive decline or impairment.

Methods: We performed a systematic search of publications (in English) using PubMed, EMBASE and PsychINFO. We included cross-sectional and prospective studies with at least 200 participants with an average age of ≥ 40 years, defined SDB by apnea-hypopnea index (AHI) or clinical diagnosis, and incorporated cognitive outcomes based on standard tests or diagnosis of cognitive impairment. We extracted and pooled adjusted risk ratios from prospective studies and standard mean differences (SMD) from cross-sectional studies, using random-effect models. We focused on three cognitive domains: global cognition, executive function and delayed memory. We tested heterogeneity between studies using the I^2 statistics, and used Egger test and funnel plot asymmetry to evaluate publication bias.

Results: We included 14 studies, of which six were prospective, and covered a total of 4,288,419 men and women. Pooled analysis of the six prospective studies indicated that those with diagnosed sleep apnea or an AHI of ≥15 were 26% (RR= 1.26; 95% CI: 1.05–1.50) more likely to develop cognitive decline or dementia, with no evidence of publication bias (p=0.74) but heterogeneity between studies (p=0.04). After removing one study that introduced significant heterogeneity, the pooled RR was 1.35 (95% CI: 1.11–1.65). Pooled analysis of seven cross-sectional studies suggested that those with SDB had significantly worse executive function (SMD=-0.05; 95%CI: -0.09-0.00), with no evidence of heterogeneity (p=0.31) or publication bias (p=0.65). SDB was not associated with global cognition or memory.

Conclusion: SDB is associated with an increased risk of cognitive decline or dementia. There is a cross-sectional association between SDB and executive function but not with other cognitive domains. Further studies are required to determine mechanisms linking these common conditions.

Support (If Any):

0469

EFFECT OF MODERATE-TO-SEVERE OBSTRUCTIVE SLEEP APNEA ON CLINICAL OUTCOMES IN PATIENTS WITH ACUTE CORONARY SYNDROME

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Introduction: Obstructive sleep apnea (OSA) is linked to increased cardiovascular risk, but the association between OSA and acute coronary syndrome (ACS) remains controversial. We hypothesized that moderate-to-severe OSA increased the number of adverse cardiovascular events in patients with ACS.

Methods: Patients with ACS who underwent an overnight sleep study during index admission were recruited prospectively. Major adverse cardiac and cerebrovascular events (MACCEs) assessed included cardiac death, myocardial infarction, unplanned revascularization, stroke, and hospitalization for heart failure.

Results: Of the 264 patients recruited, 258 successfully completed the study. Moderate-to-severe OSA was diagnosed in 153 patients (59.3%) (apnea-hypopnea index ≥15). Nine patients had received treatment for OSA. The median time of follow-up was 387 days. Among the patient who did not received treatment for OSA, there were 3 cardiac deaths, 1 myocardial infarction, 8 unplanned revascularizations, 1 stroke and 1 heart failure hospitalization occurred in group with moderate-to-severe OSA. In contrast, there were 1 cardiac death, 9 unplanned revascularizations, 1 stroke and 1 heart failure hospitalization in the non-severe group. The moderate-to-severe OSA patients had similar MACCEs compared with patients with mild OSA or without sleep apnea (13.1% versus 11.4%, P=0.68). Kaplan-Meier event-free survival curves showed the event-free survival rates were not significantly different in two groups (P=0.64, log-rank test).

Conclusion: Over a half of the patients admitted with ACS have undiagnosed moderate-to-severe OSA. The adverse outcomes for ACS up to 1-year were no different in patients with moderate-to-severe OSA compared to those with mild OSA or without sleep apnea.

Support (If Any): This study was supported by International Science & Technology Cooperation Program of China No.2015DFA30160 and Beijing Municipal Science & Technology Commission No.Z141100006014057.

0470

CHARACTERIZING ADULTS WITH OBSTRUCTIVE SLEEP APNEA WHO REPORT NOCTURNAL ENURESIS

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Introduction: Obstructive sleep apnea (OSA) is known to associate with nocturnal enuresis (NE) in children, and it has been shown that treatment of OSA may lead to resolution of NE in this population. In contrast, the association between OSA and NE in adults remains the subject of a handful of case reports and series. To characterize this relationship, we studied a population of adults diagnosed with OSA by polysomnography (PSG) at Boston Medical Center.

Methods: A database containing a subset of 84 patients out of 351 referred for PSG for evaluation of OSA was analyzed for differences between patients who reported NE and those who denied it on initial screening. The subset of patients included in the analysis met diagnostic criteria for OSA, and reported some degree of nocturia, if they did not report NE. T-tests and Chi-square analyses were used to determine differences between those with and without NE with respect to demographics, comorbidities, medications, and PSG measures.

Results: Of 351 individuals referred for PSG for evaluation of OSA, 4.0% reported NE. Of those 84 with OSA included in the analysis, NE patients were more likely to be older ($p < 0.05$), and more likely to have hypertension ($p < 0.05$) and prior stroke ($p < 0.05$). A trend was observed in which NE patients were more likely to be prescribed an opioid or benzodiazepine ($p = 0.07$). There were no differences with respect to PSG measures.

Conclusion: NE is an uncommon complaint among individuals referred for PSG for OSA screening, but may be more common among those ultimately diagnosed with OSA, and we provide evidence that it may associate with age, comorbidities, and certain medications. In light of anecdotal evidence that continuous positive airway pressure therapy may alleviate NE in adults with confirmed OSA, routine screening for NE in patients referred for PSG may aid in diagnosis and treatment of this burdensome condition.

Support (If Any): None.

0471

INSPIRATORY FLOW LIMITATION IN A LARGE AMBULATORY COHORT OF SUSPECTED SLEEP APNOEA PATIENTS

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Introduction: There is no agreed upon best diagnostic or prognostic metric for sleep apnoea. Novel percentage of inspiratory flow limited breaths, clinical pre-test probability of sleep apnoea from adjusted neck circumference, and usual estimated respiratory disturbance index (eRDI) were compared against Epworth Sleep Scale (ESS), a biomarker of sleep apnoea effect.
Methods: Complete demographics and polygraphy from 52 395 sequential patients referred for ambulatory sleep apnoea screening (www.sagatech.ca) using the Remmers Sleep Recorder (Sagatech Electronics Ltd., Calgary, Alberta, Canada) were assessed with descriptive analysis, analysis of variance, and Bayes Information Criteria (BIC) selected hierarchical cluster modelling (R 3.3.2, mclust 5.2). Inspiratory flow limitation was quantified breath by breath using an automated algorithm (US patent 8834387).
Results: 1.) Reviewing scatter plots showed inspiratory flow limitation remained elevated when eRDI did not with low Epworth scores. 2.) Inspiratory flow limitation, eRDI, and their interaction each had significant correlations with ESS (F: 55.49, 1073.71, 8.82; df = 1; all $p << 0.01$). 3.) BIC, classification, and density plots of cluster modelling showed three to four distinct groups within the 0 to 20% inspiratory flow limited range.
Conclusion: 1.) Quantified breath by breath inspiratory flow limitation remained high in mild sleepiness unlike traditional eRDI. 2.) Inspiratory flow limitation and eRDI separately and together significantly correlated with sleepiness. 3.) Three to four tightly grouped clusters of inspiratory flow limitation severity were discerned, but are of unlikely clinical utility. Further analysis of gender effects is planned.
Support (If Any): RCPSC.

0472

OBSTRUCTIVE SLEEP APNEA IN A PSYCHIATRIC POPULATION: HIGH PREVALENCE AND LACK OF RISK FACTORS

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Introduction: The prevalence of Obstructive Sleep Apnea (OSA) is on the rise with 1 in 5 adults have mild OSA and 1 in 15 have moderate/severe OSA. It is estimated that 75% of OSA cases in the United States remain undiagnosed which, if left untreated can be contribute to the development of a number of medical conditions including diabetes, hypertension, stroke, and increased morbidity rates, confirming that untreated OSA is an under recognized threat to public health. Primary care physicians are encouraged to screen for overt OSA symptoms (e.g., disruptive snoring, breathing pauses) and consider potential risk factors such as obesity, male sex, large neck size, and increased age. Less is known about the comorbidity between psychiatric illness and OSA, but some studies have found that OSA is associated with a higher prevalence of psychiatric comorbidities. One of the complications to diagnosing OSA in this population is that the symptoms of OSA overlap with those of many psychiatric conditions. Thus, clinicians may be less likely to suspect OSA in patients who present with excessive daytime sleepiness. As we expand our understanding of OSA, it is important to recognize that not all OSA patients present with the classic symptoms and stereotypical risk factors.
Methods: A sample of 249 inpatients with a variety of psychiatric conditions were screened for sleep disorders during an overnight full montage polysomnogram using a home monitoring system.
Results: Of the total, 74% patients met criteria for OSA, (42% mild; 16% moderate; 16% severe). However, when traditional risk factors were reviewed, only 57% were men, 23% were obese (BMI ≥ 30), 25% had a large neck circumference (men ≥ 17 inches; women ≥ 15 inches), 17% were over the age of 60 and only 21% reported excessive daytime sleepiness.
Conclusion: In our sample of psychiatric patients, the prevalence of OSA was markedly higher than in the general population. More importantly, standard screening tools would have failed to detect OSA, thus recommendation for a sleep study. These findings suggest that risk factors and OSA symptoms in a psychiatric population may differ significantly from a nonpsychiatric population.
Support (If Any):

0473

THE PREVALENCE OF SLEEP DISORDERED BREATHING IN THE ACUTE PSYCHIATRIC SETTING

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Introduction: Recent evidence shows a bi-directional relationship between sleep and psychiatric disorders. This study evaluates the prevalence of obstructive sleep apnea and excessive daytime sleepiness in hospitalized psychiatric patients. Factors that correlate with obstructive sleep apnea and excessive daytime sleepiness in this sample are examined.
Methods: Validated questionnaires evaluating obstructive sleep apnea and excessive daytime sleepiness were administered to 152 participants after informed consent was secured. Additional data collected included general demographics, psychiatric diagnoses, and questionnaires evaluating depression and anxiety symptoms. Statistical analyses were performed to determine the prevalence of obstructive sleep apnea and excessive daytime sleepiness, as well as their respective correlates with patient profiles.
Results: Our results showed that 39.5% of participants were found to have a high likelihood of sleep apnea and 9.9% of the participants were found to have an abnormal range of daytime sleepiness. Sleep apnea correlated with body mass index ($r= 0.2977$, $p< 0.05$), age ($r=0.203$, $p=0.05$) and depression severity ($r= 0.224$, $p<0.05$). Higher body mass index was associated with a higher likelihood of sleep apnea ($\chi^2= 15.05$, $p<0.05$). Severity of depressive symptoms was also associated with a higher likelihood of sleep apnea ($\chi^2= 8.10$, $p<0.05$).
Conclusion: Research has shown that an association between psychiatric disorders and sleep disordered breathing such as sleep apnea does exist. The biological and molecular nature behind the relationship of both disorders is multifactorial and complex but sleep apnea must be recognized in the psychiatric setting and treated accordingly.
Support (If Any): American University of Beirut- Faculty of Medicine.

0474

A NATIONAL COHORT STUDY OF OBSTRUCTIVE SLEEP APNEA IN PREGNANCY AND ADVERSE NEONATAL OUTCOMES

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Introduction: Obstructive sleep apnea (OSA) has been associated with adverse neonatal outcomes such as preterm birth and growth restriction in some studies. There are no data regarding resuscitation at birth or risk of congenital anomalies following in-utero exposure to OSA. The aim of this study is to evaluate the association of OSA with resuscitative efforts at birth and the risk of congenital anomalies.
Methods: The National Perinatal Information Center collects administrative discharge and select medical record data from major perinatal centers in the US. We studied linked maternal records and newborn records with a delivery hospitalization from 2010–2014 to assess newborn outcomes of maternal OSA based on diagnosis and procedure codes. Congenital anomalies were defined based on international classification of diseases-9, and encompassed "any" congenital anomaly as well as specific anomalies. Univariate and Multivariable logistic regression analysis was used to calculate adjusted odds ratios (aOR) and confidence intervals (CI). The model included maternal obesity, pre-pregnancy DM, gestational DM, pre-pregnancy HTN, gestational HTN, preeclampsia, tobacco, alcohol, and drug use.
Results: There were 1,577,632 pregnant women; 0.1% had OSA; 1,423,099 of all records were linked to live newborn records. Mothers with OSA had a higher likelihood of having obesity, pre-gestational hypertension and diabetes. Neonates born to mothers with OSA were more likely to be admitted to the intensive care unit (25.3% vs. 8.1%, $p<0.001$) or special care nursery (34.9% vs. 13.6%, $p<0.001$). Similarly these newborns were more likely to have resuscitation at birth (aOR 2.76, 1.35–5.64), and a longer hospital stay (aOR 2.25, 1.85–2.65) even after adjusting for covariates. The risk for congenital anomalies was higher in babies of women with OSA (aOR 1.26, 1.11–1.43), with the highest risk being that of musculoskeletal anomalies (aOR 1.89, 1.16–3.07). The risk of bronchopulmonary dysplasia was no longer significant after adjusting for covariates.
Conclusion: This is the first study to demonstrate a higher risk of congenital anomalies and resuscitation at birth in neonates born to mothers with OSA. These data further highlight the importance of identifying this condition in pregnancy and testing the impact of therapy on these complications.
Support (If Any): Restricted fund-Lifespan.

0475

COMPARISON OF PERIPHERAL ARTERIAL TONOMETRY AND POLYSOMNOGRAPHY FOR THE DIAGNOSIS OF OSA IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Introduction: Chronic obstructive pulmonary disease (COPD) is a prevalent disorder with high morbidity and mortality. Studies suggest that concomitant untreated sleep-disordered breathing (SDB) substantially worsens outcomes. In addition to cost and availability, PSG may be an unattractive option for SDB diagnosis given rapid oxygen desaturation with relatively little upper airway obstruction - and low inter-rater reliability of PSG in this patient group as a result. Thus, alternative diagnostic methods are needed. The WatchPAT (Itamar Medical) is a home sleep testing device which has been shown to be accurate for diagnosing SDB in normal population without significant lung disease. It is based on peripheral arterial tone (PAT), pulse rate, oxygen saturation, actigraphy, snoring recording, and body position. Previous WatchPAT studies excluded patients with COPD. We therefore sought to compare WatchPAT to PSG in detecting SDB in patient with COPD.
Methods: 32 patients (19 men) previously diagnosed with COPD, aged 64 ± 7 years old, underwent simultaneous recording with full night in-lab PSG and WatchPAT. PSG scoring was performed according to Chicago criteria by a RPSGT (AHI-PSG), who was blinded to the automated scoring by WatchPAT software (AHI-WPAT). All COPD patients also completed pulmonary function tests, Pittsburgh Sleep Quality Index (PSQI), and Epworth Sleepiness Scale (ESS) questionnaires.
Results: Pearson correlation between AHI-PSG and AHI-WPAT was $p = 0.638$, $p \leq 0.001$; Pearson correlation between REM AHI-PSG and REM AHI and ODI by WatchPAT for all 32 patients were 0.824 and 0.869, $p \leq 0.001$. Using a threshold of AHI ≥ 10, the sensitivity and specificity of WatchPAT for all 32 patient were 0.89 and 0.78, respectively. No significant correlations were found between AHI-PSG or AHI-WPAT with PSQI or ESS scores.
Conclusion: These findings suggest that WatchPAT may be used to accurately detect SDB in patients with COPD, especially in those with REM predominant events. More studies using WatchPAT with underlying lung diseases will be required to determine if this can be used as a screening test for SDB in COPD patients, especially those who are at risk for hypoventilation, and what factors might cause discrepancy between WatchPAT with PSG.
Support (If Any): None

0476

THE EPIDEMIOLOGY OF OBSTRUCTIVE SLEEP APNEA AND ASTHMA OR CHRONIC OBSTRUCTIVE PULMONARY DISEASE OVERLAP SYNDROMES IN ONTARIO, CANADA: A POPULATION-BASED COHORT STUDY

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Introduction: Despite their importance, the epidemiology of obstructive sleep apnea (OSA) and asthma (OSA/asthma), and OSA and chronic obstructive pulmonary disease (OSA/COPD) overlap syndromes have not been well studied.
Methods: We conducted a population-based cohort study to estimate trends in the prevalence and mortality of individuals 35 years and older with OSA/asthma or OSA/COPD in Ontario, Canada. Ontario has a diverse population of about 13 million and a universal health care system that covers most medical services including polysomnography and positive airway pressure (PAP) treatment. Validated health administrative case definitions were used to identify individuals with moderate to severe asthma or COPD. Individuals with OSA were those who received OSA-related PAP treatment. Age- and sex-standardized annual prevalence and mortality rates were estimated and compared from 2009 to 2013 and between conditions.

Results: The highest prevalence for both overlaps was in those 50 to 79-years and men. The standardized prevalence increased from 2009 to 2013: for OSA/asthma from 0.38% to 0.54% of the population, for OSA/COPD from 0.23% to 0.31%.Both overlap syndromes were associated with higher mortality than OSA alone. Higher mortality was associated with OSA/asthma compared to asthma alone (OR = 1.09, 95%CI: 1.05–1.13) with larger differences in women and those younger than 50 years. In women but not men, a higher mortality was associated with OSA/COPD compared to COPD alone: OR = 1.06 (1.01–1.11). The standardized all-cause mortality rates among individuals with both overlap syndromes decreased modestly over time.
Conclusion: In a large North American population, the prevalence of overlap syndromes was higher in men and middle-aged individuals, and increasing over time. Overlap syndromes were associated with excess mortality in spite of funded PAP treatment, particularly in women and younger people. These findings can alert health care providers and policy makers to the large and increasing burden of overlap syndromes and which high-risk groups are most affected.
Support (If Any): The Godfrey S Pettit Block Term Grants, University of Toronto; Canadian Respiratory Research Network fellowship training award; Institute for Clinical Evaluative Sciences, which is funded by an annual grant from the Ontario Ministry of Health and Long-term Care.

0477

THE EFFECT OF SLEEP AIDS ON APNEA HYPOPNEA INDEX AND OTHER PARAMETERS MEASURED IN POLYSOMNOGRAPHS

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Introduction: Prescription and over-the-counter sleep aids are widely used. Many patients who have a diagnostic polysomnograph (PSG) to evaluate for obstructive sleep apnea (OSA) are taking a sleep aid. There is concern that sleep aids may influence apnea hypopnea index (AHI) and other PSG study parameters. Our study investigated the effects of sleep aids on diagnostic PSG parameters in a group of 847 subjects. Our primary outcome was the effect of benzodiazepine (BDZ) receptor agonists and benzodiazepines on AHI. Our secondary outcomes were the effects of melatonin, antihistamines, sedating antidepressants and a sedating antipsychotic on AHI and oxygen desaturation.
Methods: This study collected data from 12 months of diagnostic PSGs at the University of Iowa Sleep Disorders Center totaling 847 subjects 18 years of age or older. The sleep aids were categorized into: benzodiazepine (BDZ) receptor agonists (Z-drugs), benzodiazepines (BDZs), melatonin agonists (MTN), antihistamines (AH), sedating tricyclic antidepressants (TCA), 5HT2A antagonists (5HTA: trazodone, mirtazapine, quetiapine). We examined multiple PSG paramters including AHI and oxygen desaturation.
Results: Out of 847 subjects, 607 were sleep aid non-users and 240 were sleep aid users. The results were controlled for age, gender and BMI. Our study showed that there was no difference in AHI between the 607 subjects that were sleep aid non-users and the 91 subjects taking Z-drugs or benzodiazepines. The AHI by subgroups were not statistically significant including sleep aid non-users AHI 9.0, Z-drug users AHI 9.3, benzodiazepine users AHI 8.3, melatonin users AHI 8.1, antihistamine AHI 9.8, TCA users AHI 6.3, 5HT2A users AHI 7.8. The oxygen desaturation was also not statistically significant. There was statistically significantly lower REM AHI in melatonin users compared to the sleep aid non-users and other sleep aid users (9.3 vs. 16.0 vs. 17.3 $p < 0.05$).
Conclusion: Sleep aid non-users and sleep aid users did not have statistically significantly different AHI values or oxygen desaturation values on PSG but a subset of users taking melatonin did have a lower REM AHI. This provides information for consideration when discussing how sleep aids effect PSG parameters.
Support (If Any): None

0478

CLINICAL PRACTICE GUIDELINE FOR DIAGNOSTIC TESTING FOR ADULT OBSTRUCTIVE SLEEP APNEA; AN UPDATE FOR 2016: AN AMERICAN ACADEMY OF SLEEP MEDICINE CLINICAL PRACTICE GUIDELINE

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Introduction: The American Academy of Sleep Medicine commissioned a task force of experts in sleep medicine to develop updated clinical practice recommendations based on a systematic review of the literature.
Methods:
Results: 1. We recommend that polysomnography, or home sleep apnea testing with a technically adequate device, be used to diagnose OSA in uncomplicated adult patients presenting with signs and symptoms that indicate an increased risk of moderate to severe OSA. (STRONG)
2. We recommend that if a single home sleep apnea test is negative, inconclusive or technically inadequate, PSG be performed for the diagnosis of OSA in symptomatic patients. (STRONG)
3. We recommend that polysomnography, rather than home sleep apnea testing, be used for the diagnosis of OSA in patients with significant cardiorespiratory disease, neuromuscular disease with respiratory muscle impairment, awake hypoventilation or high risk of sleep related hypoventilation, chronic opioid medication use, or severe insomnia. (STRONG)
4. We suggest that, if clinically appropriate, a split-night diagnostic protocol, rather than a full-night diagnostic protocol for polysomnography be used for the diagnosis of OSA. (WEAK)
5. We suggest that when the initial polysomnogram is negative and there is still clinical suspicion for OSA, a second polysomnogram be considered for the diagnosis of OSA in symptomatic patients. (WEAK)
6. We recommend that clinical tools, questionnaires and prediction algorithms not be used to diagnose OSA in adults, in the absence of objective sleep testing. (STRONG)
Conclusion:
Support (If Any):

0479

PREDICTING OBSTRUCTIVE SLEEP APNEA ON POLYSOMNOGRAPHY AFTER A NORMAL HOME SLEEP APNEA TEST

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Introduction: Home sleep apnea testing (HSAT) has become more prevalent in the evaluation of obstructive sleep apnea (OSA). A high false negative rate of HSAT creates a dilemma for clinicians and patients may require a subsequent attended in-lab polysomnogram

(PSG) to definitively rule out the presence of OSA. This study was performed to identify particular patient characteristics that can assist clinicians in accepting the negative results of a HSAT as a true negative result without the need for subsequent polysomnography.

Methods: A retrospective chart review of patients who had negative HSAT and a subsequent PSG was performed. A logistic regression analysis was used to identify individual characteristics that may predict a positive PSG (apnea-hypopnea index >5). A point system was generated based on these patient characteristics and the sensitivity, specificity and area under the curve was determined. A Markov chain Monte Carlo simulation was then used to generate a Receiver Operating Characteristic curve for the point system.

Results: A total of 106 HSAT with subsequent PSG were included. Of those, 29 (27%) had a positive PSG. A scoring system using age, gender, Body Mass Index (BMI), neck circumference, presence of hypertension, Epworth Sleepiness Scale, snoring, and insomnia resulted in a sensitivity of 0.89 and specificity of 0.65 in predicting a positive PSG with an area under the curve (AUC) of 0.74. A Markov chain Monte Carlo simulation using the same individual characteristics yielded a good predictive power with AUC of 0.80.

Conclusion: A point system based on individual characteristics performed fairly well in predicting a positive PSG after a negative HSAT in this retrospective sample. Further testing in a prospective cohort should be done before using this tool in clinical practice.

Support (If Any): None

0480

UTILITY OF ORDERING SPLIT STUDIES FOR DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA

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Introduction: Traditionally, evaluation of obstructive sleep apnea (OSA) consists of two separate polysomnographies (PSG); a diagnostic study, followed by a CPAP titration. However, to reduce costs, many insurance provides mandate performance of split studies (SPL) in lieu of 2 separate studies. This study was done to ascertain the utility of performing SPL for diagnosis and treatment of OSA.

Methods: We reviewed the laboratory records of 106 patients suspected of having OSA. Among these 51 (48.1%) were mandated to be SPL by the insurance provider. We used AASM criteria for adding CPAP to the study (apnea-hypopnea index [AHI] in the first 2 hours of sleep ≥ 40). Full in-lab PSGs were performed according to AASM standards. AHI was calculated both by AASM and CMS criteria. We calculated the sensitivity and specificity of AHI in the first 2 hours of sleep for predicting overall AHI ≥40, and ≥ 15.

Results: Among 51 patients mandated for SPL, 15 (29.4%) were split. The remaining 91 patients had diagnostic PSGs. In these 91, we examined the sensitivity, specificity, positive and negative predictive values (PPV and NPV) of AHI ≥ 40 during the first 2 hours, for predicting overall AHI ≥ 40, and AHI ≥15 both using AASM and CMS criteria. For predicting overall AHI ≥40 (AASM), these were 63%, 87.5%, 41%, 95% respectively. For predicting overall AHI ≥40 (CMS), these were 40%, 96%, 57%, 93% respectively. For predicting overall AHI ≥ 15 (AASM), these were 26.5%, 100%, 100%, 36.5% respectively. For predicting overall AHI ≥ 15 (CMS) these were 29%, 98.3%, 90%, 72.8%, respectively.

Conclusion: Conclusion: The minority of studies ordered as SPL actually end up being SPL according to AASM guidelines. For justification of CPAP (AHI ≥15), the sensitivity is low, but the specificity and PPV are high.

Support (If Any): None

0481

USING STOP-BANG AS A SCREENING TOOL FOR SUSPECTED OBSTRUCTIVE SLEEP APNEA AMONG PATIENTS REFERRED TO A COMMUNITY SLEEP MEDICINE CENTER

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Introduction: Effective screening is essential for the diagnosis and treatment of chronic obstructive sleep apnea (OSA). Early diagnosis also helps address and prevent related adverse health outcomes. The STOP-Bang is a validated screening tool used internationally for diverse patient subgroups, particularly preoperative patients and community populations. The predictive accuracy and discriminatory power among clinically referred patients is not well described. Its relative performance by gender is also poorly understood among patients with higher OSA risks.

Methods: 935 clinically referred patients suspicious of OSA were evaluated at MultiCare Sleep Medicine Center during 2015–2016. The STOP-Bang questionnaire was administered to each patient. In-center polysomnography (PSG) or home testing with portable monitors (PM) was performed for all patients. Apnea-hypopnea index (AHI) or respiratory disturbance index (RDI) was used as the gold standard for OSA diagnosis. Predictive performance of STOP-Bang was described and compared using optimal operating points (OOP) based on the Youden Index (J: maximum (sensitivity + specificity −1)) by gender. Utility of adjusted STOP-Bang was tested using alternative thresholds for body mass index (BMI) and/or neck circumference (NC) by receiver-operating characteristic (ROC) analysis. BMI at 25/30/40 and NS at 15/17 inches were taken as cutoffs for the adjustment.

Results: Of the 403 female and 532 male patients, mean age, BMI and NC were 51.1 years, 35.7, and 41.8 cm, respectively. Mean AHI/RDI score was 25.4 with gender difference (F:18.9, M: 30.3, p <.001). 22.3% of the patients were free of OSA (AHI/RDI < 5). Overall, 30% and 20.2% were identified as having severe (AHI/RDI ≥ 30) or moderate (AHI/RDI ≥ 15 but < 30) OSA, respectively. Performance utility for moderate-or-severe OSA was shown at ≥ 4 for females (J = 0.30) and 5 for male patients (J = 0.28). STOP-Bang score at ≥ 5 reflects OOP in predicting severe OSA for both genders. At all three OSA severity levels, the combination of BMI≥30/NS≥17 inches outperformed conventional STOP-Bang in predictive utility.

Conclusion: Use of STOP-Bang in clinically referred high-risk patients is appropriate but thresholds for total score and item cutoffs may need modification.

Support (If Any):

0482

PERFORMANCE OF AN INTERNATIONAL SYMPTOMLESS PREDICTION TOOL FOR OBSTRUCTIVE SLEEP APNEA USING ARTIFICIAL NEURAL NETWORK

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Introduction: Current prediction tools for obstructive sleep apnea (OSA) include responses to questions about patient symptoms within subjects from a single country. We developed and determined the diagnostic performance of a symptomless OSA prediction tool in a large number of subjects seen in the member centers of the Sleep Apnea Global Interdisciplinary Consortium (SAGIC).

Methods: 12,073 patients aged ≥18 years and referred for diagnostic in-laboratory polysomnography (PSG) for suspicion of OSA were included in the study from the following SAGIC centers: Perth, Australia (n=3,904); Columbus, OH (n=5,852); Philadelphia, PA (n=1,053); Taoyuan, Taiwan (n=1,264). A generalized regression artificial neural network (ANN) was used to generate the prediction tool (SAGICNet), which produced the desired output of OSA presence or absence. Variables chosen as inputs were: age, gender, body mass index (BMI), neck collar size, and self-reported ethnicity. The ANN was trained in 8,451 (70%) subjects randomly selected from the dataset and validated in the remaining 3,622 (30%).

Results: Subjects (55% male) were 48.8±14.0 years-old with an apnea hypopnea index (AHI) of 27.7±29.6 events/hour; the overall OSA prevalence (AHI≥15/hr) was 54%. The diagnostic characteristics of the symptomless SAGICNet for predicting the presence of OSA in the validation group were: sensitivity (Sens) = 0.75, specificity (Spec) = 0.58, positive predictive value (PPV) = 0.67, negative predictive value (NPV) = 0.67, +Likelihood ratio (+LR) = 1.78, -Likelihood ratio (-LR) = 0.43, and area under the receiver-operator-curve (AUC) = 0.734. For predicting the presence of severe OSA (AHI>30/hr), values in the validation group were: Sens = 0.35, Spec = 0.90, PPV = 0.64, NPV = 0.73, +LR = 3.49, -LR = 0.73, and AUC = 0.723.

Conclusion: The symptomless SAGICNet has a +LR comparable to previously reported tools using patient reported symptoms in predicting the presence of moderate OSA. It has high specificity (but low sensitivity) for predicting the presence of severe OSA. The symptomless SAGICNet may be a useful tool for identification of OSA risk in electronic medical records or databases for clinical and research purposes in the international setting.

Support (If Any):

0483

CLINICAL TRIAL ENROLLMENT ENRICHMENT IN RESOURCE-CONSTRAINED RESEARCH ENVIRONMENTS: MULTIVARIABLE APNEA PREDICTION INDEX (MAP) IN SCIP-PA TRIAL

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Introduction: The Multivariable Apnea Prediction Index (MAP) is a self-report, simplistic screening questionnaire for obstructive sleep apnea (OSA). The study objective was to determine the MAP predictive utility for enrollment enrichment in a clinical trial wherein enrollment was prior to OSA diagnosis by polysomnography (PSG) or home sleep test.

Methods: Secondary analysis of screening data (n=264) from a randomized, double-blind, pilot controlled trial of a positive airway pressure adherence intervention. Clinical sleep center patients with complete screening and PSG data were included. To determine diagnostic test accuracy of the MAP using apnea hypopnea index criterion (AHI) ≥10 (primary) and ≥5, ≥ 15, and ≥30 (secondary), sensitivity, specificity, negative and positive predictive values, likelihood positive and negative ratios and receiver operating curves were calculated. Predictive utility was also examined by characteristic variables.

Results: Participants were middle-aged (48.8±12.6 years), overweight or obese (94%) men and women (50.4%). Employing a MAP threshold of ≥ 0.5, sensitivity for OSA (AHI≥10) was 76.3%; specificity was 36.6% with area under curve (AUC) 0.56. In males, sensitivity was higher than in females (84.0%, 68.8%, respectively), whereas specificity in males was lower than in females (14.2%, 58.9%, respectively) with AUC 0.52 vs 0.65, respectively. In those with normal body mass index, MAP ≥0.5 had sensitivity of 100%, specificity 61.5%, and AUC=0.89. When MAP individual symptom screening items were examined, self-reported snoring (sensitivity, 76.3%; specificity, 47.3%; AUC=0.58) was equally predictive of OSA (AHI≥10). With varied AHI criteria (AHI≥5, AHI≥15, AHI≥30) overall predictive utility of MAP (≥0.5) was highest for any OSA (AHI≥5) and less discriminatory for moderate and severe OSA.

Conclusion: In resource-constrained research environments, recruitment/enrollment is a high cost endeavor. Effective screening procedures confer cost-savings but must be well-aligned with study sampling criteria and clinical population characteristics. Screening for OSA with MAP is most accurate in non-obese adults and females.

Support (If Any): Supported by Award Number R00NR011173 (Sawyer AM, PI) from the National Institute of Nursing Research. Also supported by American Nurses Foundation and Sigma Theta Tau International (Sawyer AM, PI) and the American Sleep Apnea Association (sleep apnea educational materials).

0484

SENSITIVITY AND SPECIFICITY OF THE DUKE STRUCTURED INTERVIEW FOR SLEEP DISORDERS TO ASSESS SLEEP DISORDERED BREATHING

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Introduction: The Duke Structured Interview for Sleep Disorders (DSI) is a clinical semi-structured interview developed to assess sleep disorder symptoms according to both the International Classification of Sleep Disorders (ICSD) and the Diagnostic and Statistical Manual of Mental Disorders criteria. The DSI assesses obstructive sleep apnea (OSA) by 5 clinical symptoms consistent with ICSD-2 and ICSD-3 criteria: loud snoring; gasping/choking in sleep; breathing interruption in sleep; holding your breath while sleeping; and poor, unrefreshing sleep even after an adequate night's sleep. To our knowledge, few studies have compared psychometric properties of the ICSD criteria to actual objective sleep indices. The current study evaluated the DSI in identifying OSA as compared to the ambulatory Apnealink device.

Methods: Participants were interviewed with the DSI at an in-person screening visit, and excluded for narcolepsy, periodic limb movements, and insomnia due to a medical or substance abuse disorder. If

not excluded, participants subsequently wore the Apnealink at home for one night to screen for OSA (N=42). The Apnealink apnea-hypopnea index (AHI) cutoff was ≥ 15 per hour for OSA. Sensitivity, specificity and the Receiver Operating Characteristic (ROC) curve were constructed comparing the Apnealink and DSI for OSA. All interviewers on DSI were judged as competent raters by a certified behavioral sleep medicine specialist. Approximately 67% of participants were female with mean age 43.8 years (Std. dev.=10.1, min=25.9, max=59.4). Mean AHI was 7.6 (Std. dev.=11.5, min=0, max=61).

Results: A total of 5 subjects were classified as having OSA by the AHI criteria while 10 subjects were classified as having OSA by the DSI tool, and none were classified as having OSA by both methods. Sensitivity of the DSI was 0% and Specificity was 72%, correctly classifying 64.3% of cases. The ROC area was 0.365 (95% CI =0.29 - 0.47).

Conclusion: The predictive ability of the DSI and ICSD subjective criteria alone for sleep apnea was minimal. The ICSD clinical criteria for sleep apnea should be improved to facilitate the identification of true positive cases for OSA. The DSI /ICSD criteria were more effective in identifying true negative cases

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0485

FEASIBILITY AND PREVALENCE OF HIGH RISK OBSTRUCTIVE SLEEP APNEA AND INSOMNIA ASCERTAINED BY STOP AND INSOMNIA SEVERITY INDEX IN NEUROLOGICAL DISORDERS: A NOVEL PRELIMINARY EXPERIENCE IN A TERTIARY CARE CENTER

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Introduction: Obstructive Sleep Apnea (OSA) and Insomnia are highly prevalent, however limited data exist using common sleep screening instruments in neurological patients. We evaluated the results of the STOP and Insomnia Severity Index (ISI) and report the prevalence of high risk OSA (h-OSA) and insomnia.

Methods: STOP and ISI were collected from March 2015-October 2016 at the first patient visit in Adult Psychiatry (AP), Neuro-restoration (NR), Cerebrovascular (CV), Brain Tumor (BT) and Epilepsy. STOP ≥2 was defined as h-OSA and ISI ≥15 as having insomnia. The association between h-OSA and insomnia and disease-specific outcomes including modified Rankin Scale (CV), UPDRS II scale (NR), ECOG and KPS (BT), Liverpool Seizure Severity Scale (LSSS) (Epilepsy), and PHQ-9 (all centers) was examined using multivariate logistic regression models.

Results: STOP and ISI were completed by 39.3% (R 31.3%-47.2%) and 43.2% (R- 34.1–50.5%) of 19086 new patients, respectively. Crude prevalence estimates for h-OSA and insomnia were 36.6% (R 29.5- 47.5%) and 25% (R 19.8–33.1%), respectively. After adjustment for demographic and clinical covariates, an increase of one in PHQ-9 (OR: 1.22, 95% CI: 1.20–1.24), UPDRS II (OR = 1.03; 95% CI: 1.01–1.05) and LSSS (OR = 1.02, 95% CI: 1.004–1.03) was associated with higher odds of insomnia. An increase in PHQ-9 resulted in 1.06 times higher odds of h-OSA (95% CI: 1.04–1.07). Comparing centers adjusted for covariates including PHQ-9, BT had 1.58 times higher odds of insomnia (95% CI: 1.25–2.00) compared to the reference AP. For h-OSA, all centers had significantly higher odds than AP; CV was associated with 1.91 times higher odds (95% CI: 1.59–2.30), Epilepsy 1.48 times higher odds (95% CI: 1.16–1.90), BT 1.43 times higher odds (95% CI: 1.16–1.75), and NR 1.23 times higher odds (95% CI: 1.05–1.45).

Conclusion: h-OSA and insomnia are highly prevalent in neurological patients. Routine screening is recommended.

Support (If Any): We acknowledge the Knowledge Program Data Registry of Cleveland Clinic, Cleveland, OH for providing the data used in this analysis and the Cleveland Clinic Neurological Institute Center for Outcome Research and Evaluation (NICORE) Scholar Award to Harneet Walia and the NICORE for providing biostatistical support.

0486

PROCESS IMPROVEMENT INITIATIVE TO INCREASE RECOGNITION OF OBSTRUCTIVE SLEEP APNEA (OSA) IN THE PRIMARY CARE SETTING

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Introduction: Obstructive sleep apnea (OSA) is the most prevalent and easily treated sleep-breathing disturbance affecting 24% of men and 9% of women in the general population yet it is under diagnosed. This initiative will use the STOP-Bang questionnaire (SBQ) and educational sessions to increase appropriate referral of patients at risk of intermediate to severe OSA for sleep study by 30% in our primary care setting.

Methods: This quality improvement (QI) project was conducted at the outpatient internal medicine clinic at a suburban tertiary academic teaching hospital. The interdisciplinary team consisted of a pulmonary critical care attending physician, internal medicine (IM) attending physicians, a quality specialist, office receptionists, and IM house staff.

Intervention/ Strategy for change: A process was developed to incorporate the SBQ tool as part of the patient's yearly physical visit. Patients would fill out the SBQ in the waiting room and present it to the physician during their annual visit to facilitate appropriate detection of intermediate-high risk of OSA. The process for implementation of SBQ was carried out using a series of Plan Do Study Act (PDSA) cycles. *PDSA cycle #1* included adoption of SBQ screening tool. *PDSA cycle #2*: involved education on evidence based practices and the utility of SBQ. *PDSA cycle #3* included 1:1 provider engagement, detailed education on the use of the SBQ form and use of visual reminder tools.

Measurement of improvement: The primary outcome measure was the percent of patients at intermediate-high risk for severe OSA who were appropriately referred to the sleep center.

Results: *Effects of changes:* After implementation of SBQ and a series of education, the percent of appropriate referral for sleep evaluation improved by 33% (12% to 18.8%) compared to baseline data.

Conclusion: In our population, the percent of patients at intermediate-high risk for severe OSA who were appropriately referred to the sleep center improved following introduction of the SBQ screening tool and educational sessions.

Support (If Any): Conflicts of interest--None

0487

WHAT SYMPTOMS MOTIVATE FAMILY MEDICINE PATIENTS TO PURSUE SLEEP APNEA SCREENING?

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Introduction: Obstructive sleep apnea (OSA) is difficult to identify, and studies suggest that patients are under-referred for screening from primary care. Here we look at what happens when consecutive family medicine patients are offered sleep apnea assessment: What symptoms seem to guide patients to pursue assessment? How many unrecognized cases can we find?
Methods: 295 adults over age 40 (174 women, 121 men) were recruited from two hospital family medicine clinics. None were previously assessed for sleep apnea. All completed questionnaires (Sleep Symptom Checklist (SSC), Sleep Questionnaire). Metabolic syndrome health data were collected from medical charts. All were offered an overnight polysomnography (PSG) study in a sleep laboratory. 171 (58%) completed the PSG study. Non-completers cited lack of interest (40%) and lack of time or desire to sleep away from home (18%). Completers and Non-Completers did not differ in mean age or gender ratio.
Results: Completers had a very high rate of diagnosed OSA: 80%. On self-report, Completers reported greater severity of daytime symptoms (e.g., non-refreshed in the morning, difficulty with concentration) than Non-completers. Metabolic syndrome disease was present in both groups: 59% of Non-completers had at least one of hypertension, hyperlipidemia, diabetes, or obesity and 46% of Completers. The difference was not significant. No significant differences were found between Completers and Non-Completers on severity of insomnia, sleep disorder, or psychological symptoms.
Conclusion: Family medicine patients over age 40 who were willing to complete an overnight PSG study differed in self-reported symptom severity from Non-completers primarily in daytime symptoms. Metabolic syndrome, which is strongly associated with OSA, was at least as frequent in the Non-completers as in Completers. Taken together, these data suggest that (1) Completers may be motivated by their negative daytime experience to pursue sleep testing and that (2) an important percentage of Non-completers likely have OSA.
Support (If Any): CIHR

0488

CAN INDIVIDUAL QUESTIONS OF EPWORTH SLEEPINESS SCALE PREDICT THE DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA?: A RETROSPECTIVE STUDY

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Introduction: Sleep disorders that are encountered at the level of primary health care providers may either unrecognized or under-estimated. Several factors like time constraints of clinic visit, lengthy questionnaires, and poor knowledge about sleep disorders limit in referring symptomatic patients to the sleep specialists. Of the many available tools, the Epworth Sleepiness Scale score (ESS) is widely used for assessing patients with daytime sleepiness. So we aim to see if there are any specific questions of ESS have the high probability for the Obstructive sleep apnea (OSA). This may be very helpful in daily clinical practice in primary care setting in evaluating the patients
Methods: A retrospective chart review of patients who attended the Sleep Disorder Clinic at University Hospital at Columbia, Missouri from the year July 2015 to October 2016. The patients screened for daytime sleepiness with ESS and who were subsequently confirmed to have OSA were included in the study. The significance for the individual scores obtained for these patients on 8 questions of ESS were reviewed and analyzed for the high probability in diagnosis OSA using Pearson Chi-Square test.
Results: The study population included 15 males and 15 females with mean ± SD age of 57.41 ± 13.22.There was no significance in individual questions of ESS -1) Sitting and reading (p=0.75) 2) watching T.V (p=0.24) 3) Sitting, inactive in a public place (p=0.33) 4) As a passenger in a car for an hour without a break (p=0.72) 5) Lying down to rest when circumstances permit (p=0.77) 6) Sitting and talking to someone (p=0.41) 7) Sitting quietly after lunch without alcohol (0.33). 8) In a car, while stopped for a few minutes in the traffic (p=0.08).
Conclusion: The score of individual questions have no probability that directs for OSA, however there is a rising trend for the question chance of dozing in a car, while stopped for traffic. A larger sample is needed to identify this specific question of ESS for the high probability of predicting OSA.
Support (If Any): Additional data is being collected to analyze the negative predictive value of individual questions of ESS in ruling out OSA.

0489

ASSESSMENT OF BERLIN QUESTIONNAIRE AND NECK CIRCUMFERENCE FOR SLEEP DISORDERED BREATHING IN JAPANESE SHIFT-WORKER

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Introduction: The Berlin Questionnaire (BQ) has been used to identify worker at high risk for sleep-disordered breathing (SDB) in a variety of populations. However, there are few data regarding the validity of the BQ in detecting the presence of SDB in Japanese worker. Neck circumference has been suggested to be more predictive of obstructive sleep apnea than general obesity, but the statistical validity of this conclusion has been remained. A study was undertaken to assess SDB by BQ and neck circumference in Japanese shift-worker.
Methods: We studied 161 workers (165 male 49.0 ± 9.1 yrs. and 25 female 51.1 ± 7.7 yrs.) who were measured 3% oxygen desaturation index (3%ODI) using pulse oximetry to assess SDB. Multiple domains of self-reported sleep ware assessed. Body mass index, neck circumference. SDB was defined as moderate (3%ODI≥15) and severe (3%ODI≥30).
Results: The proportion with 3%ODI≥15, 30 was 30.0% and 8.1%. BQ high score(≥2) was 45.4%. Using a BQ score to assess 3%ODI≥15, the sensitivity, specificity and AUC (95%CI) were 0.35, 0.77 and 0.51(0.30–0.72) in male and 1.0, 0.67 and 0.67 in female. Using a BQ score to assess 3%ODI≥30, the sensitivity, specificity and AUC were 0.75, 0.50 and 0.65(0.32–0.99) in male and 1.0, 1.0 and1 in female (only 1 female). Of neck circumference, severe SDB was 42cm(threshold),the sensitivity, specificity and AUC were 0.57, 0.83 and 0.74(0.60–0.89) in male and 40cm, 0.87,1.0 and 0.87 in female. Moderate SDB show 41.5cm(threshold), the sensitivity, specificity and AUC were 0.59, 0.59 and 0.61(0.60–0.89) in male and 37cm, 0.63,0.8and 0.71(0.44–0.98). Using BMI to predict severe SDB, the sensitivity, specificity and AUC were 0.45, 0.59 and 0.58 in male and 0.52, 1.0 and 0.52 in female.
Conclusion: The BQ performed with poor sensitivity and the specificity in SDB, suggesting that the BQ is not ideal in identifying SDB

in Japanese shift-worker. This study demonstrated that neck circumference may be more useful as a predictor of SDB than general obesity.
Support (If Any):

0490

UTILITY OF TYPE 3 PORTABLE MONITORING FOR DIAGNOSIS OF SLEEP APNEA IN ACUTE DECOMPENSATED HEART FAILURE

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Introduction: Sleep-disordered breathing (SDB) is a highly prevalent condition affecting up to 70% of patients with congestive heart failure (CHF). Treatment of SDB in CHF has been shown to improve LV function and transplant-free survival. Unfortunately, 80–90% of CHF patients with SDB remain undiagnosed. Portable sleep monitoring has significantly reduced the inconvenience of diagnosing SDB and may be of value in diagnosing SDB in patients admitted for acute decompensated heart failure (ADHF). The overall objective of this study was to examine whether type 3 portable monitoring can be used for diagnosis SDB in patients with ADHF.
Methods: A cross-sectional study of patients admitted with ADHF to the general medicine and heart failure services at the Johns Hopkins Medical Institutions was conducted. A full-montage unattended polysomnogram (type 2) was conducted using the MPR sleep monitor (Natus Medical; San Carlos, CA). Concurrently, a type 3 portable monitor (Apnealink Plus;Resmed) was used on the same night to collect data on oximetry, nasal airflow, and effort. Scoring of the sleep data from both portable monitors (type 2 and 3) was conducted in a blinded fashion according to standard criteria using 3% and 4% oxyhemoglobin desaturation for defining hypopneas. Agreement between the two monitors was assessed using Pearson's correlation coefficient and Bland-Altman analysis.
Results: The study sample consisted of 43 patients with ADHF and a mean age of 58.9 years (SD: 11.6). Men constituted 55.8% of the sample. The average apnea-hypopnea index (AHI) was 34.5 events/hr (Range: 2.5–92.8). The correlation between the oxygen desaturation index (ODI) between the type 2 and 3 portable monitors was high ($r=0.88$, $p<0.001$). Similarly, the overall AHI values derived from the two portable monitors were also highly correlated ($r=0.74$, $p<0.001$). Comparison of the obstructive and central AHI values from the two portable monitors revealed a high level of agreement.
Conclusion: Severity of SDB and assessing the distribution of events are comparable when comparing type 2 and 3 portable monitors in patients admitted with ADHF. Use of a type 3 portable monitor can identify SDB in a majority of patients with ADHF.
Support (If Any): The American Sleep Medicine Foundation.

0491

VALIDATION OF THE NOX-T_3 PORTABLE MONITOR FOR DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA IN CHINESE ADULTS

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Introduction: To evaluate the performance of a portable monitor (Nox-T_3, Nox Medical Inc. Reykjavik, Iceland) used to diagnose obstructive sleep apnea in Chinese adults.
Methods: Eighty Chinese adults (mean age 47.6 ± 14.0 years, 77.5% males, BMI 27.5 ± 5.4 kg/m2) performed an overnight, unattended home sleep test (HST) with the Nox-T_3 portable monitor followed by an overnight in-laboratory polysomnogram with simultaneous portable monitor recording. The portable monitor recordings were scored using automated analysis and then manually edited using different criteria for scoring hypopneas. Polysomnograms were scored based on recommended guidelines.
Results: When scoring of hypopneas required a ≥4% oxygen desaturation event, the mean apnea-hypopnea index (AHI) was 24.4 ± 20.8 events/hour on HST, 28.0 ± 22.9 events/hour on in-lab portable monitor recording, and 28.6 ± 23.9 events/hour on PSG ($p<0.0001$). Bland Altman analysis of AHI on PSG versus HST showed a mean difference (95% confidence interval) of -4.64 (-7.15, -2.13); limits of agreement (equal to ±2SD) was -26.62 to 17.35 events/hour. Based on a threshold of AHI≥5 events/hour, HST had 95% sensitivity, 69% specificity, 94% positive predictive value, and 75% negative predictive value compared to PSG gold-standard. Using an AHI≥15 events/hour, HST had 93% sensitivity, 85% specificity, 89% positive predictive value, and 91% negative predictive value. Closer agreements were present when comparing the simultaneous recordings. Similar results were obtained using different scoring criteria for hypopneas.
Conclusion: Despite known differences between HST and PSG, the results show close agreement between the two diagnostic tests in Chinese adults, especially when controlling for night-to-night variability and changes in sleeping environment.
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0492

COMPARING THREE HOME SLEEP APNEA TESTING DEVICES TO POLYSOMNOGRAPHY: SIMULTANEOUS AND MULTI-NIGHT ASSESSMENTS

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Introduction: While home sleep apnea testing (HSAT) is appropriate for diagnosing OSA, differences in device accuracy and optimal procedures are not well understood. This study compares three HSAT devices to polysomnography (PSG) to evaluate variations in results from different technologies and determine optimal number of study nights.
Methods: Consecutive patients referred to Kaiser Permanente Sleep Center (Fontana, CA) for suspected OSA and appropriate for HSAT were approached for enrollment. Participants wore three HSAT devices simultaneously for three nights: 1) Device N (Nox T-3; Nox Medical); Device A (ARES; SleepMed, Inc); Device W (WatchPAT, Itamar Medical). Nights 1 (N1) and 2 (N2) were performed at home; Night 3 (N3) was performed simultaneously with PSG. Sleep metrics and subjective experience were compared. Apnea-hypopnea index (AHI) scoring utilized the 4% desaturation definition (Medicare).
Results: 55 (27 men, 28 women; 45.1 ± 11.7 years) patients enrolled; 53 successfully completed N3 with PSG. HSAT versus PSG comparison (N3 only): AHI demonstrated strong agreements for all devices based on intraclass correlation (Device "N" R=0.96, "A" R=0.97, "W" R=0.93, $p<0.001$ for all) and Bland-Altman ("N" mean diff=0.34/2SD

19.3, "A" -3.9/19.3, "W" -4.2/30.9). Sensitivity/specificity of diagnosing OSA (AHI≥5 threshold) were "N" 92/69%; "A" 97/80%; "W" 97/62%, and diagnosing moderate-severe OSA (AHI≥15 threshold) were "N" 92/89%; "A" 87/96%; "W" 96/100%. Body position assessment varied significantly—%supine "N" R=0.91, "A" R=0.76, "W" R=0.60. Home HSAT comparison (N1 and N2): Study success rates were "N" 78%, "A" 96%, "W" 90%. Proportion of patients with at least 1 successful night were "N" 87%, "A" 98%, "W" 98%. Proportion of patients demonstrating overall/moderate-severe OSA (using higher AHI from either night) were "N" 78/51%, "A" 84/54%, "W" 78/49% demonstrating a higher diagnostic yield than PSG (N3) 70/47%. HSAT acceptance: Patient comfort/ease-of-use scores (visual analog scale 1–10) were "N" 8.1 ± 1.9/8.9 ± 1.5, "A" 5.1 ± 2.7/7.9 ± 2.1, "W" 7.4 ± 2.4/8.9 ± 1.5. Of the patients that responded to "Which device is preferred?", 24 (51%) selected "N", 23 (49%) selected "W" (none selected "A").

Conclusion: HSAT can be reliably utilized to diagnose OSA, although body-position data may be unreliable. Multi-night protocols may enhance success rates and diagnostic yield.

Support (If Any): None

0493

ARE SPLIT-NIGHT POLYSOMNOGRAMS APPROPRIATE FOR PATIENTS IN HIGH-RISK PROFESSIONS?

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Introduction: According to the AASM guidelines, split-night polysomnography (SN-PSG) is an acceptable alternative to full-night PSG (FN-PSG) and may be considered in patients who demonstrate an apnea-hypopnea index (AHI) ≥20/hr within the first two hours of the study. While the literature supports SN-PSGs as an accurate approximation of moderate-to-severe obstructive sleep apnea (OSA), there remains the potential to misclassify the severity of sleep disordered breathing utilizing this diagnostic modality. Risks associated with the misclassification of OSA severity may be significant in high-risk professions such as the military, pilots, and commercial drivers. The purpose of our study was to determine the accuracy of SN-PSGs in a cohort of high-risk professionals.

Methods: We conducted a retrospective review of active duty military service members undergoing FN-PSG. FN-PSG data (AHI, ARI, SpO2 nadir) were processed to obtain partial-night data for the first 2- and 3-hours of recording.

Results: Three-hundred consecutive patients were included in the study. Within our cohort, 79% were male with a mean age of 37.6 ± 8.4 years and mean BMI of 28.5 ± 3.3 kg/mm^2. Mean AHI for FN-PSG and 3-hour SN-PSG were 16.2 ± 17/hr and 16.7 ± 19/hr, respectively. Of our cohort, 112 patients (37%) would have qualified for a SN-PSG based upon the first 3-hour recording. Of those patients, 81 (72%) were appropriately classified as either moderate or severe OSA; however, 31 patients (28%) were misclassified. Of the 24 patients misclassified as moderate OSA on SN-PSG, 18 (75%) were observed to have mild OSA on FN-PSG while 6 patients (25%) demonstrate severe disease. Of the 7 patients misclassified as severe OSA on SN-PSG, all had moderate OSA on FN-PSG.

Conclusion: In our cohort, while there was general agreement between FN-PSG and SN-PSG, 3-hour SN-PSGs misclassified a significant portion of the cohort's severity of disease. This may be an important consideration when evaluating high-risk professionals.

Support (If Any):

0494

THE UTILITY OF HOME SLEEP APNEA TESTS IN PATIENTS WITH LOW VERSUS HIGH PRE-TEST PROBABILITY FOR MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA: EXPERIENCE IN A LARGE ACADEMIC SLEEP DISORDERS CENTER

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Introduction: Home sleep apnea tests (HSATs) are a cost-effective and convenient method to diagnose obstructive sleep apnea (OSA) in individuals with a high pre-test probability for moderate to severe OSA. However, insurance companies often mandate use in patients suspected of having OSA regardless of the pre-test probability for moderate to severe disease. Therefore, the utility of HSATs in individuals with varying degrees of pre-test probability for moderate to severe OSA must be assessed.

Methods: This is a retrospective study of all individuals who underwent HSAT after evaluation by a board-certified sleep disorders specialist from October 2013 to October 2014. Clinical characteristics were extracted from the electronic health record and included: the presence of loud snoring, tiredness, observed apneas or pauses in breathing, high blood pressure, BMI, age, neck circumference, gender, and ESS. Patients were characterized as high or low pre-test probability for moderate to severe OSA based on the presence of two affirmative answers on the STOP instrument plus either BMI >35 or male gender. In individuals with negative HSAT followed by polysomnogram (PSG), negative predictive value (NPV) was determined. Stepwise selection was used to assess which characteristics were most predictive of an HSAT diagnostic for OSA.

Results: 295 HSATs were evaluated (96 women). Pre-test probability could be determined in 196 subjects. 74 (38%) individuals had a low-pretest probability for moderate to severe OSA and 122 (62%) had a high-pretest probability. Individuals with a high pre-test probability for moderate to severe OSA had a 3.5 greater odds of positive HSAT (95% CI [1.78, 6.87], p=.0003). NPV of HSAT was 37.7%. The final logistic regression model (Wald X^2 =26.10, DF=4, p<.0001) demonstrated the following as most predictive of HSAT diagnostic for OSA: loud snoring (OR 3.47 95% CI [1.30–9.35]), age>50 (OR 3.10 95% CI [1.24–7.73]), large neck circumference (OR 11.50 95% CI [2.50–52.93]) and male gender (OR 3.58 95% CI [1.48–8.65]).

Conclusion: Despite insurer policy, HSAT should be reserved for individuals with high pre-test probability for moderate to severe OSA. NPV of HSAT is low in a heterogeneous population.

Support (If Any): None

0495

INTER-RATER VARIABILITY IN NOCTURNAL OXIMETRY INTERPRETATION

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Introduction: Overnight pulse oximetry is Level IV($S_0C_0O_3P_0E_0R_0$) monitoring used for prescription of oxygen and detection of sleep disordered breathing. Physicians are generally not formally trained in the interpretation of nocturnal oximetry, but are often asked to interpret them. We hypothesize that there is a variation in interpretation and their application of current guidelines for Medicare supplemental

oxygen prescription among pulmonary, critical care physicians and sleep specialists.

Methods: Pulmonary and critical physicians (fellows and attendings) at three academic institutions were asked to interpret five nocturnal pulse oximetry sample reports, chosen to reflect baseline desaturation, intermittent periodic desaturations and oximetry with artifacts. Inter-rater reliability for a recommendation for oxygen prescription and pre-test probability for sleep disordered breathing was calculated using statistical software.

Results: 29/40 physicians (15 fellows and 14 attendings including four with additional sleep certification) participated in the study (participation rate:73%). The overall inter-rater reliability for providing an oxygen prescription and suggesting the presence of sleep disordered breathing was poor (kappa statistic 0.121;95% CI: 0.054–0.227). Agreement among physicians did not improve significantly with increasing level of training (kappa for fellows:0.105;95%CI:0.020–0.238, attendings:0.119;95%CI:0.051–0.218). The inter-rater variability was fair among attendings with additional sleep certification but there was no statistically significant difference compared to attendings without sleep certification (kappa for sleep:0.289;95%CI:0.121–0.640 compared to non-sleep:0.095;95%CI:-0.014–0.182). Agreement was poor for the 10 attendings without sleep certification for both oxygen prescription (kappa 0.098;95%CI:-0.091–0.206) and suspicion of sleep disordered breathing (kappa0.055;95% CI:-0.049–0.206). The average percentage agreement among the four physicians with additional sleep certification was also poor at 53%. This finding however was in contrast to excellent average agreement among sleep specialists for suspicion of sleep disordered breathing at 90%.

Conclusion: There is considerable variation in impressions of the same overnight pulse oximetry tracings among pulmonary trainees and board certified attendings. While those with additional sleep certification may agree on suspicion of sleep disordered breathing, the agreement remains poor when it comes to suggesting a need for oxygen prescription. An algorithmic approach towards nocturnal oximetry report might be helpful in standardization of interpretation.

Support (If Any):

0496

CLASSIFICATION OF HYPOPNEA (OBSTRUCTIVE VERSUS CENTRAL) USING CHEST WALL EMG

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Introduction: Current AASM classification of hypopnea as obstructive (H-OB) is based on identification of flattening of inspiratory airflow, chest-abdominal paradox, or snoring. If none are present a hypopnea is classified as central (H-CEN). We hypothesized that surface chest wall EMG (CW-EMG, right 8th intercostal space), as a reflection of inspiratory effort, would be useful for hypopnea classification and AASM criteria validation.

Methods: 25 Consecutive adult positive airway pressure (PAP) titration studies with at least 10 hypopneas (including 3 putative central hypopneas) and an adequate CW-EMG signal were analyzed. The EMG signal was processed to remove ECG artifact, rectified and integrated. The integrated EMG signal (EF) was used to reflect effort. Five randomly chosen hypopneas from each patient were analyzed. An observer blind to CW-EMG and EF signals classified the hypopneas as OB or CEN based on AASM criteria. Inspiratory deflections in PAP flow (F) and EF were scaled based on pre-event breathing and a resistance (RES = EF/F) was calculated (pre-event breath RES = 1). An average RES for breaths in the first and second half of the hypopneas was calculated (odd number of breaths, middle breath included in both halves). The same observer classified hypopneas based ONLY on the smoothed flow (eliminating flattening), EF signal, and RES values. The two classifications (AASM and EF) were compared.

Results: Events by AASM criteria: 68 H-OB and 32 H-CEN. The RES 1st half event (mean ± SD) was OB: 3.6 ± 3.4 versus CEN: 1.24 ± 0.7, $P < 0.001$ and 2nd half event was OB: 9.2 ± 8.0 versus CEN: 1.35 ± 0.7, $P < 0.001$. The RES ratio (RES 2nd /RES 1st half hypopnea) was OB: 3.3 ± 3.3 versus CEN 1.15 ± 0.3, $P< 0.001$. Agreement AASM/EF classifications: Kappa= 0.76, % agreement 89%.

Conclusion: OB hypopneas had a greater resistance in both halves of the event than CEN hypopneas and the second half a larger relative RES (2^{nd} half/1^{st} half). There was good agreement between classification based on EF and AASM criteria. CW-EMG may be useful to classify hypopneas as obstructive or central.

Support (If Any): None

0497

IMPROVED RELIABILITY DETERMINATION FOR SLEEP STUDY SCORING USING AN EVENT-MATCHING PROCEDURE WITHIN EPOCHS IN A LARGE SCORING COMMUNITY

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Introduction: Inter-rater reliability [IRR] of sleep scoring is currently based on AASM guidelines stipulating the use of percent agreement comparisons of event counts at the gross epoch level, irrespective of within-epoch event matching, precluding identifying errors as omissions or commissions. The present study compares a new reliability system based on computerized within-event event matching against the current standard on an epoch-wise basis in an apples-to-apples comparison. The hypothesis is that the new method would show the current standard was less reliable then normally assumed.

Methods: In routine quarterly reliability testing, 50 sleep technologists scored 201 epochs from each of 9 selected polysomnograms for apneas, hypopneas, leg movements, and arousals, as compared to a physician(CR) gold-standard scorer. An event-matching protocol determined whether events were closely matched. Total and event-matched counts per epoch for each scored epoch were compared to the gold standard scorer using McNemar's test with Obuchowski cluster-adjustments.. The new method also separated omission errors from commission errors.

Results: In no case was reliability better in the standard method compared to the new method. Over all the within-epoch events, discordance between methods was observed in at least 1 epoch for 32.2% of studies. Apnea events showed no discordance, but 14.8% of studies had overall hypopnea discordances. Agreement rates differed in 4 of 9 PSGs (p&It0.05) for hypopneas, 6 of those ($p<0.01$) for arousals, and 1 of those ($p=0.04$) for limb movements. Descriptively, 12.4% of epochs showed an omission error for at least one event, and 7.9% showed a commission error, with some scorers varying in relative rates in the kinds of error made.

Conclusion: The event-matching method documented a key methodological flaw in the current AASM-standard approach that relies only on within-epoch event counting using percent agreements for documenting inter-scorer reliability. The new method improves reliability discrimination while producing output that will give more actionable feedback to scorers about kinds and locations of errors in their scored records, compared to a standard scorer.

Support (If Any): none

0498

ASSOCIATION BETWEEN NOCTURNAL INTERMITTENT HYPOXIA AND ACTIGRAPHIC SLEEP QUALITY BETWEEN NOCTURNAL INTERMITTENT HYPOXIA AND ACTIGRAPHIC SLEEP QUALITY

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Introduction: Intermittent hypoxia at night is an important element of sleep disordered breathing. The purpose of the present study is to clarify the association between nocturnal intermittent hypoxia and objectively measured sleep quality using actigraph.
Methods: For the present study, we recruited 313 participants aged 40 years and over. We conducted an overnight pulse oximetry at home, and assessed nocturnal intermittent hypoxia using 3% oxygen desaturation index (3%ODI). Physical activity was objectively measured using actigraph worn on the non-dominant arm for 7 nights. Based on the self-reported bed time and the rising time, total sleep time (TST), sleep efficiency (SE), and wake after sleep onset (WASO) were calculated for each day, and the mean value was used for analysis.
Results: The mean age of 313 participants was 66.3 (SD: 9.5) years and 128 (41%) were male. Compared with the lowest tertile group of 3%ODI (T1: <5.9, n=103), the highest tertile group (T3: 3%ODI ≥10, n=105) showed similar TST (389 min vs. 388.9 min P= 0.99), significantly lower SE (87.2% vs. 82.1%, P<0.01), and significantly higher WASO (51.2 min vs. 79.5 min, P<0.01). After adjusting for age, gender and body mass index, T3 showed lower SE by 4.48% (95% Confidence Interval: 1.94 to 7.02), and longer WASO by 22.6 min (95%CI: 9.5 to 35.7) than T1.
Conclusion: We found significant association between nocturnal intermittent hypoxia and actigraphic sleep quality independent of obesity.
Support (If Any):

0499

COMPARISON OF AASM AND CMS AHIS

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Introduction: Centers for Medicare and Medicaid Services (CMS) and American Academy of Sleep Medicine (AASM) have different guidelines for scoring respiratory events. To evaluate if there is a significant difference between AASM and CMS AHI (Apnea Hypopnea Index), both scoring criteria were analyzed and compared
Methods: Thirty five patients with sleep apnea who had AASM and CMS scoring during diagnostic and treatment portion of the Polysomnography (PSG). There were 27 females and 8 males. Mean age for the female group was 60.4 (sd =13.1). Mean age for men was 59.8 (sd=16). ESS Reviewed.
Results: Mean difference between AASM and CMS AHI was 17.8 (95% confidence limits 14.4–21.3, p<.001, paired t-test).
Conclusion: The AASM AHI was significantly greater than the CMS AHI. Use of CMS AHI may lead to under scoring of respiratory events. Though there may be a statistical significance in the AHIs, clinical significance and outcome is yet to be determined.
Support (If Any): N/A

0500

STOPBANG QUESTIONNAIRE CORRECTLY DETECTS THE ABSENCE OF OBSTRUCTIVE SLEEP APNEA IN THE FIRST TRIMESTER OF PREGNANCY

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Introduction: Sleep disordered breathing (SDB) is a common occurrence in pregnancy but data assessing the performance of screening tools are scarce in this population. The performance of screening questionnaires may also vary by the stage of pregnancy. The aim of this study was to examine progression of SDB and daytime sleepiness around conception and assess the ability of the STOPBANG and Epworth Sleepiness Scale (ESS) questionnaires to detect obstructive sleep apnea (OSA) in the first trimester of pregnancy.
Methods: Women with obesity in the first trimester of a singleton pregnancy were recruited. Participants answered sleep questionnaires (STOPBANG and ESS) regarding current symptoms that occurred since conception (c-) and symptoms that were present prior to pregnancy (pre-). Participants also underwent a level III home sleep apnea test. Sleep apnea was defined as apnea hypopnea index (AHI) ≥5 events per hour and hypopnea defined based on 3% oxygen desaturation. Descriptive statistics, Pearson's correlation coefficient, non-paired t-test, and sensitivity and specificity analyses were performed.
Results: A total of 105 women were recruited. Mean age was 29 ± 6; mean BMI was 34.3 ± 8. Thirty percent of women were nulliparous, 10% had pre-gestational hypertension and 2% had pre-gestational diabetes. Mean gestational age at enrollment was 10.5 ± 2 weeks. Eighteen percent of women had OSA. Pre- and c-STOPBANG, correlated strongly (r=0.86, p<0.05), and so did pre-ESS and c-ESS (r=0.80, p<0.05). However, average scores were significantly higher in the 1st trimester (STOPBANG 2.32 ± 1.1 vs. 2.14 ± 1.1, p=0.009, ESS 11 ± 5.3 vs. 8 ± 5.1, p<0.0001) compared to pre-conception. C-STOPBANG and pre-ESS scores were significantly associated with OSA diagnosis (p=0.003 and p=0.03, respectively). Specificity of both pre and c-STOPBANG was 97.5% whereas sensitivity was <17%. Sensitivity of pre-ESS scores was 61% but specificity was poor for both pre- and c-ESS scores.
Conclusion: The STOPBANG questionnaire demonstrated good ability to correctly detect patients without a diagnosis of OSA but limited ability to identify patients with OSA. Symptoms of sleep-disordered breathing and daytime sleepiness worsen as early as the first trimester of pregnancy compared to preconception.
Support (If Any): NICHD 5R01HD078515-03

0501

ASSOCIATION BETWEEN SLEEP-RELATED SYMPTOMS AND RESPIRATORY DISTURBANCE INDEX AMONG COMMUNITY-DWELLING SCHOOL CHILDREN

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Introduction: Symptoms of snoring, trouble breathing, un-refreshed (STBUR) were associated with perioperative respiratory adverse event in children (Tait AR et al.,2013). However, the association between STBUR and sleep disordered breathing among community dwelling school children in Japan is to be elucidated.
Methods: A questionnaire was delivered to care-givers of the whole primary school children in a city (26,599) via the schools, and their

response was collected unanimously by teachers. High risk children for sleep apnea were identified using apnea-associated symptoms related either to sleeping, anxiety, attention deficiency or emotional behavior. The participants whose information was not available were omitted from the analysis. Uni-variable and multivariable regression and logistic analyses were conducted, using SAS version 9.0 software.
Results: More than 90% of care-givers responded to the questionnaire, and 75% of them revealed the STBUR score of 0, while 0.3% did STBUR score of 3 or greater. Mostly 1,800 pupils were regarded as having higher risk for sleep apnea, and thus invited for detailed examination. Data from around 700 participants were available for the subsequent analysis. The prevalence of severe sleep apnea (RDI = 5 or over) was 0.9% in those with STBUR scores of 0, 3.0% with STBUR scores of 1, 6.4% with STBUR scores of 2, and 13.3 with STBUR scores of 3, 4, and 5. According to multivariable logistic analysis odds ratio (95% confidence interval) vs STBURN score 0 were 3.54 (0.76 to 16.64) in STBURN score 1, those STBURN score 2 were 8.10 (1.71 to 38.40) after adjusted with grade, attention deficiency, hyper dyskinesia, while those of STBURN score 2 were 19.61 (3.33 to 115.47) after adjusted with grade, attention deficiency, hyper dyskinesia (p trend <.0001).
Conclusion: STBUR scores and RDI values were associated, suggesting that high STBUR score (3 or over) well predicts sleep apnea (5/hr<RDI).
Support (If Any):

0502

RELATIONSHIP BETWEEN ANTHROPOMETRIC PARAMETERS AND OBSTRUCTIVE SLEEP APNEA IN SCHOOL AGE CHILDREN

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Introduction: Pediatric obstructive sleep apnea (OSA) is more common in obese children. However, the role of fat distribution in the pathogenesis of OSA in this age group is controversial. We evaluated the association of OSA to excess adiposity and abdominal fat. We hypothesized a positive correlation between anthropometric parameters and OSA and an inverse correlation between obesity and the oxyhemoglobin saturation (SpO2) nadir in a large sample of school-aged children with OSA.
Methods: We investigated the baseline data from the childhood adenotonsillectomy trial (CHAT). The relationship between apnea hypopnea index (AHI), SpO2 nadir, peak CO_2 during sleep and body-mass index Z-score (BMI z-score), waist:height ratio (WTHR) and neck:height ratio (NHR) was evaluated. AHI was evaluated using linear regression in log scale which improved its distribution towards normal. Other outcomes were evaluated using Spearman correlations.
Results: 452 children were analyzed (52% girls). The mean ± SD age was 7 ± 1.4years. The mean BMI Z-score was 0.8 ± 1.3. There was a positive correlation between log AHI and BMI Z-score (β=0.06, r=0.10, p=0.03) and WTHR; (β=1.00, r=0.10, p=0.03), and an inverse correlation between SpO2 nadir and BMI z-score (r=-0.19, p=0.00005), and WTHR (r=-0.17, p=0.0002) and NHR (r=-0.12, p=0.008). When corrected for multiple comparisons, there remained an inverse correlation between SpO2 nadir and BMI z-score and SpO2 nadir and WTHR.
Conclusion: BMI Z-score and WTHR, an index of visceral fat, correlate with the degree of desaturation during sleep in school-age children. However, in contrast to adults, anthropometric measures do not correlate with indices of upper airway obstruction such as the AHI. We speculate that restrictive lung disease and a lower pulmonary reserve in obese children predisposes to deeper oxyhemoglobin desaturation with obstructive events.
Support (If Any): Funded by the National Institutes of Health; CHAT ClinicalTrials.gov number, NCT00560859.

0503

EXERCISE PRACTICE IS INDEPENDENTLY ASSOCIATED WITH PERCEIVED SLEEP QUALITY, BUT NOT SLEEPINESS IN SEVERE OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: Obstructive sleep apnea (OSA) patients may be asymptomatic. Regular exercise improves the sense of well-being and may alleviate OSA symptoms. In the present study we investigated in severe OSA patients whether exercise is associated with better sleep quality and milder symptoms.
Methods: Subjects answered the International Physical Activity Questionnaire and were then classified as exercisers or non-exercisers. Additional questionnaires about sleep-related symptoms were applied before undergoing full-night polysomnography. Only subjects with apnea-hypopnea index (AHI)>30 events/hour were included. Sleepiness was assessed by the Epworth scale, tiredness by one question of the STOP questionnaire, sleep misperception by the question: "Do you wake-up feeling like you had not slept?", and "Rate from 0 to 10 the quality of your sleep."; scores <5 indicated poor sleep.
Results: We included 488 exercisers (35%) and 907 non-exercisers, 81% men. The mean (±SD) age was 49 ± 14 years, body mass index, 33 ± 6.9kg/m^2, and AHI, 53 ± 20 events/hour. Exercisers and non-exercisers were significantly different in terms of anthropometric, polysomnographic, and perceived-sleep variables. Exercisers had lower AHI (48 ± 17 vs. 56 ± 21 events/hour), snoring score, time with saturation below 90% (36 ± 43 vs. 50 ± 52 minutes), and higher minimum saturation (77 ± 9 vs. 75 ± 10%; P<0.001 for all comparisons). Exercisers had also lower tiredness, poor sleep, and sleep misperception. The Epworth sleepiness scale score was also lower in exercisers (P=0.002) but did not resist adjustment for confounders. Exercise practice was associated with ~30% lower odds ratio for tiredness, poor sleep, and sleep misperception after full adjustment.
Conclusion: About one third of severe OSA cases perform programed exercise contrary to the expectation of generalized sedentarism in this population. Exercise is independently associated with better perceived sleep quality and less tiredness. This finding should be taken in consideration when employing symptom-based scores to assess OSA risk in exercisers since they are more likely to be asymptomatic.
Support (If Any): Nothing to declare.

0504

EFFECT OF AGE ON CLINICAL AND POLYSOMNOGRAPHIC CHARACTERISTICS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA SYNDROME (OSAS)

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Introduction: There is limited data on clinical and polysomnographic characteristics in patients with obstructive sleep apnea syndrome (OSAS) in different age groups. We aimed to investigate possible

influence of age on sleep architecture and daytime sleepiness in a large sample of OSAS patients.
Methods: We enrolled 2399 patients with OSAS (apnea-hypopnea index, AHI ≥ 5) divided into two age groups: over 65 (n = 1180, mean age 70.2±4.5 years), and 65 or under (n = 1219, mean age 50.1, ± 10.9 years). Subjective daytime sleepiness, reflected by the Epworth sleepiness scale (ESS), and polysomnographic parameters were recorded and compared between the two groups.
Results: There were no significantly differences regarding gender, BMI, daytime sleepiness (31.9% vs 46.7% had ESS>10) between the elderly and younger patients with OSAS, but the incidence of comorbidities such as hypertension and other cardiovascular diseases was significantly higher ($p<0.001$). The sleep architecture was significantly worse in elderly OSAS patients with lower SE (%) ($p<0.001$), REM (%) ($p<0.001$), and higher NREM (%) and WASO ($p<0.001$) compared with the younger patients. The percentage of SWS, apnea hypopnea index (AHI), and oxygen desaturaion index (ODI) had no significantly difference in the two groups. The mean and the lowest oxygen saturation and arousal index were significantly decreased in elderly OSAS patients ($p<0.001$).
Conclusion: Our results suggest that objective sleep quality was more impaired in elderly compared to younger-aged patients. Additionally the prevalence of sleepiness in the elderly group was low and elderly had more cardiovascular comorbitities.
Support (If Any): None

0505

SLEEP APNEA BREATHING DISTURBANCES ARE ASSOCIATED WITH OBJECTIVE SLEEPINESS INDEPENDENT OF HYPOXIA

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Introduction: Sleep-disordered breathing (SDB) is associated with sleepiness, high blood pressure, and cardiovascular events. Cardiovascular associations have been linked to oxygen desaturation. Less is known regarding SDB associations with sleepiness. Different physiologic associations (e.g. arousal vs desaturation) of SDB events may result in different pathobiologic outcomes.
Methods: 2,112 nocturnal polysomnograms (PSGs) from 1,022 subjects in the Wisconsin Sleep Cohort were analyzed with our automated algorithm, which was developed to detect breathing disturbances (decrease of 30% in nasal airflow for at least 10 seconds, without a concomitant increase in oral flow) and desaturations. Breathing disturbance events were time-locked to desaturations, resulting in 2 indices: desaturating (H-BDI) and non-desaturating (NH-BDI) events. Systolic and/or diastolic hypertension was used as a measure of cardiovascular health. Measures of subjective (Epworth Sleepiness Scale) and objective (2,981 MSLTs from a subset of 865 subjects) sleepiness were analyzed. Additional, clinically relevant variables were accounted for in modeling associations.
Results: H-BDI, but not NH-BDI, correlated strongly with SDB severity indices that included hypoxia ($r\geq0.89$, $p\leq0.001$ with ODI 3% and AHI with 4%-desaturations). Each twofold increase in desaturation-associated events was associated with an increased risk of hypertension (3% ODI OR=1.06, 95% CI=1.00–1.12, $p<0.05$) and daytime sleepiness ($\beta=0.20$ ESS score, $p<0.0001$; $\beta=-0.20$ min in MSL on MSLT, $p<0.01$). Non-desaturating events were more strongly associated with objective sleepiness ($\beta=-0.52$ min in MSL on MSLT, $p<0.001$), but had less association with subjective sleepiness ($\beta=0.12$ ESS score, $p=0.10$). In longitudinal analyses, severity of baseline non-desaturating events was independently associated with worsening of 3% ODI over a 4-year follow up.
Conclusion: In SDB, non-desaturating events are independently associated with objective daytime sleepiness, beyond the effect of desaturating events. The independent association of baseline non-desaturating breathing disturbances with a future worsening of desaturating suggests that non-desaturating events reflect a milder form of SDB.
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0506

FALLING ASLEEP VERSUS FEELING SLEEPY IN SLEEP APNEA SCREENING

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Introduction: The symptom of sleepiness can be assessed by different methods such as the multiple sleep latency test, the maintenance of wakefulness test and the Epworth sleepiness scale (ESS), each one contemplating different dimensions of sleepiness. ESS, for instance, assesses the propensity to falling asleep in soporific situations. The ESS correlates weakly with the apnea-hypopnea index (AHI) and is a poor predictor of obstructive sleep apnea (OSA). We performed a retrospective cross-sectional study to test whether a single question on perceiving oneself as sleepy can replace the ESS to detect different levels of AHI.
Methods: From a sleep laboratory database we selected records of adults that underwent baseline in-laboratory full-night polysomnography performed with standard equipment and scored using AASM criteria. All subjects replied to the following question: "Do you consider yourself sleepier than other people?" and answered the ESS.
Results: Exactly 3785 patients were included; 63% were men, the mean (±SD) age was 44±13 years, body mass index (BMI), 29.6±5.9kg/m^2, and AHI, 22.4±23.7 events/hour. ESS>10 was observed in 1381 (36.5%) patients; 1887 (49.9%) considered themselves sleepier than other people (Sleepier). Factor analysis indicates that this question remains in the same component as the eight ESS items. Sleepier and ESS>10 patients were significantly different in terms of anthropometric, polysomnographic, and perceived-sleep variables. The Sleepier group had AHI>5 in 72.9% of the cases; the ESS>10 group had AHI>5 in 72.3% of the cases. Those in the Sleepier group had AHI>30 in 32.3% of the cases; those in the ESS>10 group had AHI>30 in 23.7% of the cases. To detect AHI>30, being in the Sleepier group had a sensitivity of 73%, specificity of 46%, accuracy of 54%; having an ESS>10 had a sensitivity of 58%, specificity of 58%, accuracy of 58%.
Conclusion: Sleepiness is knowingly a poor predictor of OSA. In case of time limitation to obtain the ESS score, one question on self-perceived sleepiness will perform only slightly inferiorly to the ESS, in OSA screening. Feeling sleepy reproduces the same dimension

of the sleepiness symptom as falling asleep in soporific situations and can replace the ESS when necessary.
Support (If Any): -

0507

EFFECT ON RETRO-PALATAL AND RETRO-GLOSSAL DIMENSIONS WITH PRESSURE FORCING COMPARING TO HYPOGLOSSAL NERVE STIMULATION

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Introduction: The retro-palatal and retro-glossal regions are considered the most common collapsible regions of the upper airway. These regions are affected by the more selective active treatment- unilateral hypoglossal nerve stimulation (HNS)- as well as by CPAP, which improves patency using internal airway forces. The aim of this study was to compare volumetric effects on both regions induced by HNS vs. CPAP.
Methods: Seven adult patients (4M, 3F: age range 39 to 68 year) with moderate or severe OSA who had HNS (Inspire Medical Systems, Maple Grove, MN) had cone beam CT collected in the seated position during a) resting breathing, b) HNS, and c) CPAP pressures of +10 cmH2O applied by a full facemask. Sagittal slices were reconstructed from 3D volumes and linear measurements were performed in both regions. Reconstruction algorithms calculated volumes for the total upper airway.
Results: HNS significantly increased the retro-palatal and retro-glossal regions 29% (from 6.60 to 8.5 mm, p0.018) and 51 % (from 7.01 to 10.64 mm, p 0.018) respectively, with the total airway volume increasing 48% (from 29.5 to 43.6 cc p 0.02). A pressure of 10cmH2O produced increases the retro-palatal and retro-glossal regions 21% (from 6.60 to 8.04mm, p0.018) and 51 % (from 7.01to 10.62mm, p 0.018) respectively. With the total airway volume increasing +36% (from 29.5 to 37.8 cc p 0.02).
Conclusion: HNS and positive pressure have a similar effect on opening of the collapsible regions of the upper airway and total upper airway volume. Any difference between retro-palatal and retro-glossal regions with HNS appeared to parallel differences in airway compliance.
Support (If Any): VA Medical Service, University Hospitals Cleveland Medical Center, Inspire Medical Systems.

0508

SLEEP APNEA AND ATRIAL FIBRILLATION - PHENOTYPE AND OUTCOMES

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Introduction: Sleep apnea, especially central (CSA), is associated with atrial fibrillation (AF). We hypothesized that AF patients are at high risk for treatment-emergent/complex apnea, and residual disease during long-term therapy with positive airway pressure.
Methods: The sleep laboratory database at the Beth Israel Deaconess Medical center and affiliated services was queried, focusing on patients with AF, to extract polysomnographic information. The BIDMC Online Medical Records was used to collect co-morbid information. Residual apnea and related information was extracted from the EnocreAnywhere database; at the BIDMC, tracking is life-long, enabling assessment of outcomes beyond 6 months.
Results: Three hundred and eighteen patients had complete clinical/polysomnographic data, and 212 were reviewed in EncoreAnywhere. Split night was 31%. Summary statistics: age 68.3 ± 11.1 years, 69.1% male, BMI 33.6 ± 8 Kg/M2, ejection fraction 53.5 ± 10.8 (22% less than 50%), hypertension 68.6%. Baseline total sleep time (TST): 181.4 ± 116.3 minutes, sleep efficiency 62.9 ± 19.3 %, N1 24.3 ± 21.5% TST, N3: 9.7 ± 13.9 % TST, RDI: 39.4 ± 21.7, AHI4% 8.2 ± 11.9, minimum saturation 81.8 ± 10 %. Titration data: TST: 242 ± 98.9 minutes, sleep efficiency 66.9 ± 19.8 %, N1: 18 ± 15.2 %, RDI 27 ± 21.6, AHI4% 5 ± 8.5, minimum saturation 85.4 ± 6.9 %. CSA was noted in 4% on baseline, and treatment-emergent/complex apnea in 30%. The mean duration of use of positive airway pressure (93% continuous) was 21 ± 3 months, mean use 4.1 ± 2.1 hours. Residual AHI-flow was 11.6 ± 7.8 / hour of use, and periodic breathing of at least 10 minutes duration on visual waveforms inspection in 76.4 %.
Conclusion: Patients with AF have highly fragmented sleep during diagnostic and titration polysomnograms. Complex sleep apnea is common, as is residual sleep apnea and periodic breathing on waveforms. This likely reflects persistently elevated loop gain. AF patients with sleep apnea are at high risk for reduced treatment effectiveness, and may require a dedicated phenotype-driven clinical pathway for optimal management.
Support (If Any): Beth Israel Deaconess Medical Center Chief Academic Officer's Innovation Grant.

0509

IMPACT OF AUTOMATED WEB-EDUCATION AND CPAP TELE-MONITORING ON CPAP ADHERENCE AT 3 MONTHS AND 1 YEAR: THE TELE-OSA RANDOMIZED CLINICAL TRIAL

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Introduction: The Tele-OSA study is a 4-arm randomized clinical trial evaluating the impact of two telemedicine mechanisms (OSA web education [Emmi, Emmi Solutions Inc] and; CPAP tele-monitoring with automated patient feedback [U-Sleep; ResMed Corp]) on CPAP adherence.
Methods: This 4-arm randomized clinical trial was conducted at Kaiser Permanente sleep center (Fontana, CA) in patients referred for suspected OSA and appropriate for home sleep apnea testing; if indicated, CPAP was ordered with cellular connectivity. Patients were randomized into: 1) Traditional pathway (usual care)| 2) Education pathway (usual care + web education)| 3) Tele-monitoring pathway (usual care + automated patient feedback messaging via text/email/phone triggered by CPAP data)| 4) Both pathway (usual care + web education and tele-monitoring). CPAP adherence was compared at 3 months and 1 year.
Results: 556 patients were prescribed CPAP (58.5% males; mean age 50.5 ± 12.1, BMI 34.5 ± 7.7, AHI 31.9 ± 25.8). There were no differences in baseline characteristics among the four groups. 90-day CPAP compliance (Medicare) was: Traditional 53.5%| Education 60.7%| Tele-monitoring 65.6%| Both 73.2%. Both groups receiving tele-monitoring had significantly better CPAP use compared to Traditional (Tele-monitoring pathway $p=0.05$; Both $p<0.01$), while Education did not significantly impact CPAP use ($p=0.21$). Tele-monitoring improved usage without an increase in sleep provider intervention (Median number of encounters during this period was zero, and all means were ≤0.5).For tele-monitoring patients that stopped receiving auto-feedback messaging after 90 days, 1 year assessment showed gradual decline in adherence with use similar to the "No tele-monitoring patients" at month 12 (% days used, 48.5%±44.4% vs. 47.8%±43.7%; $p=0.88$). However, for tele-monitoring patients

randomly selected to continue the auto-feedback messaging indefinitely (n=73; 27.8%), higher CPAP use persisted through to month 12 with a trend towards significance (% days used, 58.4%±41.1% vs. 47.8%±43.7%; p=0.06).
Conclusion: CPAP tele-monitoring with automated patient feedback significantly improves adherence at 3 months without an increase in provider utilization. This study suggests that feedback messaging should be continued indefinitely for sustained effect. Telemedicine education did not impact adherence.
Support (If Any): ASMF Strategic Research Grant 104-SR-13 & ResMed Corp.

0510

USE OF A PERSONALIZED VIDEO TO ENHANCE PAP ADHERENCE: PRELIMINARY REPORT FROM A RANDOMIZED CLINICAL TRIAL

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Introduction: Positive Airway Pressure (PAP) is an effective treatment for Obstructive Sleep Apnea (OSA), but adherence to treatment is suboptimal. Since OSA occurs during sleep, poor adherence may be due to low perceived disease risk since patients never see themselves actively expressing the disorder. In our previous pilot work, we found that presenting patients a video of themselves during their diagnostic sleep study markedly enhanced their subsequent PAP adherence. The current report provides preliminary data from our ongoing randomized trial to replicate these findings.
Methods: Twenty-four newly diagnosed participants with moderate-severe OSA were randomized to receive education + personalized video (PVD, N=10), education + non-personalized video (NPV, N=8) or treatment as usual (TAU, N=6). The personalized video demonstrated that patient having several apneic episodes as well as the oxygen desaturations that co-occurred and then subsequently showed personalized sleep with PAP. The standard video explained what apnea is and why treatment is important, also demonstrating apnea through a non-personalized video. Both interventions lasted approximately 30 minutes each and were delivered a single time prior to the initiation of PAP therapy. PAP adherence measured by download data form PAP devices over the first 90 days of use served as the primary outcome measure.
Results: An 3 (treatment group) x time (90 days) ANOVA adjusted for age, educational level and baseline AHI showed a main effect for treatment group ($F(2, 1764) = 4.67$, $p = .02$). The PVD group (M = 6.5 hrs.) used their PAP devices over 2 hours per night longer than did the NPV (M = 4.1 hrs.) and TAU (M = 3.5 hrs.) across the 99-day time period examined.
Conclusion: Use of a PVD may enhance a patient's disease risk perception and, therefore, improve adherence to PAP therapy. These videos are available in most clinical settings and the intervention can be delivered in brief intervention sessions by line staff (sleep technologists; physician extenders, etc.) without significant training.
Support (If Any): Support: This research is being supported by the National Heart Lung and Blood Institute, Grant # R01 HL120693.

0511

SPOUSAL INVOLVEMENT IN ADHERENCE TO CPAP TREATMENT

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Introduction: Poor adherence to continuous positive airway pressure (CPAP) treatment has been the foremost obstacle in the effective management of obstructive sleep apnea (OSA). This study examined spousal involvement in CPAP treatment in a cohort of newly diagnosed OSA patients and their domestic partners. We hypothesized that spousal behaviors regarding CPAP would predict the level of CPAP use.
Methods: CPAP naïve OSA patients and their spouses were recruited and followed up for 3 months after treatment initiation. A validated tool with three subscales was used to evaluate spousal involvement in CPAP therapy: support (acted supportively in the use of CPAP), collaboration (helped solve a problem with CPAP, helped with the CPAP machine), and pressure (asked about using CPAP, tried to persuade to use CPAP, dropped hints about using CPAP). Both the patient and the spouse independently evaluated spousal involvement daily during the first week of therapy, and then at 1-, 2-, and 3-months after treatment initiation. CPAP adherence was objectively assessed as average daily use during the first 90 days.
Results: A total of 136 couples participated, including 7 same-sex couples, with the majority being male patients with female partners (67.6%). The couples were together an average of 20 years (range 1–55 years). Mean nightly CPAP use during the first 90 days was 4.9 ± 2.2 hours, with 66.9% using CPAP at least 4 hours per night. Assessed by the partner at 1-month after CPAP initiation and controlling for relevant demographic and clinical factors including patient self-efficacy, spousal pressure predicted lower overall CPAP adherence ($B=-0.716$, $p<0.001$), and spousal support predicted greater CPAP adherence ($B=0.620$, $p=0.002$). Similar relationships were observed when the spousal behaviors regarding CPAP were assessed at other time points, including during the first week and at 2-, and 3-months.
Conclusion: Our findings confirm the spouse plays an important role in CPAP adherence. Spousal involvement in CPAP therapy could have both positive and negative impacts on patient CPAP use. Future research is needed to design interventions that effectively engage partners to optimize CPAP adherence.
Support (If Any): This work was supported by the National Institutes of Health R15NR013274 (PI: Ye).

0512

RESIDUAL SLEEPINESS ON CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) THERAPY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA (OSA)

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Introduction: There are few large studies assessing factors associated with residual sleepiness on continuous positive airway

pressure (CPAP) therapy in patients with obstructive sleep apnea (OSA).

Methods: We evaluated the determinants of sleepiness, as measured by ESS score >10, after 6 months of CPAP therapy in patients with OSA in the Apnea Positive Pressure Long-term Efficacy Study (APPLES) cohort. We also assessed the predictors of residual sleepiness specifically in participants with good adherence to CPAP (>4 hours/night).

Results: Increased sleepiness was present in 49.1% of the 1105 APPLES study participants at baseline. Randomization to the CPAP group was associated with lower odds of sleepiness at 6-months compared to randomization to the sham group (OR=0.62, P= 0.04). After 6 months of CPAP therapy, 88 (22.3%) of the 394 participants in the CPAP group still had ESS >10. Lower hours of CPAP use and higher ESS scores at baseline were independently associated with higher 6-month ESS scores in a linear regression model. A logistic regression model showed lower odds of sleepiness in those using CPAP>4 hours a night (OR=0.42, P=0.001), and higher odds in those who were sleepy at baseline (OR=5.1, P<0.001). Women had lower odds of sleepiness than men (OR=0.58, P=0.049), the presence of chronic pain was associated with higher odds (OR=2.3, P=0.008) and the presence of depression was associated with a trend towards higher odds of sleepiness (OR=1.8, P=0.059).

The prevalence of ESS >10 was 18.1% (48/265) among those using CPAP >4 hours a night. Those with sleepiness (ESS>10) at baseline still had significantly higher odds (OR 8.2, P<0.001) of sleepiness at 6 months despite adherence to CPAP therapy. No other variables such as age, BMI, AHI on the sleep study done at 6-months, presence of depression, chronic pain or GERD were associated with significant increased or decreased odds of sleepiness.

Conclusion: After 6 months of CPAP therapy, lower average nightly CPAP and presence of sleepiness at baseline are the primary determinant of sleepiness. Patients who are sleepy at baseline are at higher risk of sleepiness independent of CPAP adherence and should be followed closely.

Support (If Any): APPLES.

0513

MECHANISMS OF CONTINUOUS POSITIVE AIRWAY PRESSURE RESIDUAL SLEEPINESS USING DIFFUSION MAGNETIC RESONANCE IMAGING

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Introduction: With high level nightly CPAP use, some patients experience residual sleepiness. A plausible hypothesis is that intermittent hypoxemia associated with OSA may cause injuries to the brain white matter (WM), resulting in non-response to CPAP therapy. This is supported by a recent study using diffusion tensor (DTI) magnetic resonance imaging (MRI) that revealed the difference in mean diffusivity (MD) and radial diffusivity. Whether these compromises affect the whole brain or just individual tracts, remains unclear. Fractional Anisotropy (FA) - a common MRI parameter to quantify WM integrity, can be applied to identify brain alterations. The purpose of our study is to investigate the possible differences in FA as well as MD between those with and without residual sleepiness among OSA patients with high CPAP use.

Methods: Twenty-seven OSA male patients (age: 30–55 years) on CPAP (CPAP≥6h/night for at least 30 days) were enrolled. Based on Psychomotor Vigilance Task (PVT) results, participants were divided into a non-sleepy (PVT lapse≤5; n=18) and sleepy group (PVT lapse>5; n=9). All subjects underwent DTI MRI scans at 3 Tesla with b-value of 1000 s/mm^2 and 27 gradient directions. Tract-based spatial statistics (TBSS) was utilized to analyze the whole-brain DTI data and group differences were compared. Based on a brain skeleton using a JHU-ICBM-labels-1mm template, regional FA and MD, comparisons were made on selected fiber tracts and correlated with PVT or Epworth Sleepiness Scale (ESS).

Results: In the whole-brain analysis, the sleepy group exhibited significantly lower FA and higher MD than the non-sleepy group ($p < 0.05$). These differences are particularly evident in anterior corona radiata (ACR), anterior limb of internal capsule (ALIC), corpus callosum (CC), sagittal stratum (SS), superior longitudinal fasciculus (SLF), etc. Additionally, FA correlated negatively while MD positively with the PVT or ESS in specific WM fiber tracts ($r = 0.43–0.59$).

Conclusion: The significant differences in FA and MD between the non-sleepy and sleepy high- use groups support the hypothesis that brain WM structural changes can be responsible for the differing response to CPAP treatment.

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0514

SIX MONTHS OF CONTINUOUS POSITIVE AIRWAY PRESSURE TREATMENT IMPROVES NEUROBEHAVIORAL FUNCTION AND QUANTITATIVE SLEEP ELECTROENCEPHALOGRAM MEASURES IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Untreated obstructive sleep apnea (OSA) is associated with neurobehavioral deficits and altered brain electrophysiology. We evaluated the effect of continuous positive airway pressure (CPAP) treatment on quantitative electroencephalogram (EEG) measures during sleep and cognitive function in OSA.

Methods: We studied 162 OSA patients (age 50 ± 13, AHI 35.0 ± 26.8) before and after 6 months of CPAP treatment. Neurobehavioural tests were performed to assess working memory (2-back and 3-back accuracy), sustained attention (Psychomotor Vigilance Task, PVT), visual-spatial scanning (Letter Cancellation Task, LCT) and executive function (Stroop). All participants attended the sleep laboratory

for overnight PSG at baseline and after CPAP. Power spectral analysis was performed on all-night EEG data (C3/M2) in a sub-set of 90 participants. Slow wave activity (SWA, absolute delta EEG power) and spindle frequency activity (SFA, sigma EEG power) in NREM sleep and a measure of EEG slowing in REM were calculated. Spindle density (events p/min) & characteristics (duration, amplitude, frequency) in stage N2 sleep were also derived using an automated spindle event detection algorithm. All outcomes analysed as change from baseline, and are mean [95%CI] or median [IQR].

Results: Six months of CPAP improved neurobehavioural function across all cognitive domains: 2-back (accuracy: 4.5[24%], p<0.0001); 3-back (accuracy: 6[24%], p<0.0001); and PVT (mean slowest 10% RRT: 0.12[0.8], p=0.002) LCT (average hits: 3.8[8.5], p<0.0001) and Stroop colour (accuracy: 2.0[19.2%], p<0.0001). In our sub-set, CPAP increased SWA (105.3[61.7–148.8μV^2], p<0.0001) and SFA (1.50[0.70–1.18], p=0.0003) in NREM. CPAP significantly increased sleep spindle density (p=0.003), spindle duration (p=0.019) and amplitude (p<0.0001). Associations between baseline sleep EEG and change in performance with CPAP were found with less SWA in NREM and improved sustained attention on the PVT(rho=0.24, p=0.03) and greater EEG slowing in REM and improved working memory(rho=0.25, p=0.01).

Conclusion: Six months of CPAP improved performance and enhanced sleep EEG features. Reduced SWA in NREM and greater EEG slowing in REM at baseline showed the greatest improvement in some measures of performance with CPAP. Sleep EEG measures via PSG may provide information on which patients are most at risk of neurobehavioural dysfunction.

Support (If Any): Australian National Health and Medical Research Council Project Grant 57355.

0515

EFFECTS OF CONTINUOUS POSITIVE AIRWAY PRESSURE ON BODY COMPOSITION, PHYSICAL ACTIVITY, AND FOOD INTAKE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) may promote weight gain by affecting physical activity (PA), food intake, hunger/satiety hormones, and/or energy metabolism. We aimed to determine if continuous positive airway pressure (CPAP) alters behaviors involved in regulating body composition in individuals with OSA.

Methods: These are preliminary data from a prospective study of CPAP in obese OSA patients. To date, 9 individuals (n=3 females), age (± SEM) 48.1 ± 4.1 y and apnea-hypopnea index 51.0 ± 14.0 events/h, were studied. Outcomes were assessed at baseline and after 2 months of nightly CPAP use. Body composition measures included body mass index (BMI), and air displacement plethysmography (BodPod) for fat mass (FM) and fat-free mass (FFM). Free-living PA was recorded with wrist-actigraphy for 7 days. Food intake was assessed by providing participants with a stipend to purchase food items of their choice, and quantifying energy and macronutrient content of food consumed in the laboratory.

Results: BMI slightly but significantly increased after CPAP (35.5 ± 1.5 vs. 35.8 ± 1.4, p=0.06). FM% decreased (39.4 ± 2.4 vs. 38.1 ± 2.4%; p=0.09), and FFM% increased (60.6 ± 2.4% vs. 61.9 ± 2.4%; p=0.09), corresponding with a significant increase in FFM (135.7 ± 8.2 vs. 140.7 ± 9.4 kg; p=0.02). Estimated resting metabolic rate (based on the Nelson Prediction Equation from FFM and FM obtained from the BodPod) increased after CPAP (1750.3 ± 95.8 vs. 1787.2 ± 102.7 kcal/d; p=0.06). Percent time in moderate-to-vigorous PA (MVPA) was significantly increased (3.2 ± 0.7% vs. 5.6 ± 1.1%, p=0.04). Percent time in sedentary and light PA were unchanged (p-values ≥0.30). Actiwatch-derived average energy expended/hour increased (70.8 ± 11.5 vs. 78.9 ± 11.9 kcal/h; p=0.06). No differences were seen for food intake (energy and macronutrient), except for percent energy consumed as carbohydrate, which decreased after CPAP (55.0 ± 2.4 vs. 48.7 ± 1.5% p=0.04).

Conclusion: Increased FFM appears to contribute to body weight gain after CPAP, and may be driven by increased levels of MVPA. Findings suggest that CPAP could be useful to encourage optimal cardiometabolic outcomes in OSA patients.

Support (If Any): American Heart Association 15SDG22680012.

0516

LONG TERM EFFECTS OF COMPLIANCE WITH POSITIVE AIRWAY PRESSURE (PAP) THERAPY IN PATIENTS WITH OBESITY HYPOVENTILATION SYNDROME (OHS)

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Introduction: To assess the role of different levels of compliance and long-term effects of PAP therapy on gas exchange, sleepiness, quality of life, depression and death rate in patients with OHS.

Methods: Two hundred fifty two patients with newly diagnosed OHS, who have been recommended PAP therapy, were followed up for a minimum of 2 years. Arterial blood samples were taken for gas level measurements with patients awake, for more than 4 h since wakening. The hours/day and percentage of days PAP was used were monitored. Epworth sleepiness scale (ESS), quality of life (Short Form 36-SF-36) and Beck Depression Inventory (BDI) were recorded together with the death rate before and at the end of the follow up period.

Results: At the end of the follow-up period (mean duration, 42 months), PaO_2 had increased from baseline (p<0.001), and both $PaCO_2$ and HCO_3^- had decreased (p<0.001). PAP therapy also significantly improved ESS (p<0.001), BDI (p<0.001) and SF-36 (p<0.001) scores. During follow-up, 11 patients died (2 due to progression of respiratory failure). Patients who used PAP therapy for > 6 hours/day had a considerably greater improvement in blood gases and questionnaires scores than less adherent patients.

Conclusion: Increased hours of use and long-term therapy with PAP are effective in the treatment of patients with OHS. Clinicians should encourage adherence to PAP therapy in order to provide a significant improvement in clinical status and gas exchange in these patients.

Support (If Any): None.

0517

A RETROSPECTIVE COMPARISON OF CONVENTIONAL BILEVEL POSITIVE AIRWAY PRESSURE WITH BACK UP RATE TO AVERAGE VOLUME ASSURED PRESSURE SUPPORT IN PATIENTS WITH RESPIRATORY INSUFFICIENCY RELATED TO NEUROMUSCULAR DISEASE

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Introduction: Bilevel positive airway pressure with back up rate (BPAP-ST) is the most common ventilation mode in neuromuscular disease patients. The role of Average Volume Assured Pressure Support (AVAPS) has not been established. Our aim was to compare ventilatory and sleep parameters and patient preference of BPAP-ST vs AVAPS.

Methods: We implemented a sequential titration protocol of BPAP-ST followed by AVAPS during polysomnography in 10 patients (all had known or suspected ALS) and retrospectively reviewed their data.
Results: Patients (50% female) averaged 66 years(± 6 SD) with maximal predicted inspiratory and expiratory pressures, and vital capacity of 46% (± 17), 36% (± 23), and 65% (± 25) respectively. At optimal titration of each device, average tidal volumes were 93.2 ml (± 61) higher on AVAPS with transcutaneous CO2 0.7 mmHg (± 2.9) higher on BPAP-ST. Average respiratory rate was 2.8 bpm (± 5) higher while nadir NREM SaO2 was 4.7% (± 8) lower on BPAP-ST with no difference in REM (0±2). Tidal volumes tolerated by patients on AVAPS were 47ml (± 55) lower than those recommended per the manufacturer's reference table (8ml/kg). The average apnea-hypopnea index was 2.9 events/hour(± 10) higher on BPAP-ST. Sleep efficiency was on average 0.7% (± 18) higher on BPAP-ST. None of the ventilatory or sleep parameters differed significantly (p> 0.05) between BPAP-ST and AVAPS. A majority of the patients preferred BPAP-ST (70%).
Conclusion: BPAP-ST and AVAPS provided equivalent ventilator and sleep parameters during polysomnography in a neuromuscular disease patient cohort while these patients tended to prefer BPAP-ST.
Support (If Any):

0518

TREATMENT OF SLEEP DISORDERED BREATHING IN HYPERMOBILE PATIENTS

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Introduction: Patients with hypermobility syndromes often have difficulty using Positive Airway Pressure (PAP) Therapy for treatment of their Sleep Disordered Breathing. To investigate this, the CPAP titrations of patients with hypermobility were studied in detail.
Methods: The attended PAP titrations of 19 consecutive patients with a Beighton hypermobility score of 5 or greater at a neurology institute were retrospectively reviewed. Of 19 patients, 6 had Sleep Apnea - Unspecified (Upper Airway Resistance Syndrome) (G47.30) and 13 had Obstructive Sleep Apnea (G47.33). All ± values reflect the standard error of the mean.
Results: During titrations, after an initial nadir for scorable hypopneas was achieved, 11 of 19 patients experienced an average increase of 10.24±2.5 in their hypopnea index as pressure was increased. At their hypopnea nadir, 15 of 19 patients' AHI was 0 and an average Respiratory Effort Related Arousal Index of 38.4±6.7 remained. Example titrations and images of typical airways in hypermobile patients will be presented.
Conclusion: 1. In typical CPAP titrations hypopneas and RERAs should generally decrease and eventually plateau as PAP is increased. However, the pattern observed in the titration of these patients with hypermobility is somewhat atypical.
2. In hypermobile patients, the high RERA index at the hypopnea nadir, with subsequent increases in both with increasing pressure, could be explained by the following mechanism: In hypermobile patients, the epiglottis is more flexible than usual, and even though the upper portion of the lower airway can be expanded by PAP, increasing pressure in hypermobile patients could lead to epiglottal closure.
3. Auto-titrating CPAPs currently do not measure RERA's well, because of their inability to assess EEG arousals, despite having formidable algorithms which can measure changes in airway resistance. Thus, the use of auto-titrating PAP devices may not be effective in the relief of sleep complaints in patients with hypermobility and SDB.
4. This lack of effectiveness could lead to poor compliance with PAP therapy in patients with hypermobility.
5. Thus, patients with hypermobility probably need an attended PAP titration to achieve optional airway patency, and resolution of their complaints related to SDB.
Support (If Any):

0519

CAROTID ARTERY WALL THICKNESS IN OBESE AND NON-OBESE WITH OBSTRUCTIVE SLEEP APNEA BEFORE AND FOLLOWING POSITIVE AIRWAY PRESSURE TREATMENT

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Introduction: Debate persists as to whether obstructive sleep apnea (OSA) is an independent risk factor for subclinical atherosclerosis in the carotid arteries. Moreover, there is a lack of information on the effect of positive airway pressure (PAP) treatment on carotid wall thickness, an early sign of atherosclerosis, and existing results are conflicting. The purpose of this study was to compare carotid artery wall thickness between in obese and non-obese adults with and without OSA, as well as among OSA cases following PAP treatment.
Methods: A total of 206 adults newly diagnosed with OSA with an apnea/hypopnea index (AHI) between 15 and 75 events/hour and 53 controls with AHI < 10 events/hour were enrolled. Waist circumference >107 centimeters in men and >96 centimeters in women was used to classify subjects as obese. Bilateral common carotid artery B-mode ultrasound was performed in all subjects at baseline to assess intima-media thickness (IMT) as a primary outcome and arterial-wall mass, diameter, and circumferential wall stress as secondary outcomes. Measurements were repeated in 117 OSA participants who completed 4-months of PAP treatment and had an average daily use over that period of ≥ 4 hours/day.
Results: No significant differences in carotid IMT, diameter, or arterial-wall mass were present at baseline between subjects with OSA and controls stratified by obesity status, after adjusting for other cardiovascular risk factors. In those subjects with OSA who had adequate PAP adherence over the 4 month treatment, carotid artery diameter significantly increased (mean change [95% CI] = 0.12 [0.05, 0.19] mm; p=0.002), but no significant changes in carotid IMT, arterial-wall mass, and circumferential stress were observed in either obese or non-obese subjects.
Conclusion: Regardless of obesity status, carotid IMT was not increased in moderate to severe OSA versus controls and did not change in response to the PAP treatment. Only the diameter of carotid arteries significantly increased over the 4-month treatment period.
Support (If Any): This study was supported by National Institute of Health (NIH HL094307).

0520

INPATIENT SLEEP STUDY FOR SLEEP DISORDERED BREATHING AND ITS ASSOCIATIONS WITH 30-DAY EMERGENCY DEPARTMENT REVISIT AND READMISSION RATES

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Introduction: Prevalence of Sleep Disorder Breathing (SDB) is approximately 77% of hospitalized patients in tertiary care center. Untreated SDB is associated with increased readmission rate in hospitalized cardiac patients. We investigated the feasibility of performing PSG in hospitalized patients and its association with 30-day emergency department revisit and readmission rates.
Methods: This is a retrospective chart review of adult, hospitalized patients with a sleep medicine consultation for SDB at the Tulane Sleep Center (4-bed lab) from June 2013 to June 2016. Patients were classified into 2 groups, with and without inpatient PSG.
Results: A total of 47 patients were included in the study. Forty seven percent were male. The mean age and body mass index was 57.95 ± 14.97 and 38.77 ± 10.84, respectively. Co-morbidities were hypertension 70.5%, obesity 65.5%, and congestive heart failure (CHF) 63.6%. Admission diagnoses were CHF exacerbation 34.1%, COPD exacerbation 15.9%, both CHF and COPD exacerbation 9.1%, other respiratory failures 25.0%, and other causes 13.6%. Fifteen patients (32%) underwent inpatient PSG. Twenty percent of patients had mild OSA, 13.3% moderate OSA, 53.3% severe OSA, and 13.3% no OSA. The group with inpatient PSG, compared to without, had a higher prevalence of CHF (86.8 vs. 51.7%, p=0.022). Among patients who were discharged without PSG, 7 had PSG performed as an outpatient with median discharge-to-PSG time of 20 days. Of those, 42.9% had mild, 14.3% moderate, and 42.9% severe OSA. There were no differences between groups with and without inpatient PSG in 30-day ED revisit (20% vs. 17%, p=0.56) and re-hospitalization (20% vs. 17%, p=0.56) rates. However, there was a trend of a lower combined ED revisit and rehospitalization rate due to cardiopulmonary complications in the group with inpatient PSG (6.7% vs. 10.3%, p=0.57).
Conclusion: Inpatient PSG is successfully performed in one third of inpatient sleep medicine consult for SDB and may reduce ED revisit and re-hospitalization rate due to cardiopulmonary complications.
Support (If Any): NA.

0521

IMPACT OF MASK TYPE ON CONTINUOUS POSITIVE AIRWAY PRESSURE EFFICACY AND COMPLIANCE: A META-ANALYSIS

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Introduction: Continuous positive airway pressure (CPAP) is the standard treatment for obstructive sleep apnea (OSA). The impact of the mask type on the efficacy and acceptance of CPAP is inconclusive. The present study aimed to compare the effects and compliance of oronasal and nasal mask by the meta-analysis of the existing trials.
Methods: Studies were retrieved from PubMed, EMBASE, and CENTRAL up to August 2016. The literature was reviewed by two independent authors. The mean difference of residual apnea-hypopnea index (AHI), therapeutic pressure, usage hour, and preference between oronasal and nasal mask was quantified. The pooled effect was analyzed with random-effect generic inverse variance and the heterogeneity was assessed with I^2.
Results: From 6070 articles, 13 studies comprising 4000 subjects were included for the meta-analysis. The number of recruited subjects was different and the recruited trials were heterogeneous for all four outcomes. The lNewcastle-Ottawa scale showed that two studies (120 subjects) enrolling participants inadequately response to oronasal CPAP were biased. Compared to nasal masks, the oronasal masks had higher residual AHI for 5.5/hour (95% CI 2.3–8.8, p<0.001, I^2 94%, 676 subjects), higher therapeutic pressure for 1 cmH_2O (0–2.1, p=0.05, I^2 76%, 534 subjects), and shorter usage per night for 0.8 hour (-1.06 - -0.54, p<0.001, I^2 25%, 1364 subjects), and less preferred (odds ratio 0.05, 95% CI 0–0.6, p=0.02, 153 subjects). The subgroup analysis of 11 unbiased trials (3880 subjects) gave the same results for all four outcomes. Subgroup analysis of 5 randomized control trials (RCT) (176 subjects) had similar results except that therapeutic pressure was similar between two masks (p=0.97).
Conclusion: The present studies showed that oronasal masks were associated with higher residual AHI, higher therapeutic pressure, shorter usage, and less preference compared to nasal masks.
Support (If Any): This study was supported by National Taiwan University (NTU) Hospital (105-S2998), Ministry of Science and Technology (103-2314-B-002-139-MY3), and NTU (NTU-ERP-105R8951-1).

0522

A RANDOMIZED-CONTROL TRIAL OF ADHERENCE AND ACCEPTANCE OF A TELEMEDICINE MONITORING SYSTEM FOR OSA PATIENTS TREATED WITH CPAP

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Introduction: Adherence to CPAP treatment in OSA patients is still not optimal and is still a clinical problem. New telemedicine monitoring systems can improve adherence, but this has not been clearly demonstrated yet. Primary outcome of this study was to assess PAP adherence (hours of use per night and percentage of days of use) after 1, 3 and 6 months in telemicine patients compared to standard care patients. Secondary outcome measures were subjective sleep quality and patient's satisfaction
Methods: randomized controlled trial that compared standard care CPAP treatment versus CPAP treatment by a telemedicine monitoring system (EncoreAnywhere, Philips Respironics). 30 patients (mean age 53.3 ± 9.5 yrs) with moderate to severe OSA (mean apnea hypopnea index (AHI) 45.3 ± 21) that had PAP prescribed, were randomized to either standard care (SC) or to telemedicine (TM), an autotitrating PAP machine that transmitted data (adherence, leaks, residual AHI) daily to a website that could be reviewed by clinical staff. If problems were identified from information from the website, the patient were contacted by telephone as necessary according to set criteria.
Results: 16 patients were randomized to TM and 14 to SC. After 1 month, mean PAP adherence was significantly greater in the TM arm (379 min per day) versus the SC arm (324 min per day; mean

difference = 55 min, p<.05). Percentage of days of use for more than 4 hrs at 1 month was 89.7% in the TM arm and 60.8 % in the standard arm (p < .05), 92% vs 74.8% at 3 months and 93.3% vs 73.4% at 6 months. Significant independent predictors of adherence was the use of TM (p<.001). On average, we calculated a reduction of the number of visits per patients in the TM arm compared with the SC arm (5 vs 9, p<.05). Patients satisfaction was significantly superior in the telemedicine group (p<.05).

Conclusion: PAP adherence and satisfaction can be improved with the use of a web-based telemedicine system implemented at the initiation of treatment and used for long-term monitoring of compliance.

Support (If Any): This research was supported by Philips Respironics Italy.

0523

CPAP ADHERENCE IN SLEEP APNEA MANAGED WITH VIRTUAL CARE AND EHR INTEGRATION

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Introduction: CPAP has a track record of high abandonment and suboptimal use. This report examines 6 month measures of disease control, CPAP use and CPAP abandonment in sleep apnea patients in a health care system employing wireless daily data transfer incorporated with EHR-integration and structured virtual care over a 3 year time period.

Methods: Study participants. Consecutive patients with obstructive sleep apnea (N=1,530), ≥18 years of age with AHI≥15 who identified CPAP as primary therapy and used it for at least 6 months were included (baseline AHI: 50±31, BMI: 37±8, Epworth Sleepiness Scale score: 10±5). Measures. Adherence was measured by average daily CPAP use in five time periods specified by days from therapy initiation* and the contribution of each period to the variation in average daily use over the entire 6 months was measured by coefficients of determination (r^2). Abandonment was defined during any time period by two methods as a) average use of 0 minutes or b) all days < 20 minutes.

Results: The range of average CPAP use across all time periods was remarkably stable at 5.3–5.6 hours with and average use of 5.4±2.1 hours over 6 months and 75% of patients > 4 hours with a mode at 7 hours use. Abandonment was low by both definitions and across time periods (2–6%). Less than 1% of the variation in CPAP use over 6 months could be explained by AHI, ESS, age or gender. AHI over 6 months was 3±3. Variability in CPAP use over 6 months was best predicted by measures* after 60 days: 1) 27% at 1–7 days, 2) 38% at 1–14 days, 3) 52% at 1–30 days, 4) 83% at 61–90 days, 5) 78% at 151–180 days. Abandonment was low by both definitions and across time periods (2–6%). Outcome data were missing for less than 3% of the patients.

Conclusion: Sleep apnea can be managed with EHR integration and structured virtual care with high CPAP adherence and low abandonment rates. Over 6 months observation, prediction of average CPAP use improves with continuous monitoring, peaking after 60 days use.

Support (If Any): Fairview Health System.

0524

THE INDIANA TELEMONITORING TO OPTIMIZE USE OF CPAP AT HOME PROGRAM

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Introduction: Approximately 20% of Veterans have obstructive sleep apnea (OSA). An estimated 100,000 Veterans with OSA receive new positive airway pressure (PAP) devices annually. The Veterans Health Administration (VHA) Sleep Medicine services are struggling to provide timely access to this volume of patients. We tested a new "TeleSleep" program that used remote PAP monitoring and leveraged VHA Sleep Medicine and TeleHealth infrastructure to provide in-home OSA care. Our objectives included: evaluating program effectiveness, assessing patient satisfaction, and constructing a business-case analysis.

Methods: OSA patients received ResMed AirSense-10 PAP machines with wireless capability. Sleep Medicine staff performed PAP set up. Telemedicine nursing staff followed patients using a TeleSleep disease-management protocol. We evaluated effectiveness and patient satisfaction six months after PAP setup. Effective PAP therapy was defined as: median use >4hours/night for >70% of nights, leak <30 L/min, and residual apnea-hypopnea index (AHI) <5/hour. We used automated telephone-response calls and in-person questions to obtain patient satisfaction. The business-case analysis was constructed from the VHA facility perspective and included program implementation costs.

Results: Among N=200 patients receiving PAP devices (N=59 TeleSleep; N=103 usual care), TeleSleep patients had improved effective PAP therapy (50.0% versus 29.8%, p=0.042). Benefits reported by patients included: lower travel burden "just for a download," having someone in telehealth "to call to help" as they adjusted to PAP, and satisfaction with care provided by VHA staff. The proportion of patients who were mostly or very satisfied with their sleep care was similar in both groups: TeleSleep, 15/20 (75%) versus usual care, 68/105 (67%, p=0.447). The business-case analysis favored the TeleSleep program on the basis of financial endpoints and non-financial elements.

Conclusion: This TeleSleep program improved clinical outcomes and received a high degree of patient satisfaction. TeleSleep could be expanded as a patient-centered innovation to help address the needs of OSA patients.

Support (If Any):

0525

UNMASKING PREDICTORS OF CONTINUOUS POSITIVE AIRWAY PRESSURE COMPLIANCE

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Introduction: Continuous positive airway pressure (CPAP) remains the treatment of choice for obstructive sleep apnea (OSA). Although it is an effective treatment, adherence is poor. The literature has failed to identify treatment variables that consistently predict CPAP adherence.
Methods: We performed a retrospective analysis of patients with OSA started on CPAP in our clinic over the past 7 years. We compared those who were compliant after 30 days of CPAP use with those who did not demonstrate regular use, defined as CPAP use for ≥4 hours per night on 70% of nights. We assessed several clinical and demographic variables for their relationship with CPAP adherence including self-identified race, gender, sedative-hypnotic use during the diagnostic polysomnogram, mask type and brand. Differences between the groups were determined through the Chi-square test and Fisher's Exact test.
Results: Two-thousand and four patients were included in the analysis (91% men, mean age 45.2 years ±10.8, mean AHI of 19.79±15.1, mean BMI of 29.49±8.7). At 30 days following the initiation of CPAP therapy, overall compliance was 66%. Patients treated with a full face mask (56.6%) were significantly more compliant (68.2%) compared to those using a nasal interface (63.5%; p-value of 0.032, OR 1.2). In regards to the different mask brands, there was no statistical significance between the six separate interfaces included in the database. Self-identified Asian patients (2%) were also more likely to be compliant (77.8%; p-value of 0.000, OR 2.9) compared to other categories of race. The use of a sedative hypnotic, eszopiclone or zolpidem, during the polysomnogram was not indicative of compliance (p-value of 0.887).
Conclusion: Our study demonstrates a statistically superior CPAP compliance at 30 days amongst patients treated with full face masks. Although statistically significant, these findings are not felt to be clinically relevant. However, this contradicts previously published data that full face masks negatively affect CPAP adherence. Additional investigation is warranted to further identify treatment variables associated with improved CPAP compliance.
Support (If Any):

0526

ANNIE: THE VETERANS HEALTH ADMINISTRATION'S PERSONALIZED TEXT MESSAGE APPLICATION PROMOTES COMPLIANCE WITH POSITIVE AIRWAY PRESSURE

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Introduction: Estimated compliance with positive airway pressure (PAP) in the US population ranges from 40–50%. Our prior research revealed that PAP adherence in patients diagnosed with both traumatic brain injury (TBI) and obstructive sleep apnea (OSA) is significantly lower at 19%. Our objective was to demonstrate that personalized text message reminders improve adherence to PAP therapy in veterans with TBI and OSA.
Methods: In a randomized, double-blind, controlled trial, nineteen veterans with chronic stage TBI and newly diagnosed OSA were randomized into either a reminder group, who received intensive education at the initial visit and nightly text message reminders to use PAP or to a standard-of-care (SOC) group. We piloted the Veterans Health Administration's (VHA) secure text message application ANNIE. Text messages were personalized by inclusion of the patient's name and the patient's choice of message delivery time with the option to stop, pause, or resume messages at any time. Mean overall percent compliance and percent compliance greater than 4 hours per night was measured at 7 and 30 days. Groups were compared using the Student's t-test.
Results: Mean overall percent compliance during the first 7 days was significantly greater in the reminder group (83.9% vs. 55.4%, p=0.04). Mean overall percent compliance at 30 days was also greater in the reminder group, but not statistically significant (58.9% vs. 36.9%, p=0.22). The reminder group demonstrated greater four hour threshold compliance at 7 days (48.2% vs. 30.4%, p=0.29) and 30 days (36.9% vs. 15.4%, p=0.13), although neither reached significance. None of the reminder group patients chose to stop or pause the nightly messages during the trial except one, who paused at day 28 due to travel.
Conclusion: Personalized, automated text messages significantly improved PAP compliance during the first week of use with a trend toward increased PAP utilization in the first month. Personalized, automated reminders can be a useful tool to promote PAP adherence in patients with TBI. Further investigation with a larger sample is warranted.
Support (If Any): Supported by the Department of Veterans Affairs, Veterans Health Administration, 2015 VISN 5 New Investigator Grant.

0527

ROLE OF SPOUSE IN CPAP ADHERENCE

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Introduction: Continuous positive airway pressure (CPAP) adherence among patients with obstructive sleep apnea (OSA) remains suboptimal. This study determined whether marital quality and spouse involvement affects adherence with CPAP therapy, and whether it differs by gender.
Methods: 194 subjects recruited from Apnea Positive Pressure Long Term Efficacy Study (APPLES) completed the Dyadic Adjustment Scale (DAS) 3 years after the study. The majority of participants were Caucasian men (84% and 74% respectively), with mean age of 56 years mean BMI of 31 *kg/m2,* and 62% had severe OSA. Inclusion required that subjects were married during APPLES and still married at the time of DAS administration. The DAS is a validated 32-item self-report instrument measuring marital dyadic consensus, satisfaction, cohesion, and affectional expression. Additionally, questions related to spouse involvement with general health and CPAP use were asked. CPAP compliance was defined as usage documented by device download ≥ 4 h/night.
Results: Overall marital quality between the compliant and noncompliant subjects was not different; however, spousal involvement was associated with increased CPAP adherence at 6 months (p=0.01). Gender stratification demonstrated significance only among males (p=0.03). Three years after completing APPLES, 82 participants were still compliant by self-report. At this time point, spousal involvement was not associated with CPAP compliance even after gender stratification.
Conclusion: Wife support of husband's general health, but not husband's support of wife's general health is important in determining CPAP compliance in the first 6 months after initiation of therapy, but

is not predictive of longer-term adherence. In contrast, marital quality measures were not an important factor in CPAP compliance in this study. This finding for dyadic support by wives, but not husbands is consistent with prior DAS studies. Involvement of both husbands and wives should be considered an integral part of CPAP initiation procedures.
Support (If Any): Support (optional): HL068060.

0528

THE INFLUENCE OF PRE-TREATMENT HEALTH BELIEFS ON THE TRAJECTORY OF PAP USE DURING THE FIRST 12 WEEKS OF TREATMENT

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Introduction: Data are equivocal on whether pre-treatment health beliefs (Risk Perception [RP], Outcome Expectancies [OE], and Self-Efficacy [SE]) about obstructive sleep apnea (OSA) and positive airway pressure (PAP) predict treatment adherence. However, limited research has examined the association of these health beliefs on the trajectory of PAP use. Our aim was to determine if pre-treatment RP, OE, and SE influenced the trajectory of PAP adherence in US veterans.
Methods: Consecutive PAP-naïve OSA patients (n=185, 94% men, 42% black) attended the Miami VA sleep clinic to receive PAP and complete baseline questionnaires. Social cognitions about OSA and PAP were assessed with the Self-Efficacy Measure for Sleep Apnea (SEMSA). Patients returned for follow-up and adherence download. Outcomes were weekly averages of PAP use (mins). Models were fitted for the initial 12 weeks of treatment and time-centered at week 1. We used longitudinal multi-level modeling to characterize the influence of RP, OE, and SE on the trajectory of this outcome. Models were adjusted for relevant covariates (age, race, apnea-hypopnea index, sleepiness, insomnia, depression, and prescribed pressure).
Results: During initial use (at week 1), pre-treatment RP, OE, and SE were positively associated with more PAP use. A 1-point increase (on a 4-point scale) was associated with a 42 min increase (p=0.04) in PAP use for RP (p=0.04), 62 min increase in PAP use for OE (p<0.01), and 43 min increase in PAP use for SE (p=0.02). A significant reduction in PAP use was observed over 12 weeks; However, neither RP, OE, or SE interacted with this reduction in PAP use.
Conclusion: These data demonstrate that lower scores on pre-treatment social cognitions predict worse PAP use during the first treatment week. Individuals' PAP use declined in parallel regardless of pre-treatment health beliefs. Pre-treatment social cognitions about OSA and PAP can identify individuals for behavioral intervention before initiating PAP therapy to mitigate adherence decrements.
Support (If Any): None.

0529

ADHERENCE TRAJECTORIES DURING THE FIRST SIX WEEKS OF PAP THERAPY DURING THE FIRST 6 WEEKS OF PAP USE DURING THE FIRST 6 WEEKS OF PAP USE

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Introduction: Prior research has shown daytime sleepiness, insomnia symptoms, and outcome expectations predict level of adherence. Limited research has examined what predicts the trajectory of cPAP adherence over time. Our aim was to examine adherence over a 6-week follow up period and what predicts it.
Methods: In this sample of 205 veterans, growth mixture modeling was used to derive trajectory of cPAP adherence based on percentage of nights where usage was greater than or equal to 4 hours. Baseline predictors included: AHI, PAP pressure, mood disorder diagnosis, daytime sleepiness, nighttime insomnia symptoms, risk perception, outcome expectation, and self-efficacy.
Results: Two trajectories emerged categorizing the sample into Adherers (27%) and Non-Adherers (73%). At week one, adherers used the machine >= 4 hours an average of 81% of nights and had a non-significant slope, indicating the week one usage was sustained over the 6-week period. In contrast, non-adherers used the machine >= 4 hours an average of 29% of nights and had a significant decline of 3.4% per week. This indicates usage >= 4 hours at week 6 would be approximately 8%. Participants increased their odds of being a Non-Adherer if they had 1) higher PAP pressure, 2) mood disorder diagnosis, 3) more daytime sleepiness, 4) more insomnia symptoms, and 5) lower self-efficacy. AHI did not predict adherence.
Conclusion: These findings suggest psychological and behavioral factors distinguish adherence trajectories over time. Future interventions should focus on these modifiable risk factors to improve cPAP adherence.
Support (If Any): N/A.

0530

ARE WE UNDERSELLING POSITIVE AIRWAY PRESSURE (PAP) COMPLIANCE AND CONFOUNDING SLEEP RESEARCH? LARGE MULTI-CENTER ANALYSIS SHOWS PAP COMPLIANCE DATA THAT IS MUCH HIGHER THAN PREVIOUSLY REPORTED

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Introduction: Clinical sleep medicine is guided by published literature that drive treatment. For obstructive sleep apnea (OSA), many such studies are flawed because treatment groups used for analysis have Positive Airway Pressure (PAP) compliance levels lower even than current minimum Medicare requirements for ongoing treatment coverage. Acceptance of poor PAP usage data stems from previous publications on PAP compliance, which have similar flaws and small cohorts (i.e., < 100 subjects). We contend that such studies cite compliance thresholds that easily are eclipsed by sleep centers employing effective protocols, and utilization of these data lead to conclusions hindering proper progression of sleep medicine. We collected data to demonstrate higher PAP compliance can be achieved than what currently is reported.
Methods: We analyzed 1580 consecutive patient charts from two comprehensive sleep centers, Comprehensive Sleep Medicine Associates (Greater Houston, TX) and Pulmonary and Sleep Associates of Marin (Novato, CA). Included were patients who had received a PAP device for OSA 90+ days prior to data analysis and whose compliance could be tracked remotely through AirView. All others were excluded. Compliance was defined in two ways: "CMS compliance" (4+ hours of PAP use for 21/30 consecutive days within the first 90 days of PAP initiation) and "all compliance" (4+ hours of PAP use for 21/30 consecutive days within any 90-day period).

Results: 1383 patients met inclusion criteria. 964 (70%) met CMS compliance, and 1072 (78%) met all compliance. 26% (110 patients) of those who did not meet CMS compliance later became compliant.
Conclusion: Our results show higher PAP compliance than prior studies. Examples of flawed studies utilizing sub-optimal PAP compliance include, "Noninferiority of Functional Outcome in Ambulatory Management of Obstructive Sleep" (Kuna, 2011) and "Lack of Secondary Cardiovascular Morbidity Prevention with PAP" (McEvoy, 2016). Both used PAP treatment groups with average compliance far below the CMS compliance threshold. Higher compliance levels similar to ours are not unreasonable to obtain, but may require comprehensive measures, including aggressive clinical follow-up, concomitant cognitive behavioral therapy for insomnia, collaboration with other health professionals, clinic interventions (e.g., mask fittings, PAP Naps), and proper pressure settings.
Support (If Any): N/A.

0531

EFFECT OF ADAPTIVE SERVOVENTILATION THERAPY ON HOSPITALIZATIONS: A POPULATION BASED STUDY

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Introduction: Adaptive servoventilation (ASV) has been shown to provide significantly better control of central sleep apnea (CSA) compared to continuous positive airway pressure (CPAP), bilevel PAP and supplemental oxygen, and may be tolerated better than CPAP. Prior studies have documented a reduction in healthcare utilization after treating obstructive sleep apnea with CPAP. In this study we evaluated the impact of ASV on healthcare utilization in patients with CSA.
Methods: All cases of CSA (n=1,237) from Olmsted County, MN were identified utilizing the Rochester Epidemiology Project database and a further search was done to find those patients commenced on ASV. The number of hospitalizations 2 years before and after ASV was prescribed was compared. Patients with a follow-up period of <1 month prior to and/or after the commencement of ASV were excluded. Manual review of charts was performed to obtain all relevant data.
Results: A total of 315 patients (mean age 69.8 ± 13.5 years) were included. Of these, 80.6 % were men, 97.1% White, 56.1% smokers, mean body mass index (BMI) was 31.6 ± 6.5 kg/m2 and mean apnea-hypopnea index (AHI) 41.8 ± 26/hour (mean central apnea index 14/hour). Treatment-emergent CSA (73%) was the most common sub-type; 14% were fully adherent (≥4hours/night on ≥70% nights) to treatment at 1 month, 66% partially adherent, 11% non-adherent, and 9% unknown. Seventy-six (24.1%) patients died during follow-up.

139/315 patients had ≥1 hospitalization pre-ASV and 148/315 post-ASV, with 110/315 having none either pre- or post-ASV. Mean hospitalization rate pre-ASV (n=315) was 0.64 ± 1.50 and post-ASV was 0.78 ± 1.51 per year (p=0.15). Age, sex, BMI, AHI and smoking status were not predictive of the rate of hospitalization (all $p<0.05$). There was no significant difference in rate of hospitalization after accounting for CSA subtype or change in status of various comorbidities before and after ASV (all $p<0.05$).
Conclusion: In our cohort of patients with predominantly treatment-emergent CSA, ASV use was not associated with a change in hospitalization rate after accounting for multiple confounders. The high mortality rate during follow-up indicates that these patients were very ill.
Support (If Any): This study was funded by ResMed Corp.

0532

TEXT MESSAGE REMINDERS AND INTENSIVE EDUCATION IMPROVES POSITIVE AIRWAY PRESSURE COMPLIANCE AND COGNITION IN VETERANS WITH TRAUMATIC BRAIN INJURY AND OBSTRUCTIVE SLEEP APNEA: ANNIE PILOT STUDY

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Introduction: Previous research has shown that patients with both traumatic brain injury (TBI) and obstructive sleep apnea (OSA) have more cognitive problems than patients with TBI alone. Our objective was to determine if intensive education and text message reminders improved positive airway pressure (PAP) compliance and cognition in veterans with OSA and TBI.
Methods: In this randomized, double-blind, controlled trial, nineteen veterans with chronic stage TBI and newly diagnosed OSA were assigned to receive intensive education at the initial visit and nightly text message reminders to use PAP (reminder group) or to a standard-of-care (SOC) group. Mean percentage overall PAP compliance was averaged over the first seven days and at one month. The Epworth Sleepiness Scale (ESS) and cognitive tests were administered at baseline and 1 month. Effect sizes that incorporated both pre/post and between group differences were calculated.
Results: The reminder group was significantly more compliant with PAP over the first seven days compared to the SOC group (83.94% vs. 55.35%, p=0.04). Reminder group compliance was also greater at 30 days, although not significant (58.85% vs. 36.86%). Twelve patients completed the ESS and cognitive testing at 1 month. Compared to baseline, reminder group ESS scores improved to the normal range (10.14 ± 5.08 to 7.29 ± 4.89) with a medium effect size (d_{ppc2} = -0.39). Medium effect sizes were observed in the cognitive domains of attention on the Rey Auditory Verbal Learning Test List B (d_{ppc2}=0.52), verbal speed of information processing on the Stroop Color Naming test (d_{ppc2}=0.48), and speeded inhibition on the Stroop Color Word Test (d_{ppc2}=0.38), which is a measure of executive function.
Conclusion: Intensive education and text message reminders significantly improved PAP compliance. The reminder group showed clinically relevant improvements on subjective sleepiness and on cognitive measures of attention, processing speed and executive function in veterans with TBI and OSA.
Support (If Any): Supported by the Department of Veterans Affairs, Veterans Health Administration, 2015 VISN 5 New Investigator Award.

0533

AROUSAL THRESHOLD, OBESITY, AGE AND RACE PREDICT CONTINUOUS POSITIVE AIRWAY PRESSURE USE AMONG U.S. VETERANS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: While the respiratory arousal threshold (ArTH) is a key factor in obstructive sleep apnea (OSA) pathogenesis, limited knowledge exists regarding its distribution, association with physiological and clinical patient characteristics and relationship with continuous positive airway pressure (CPAP) use in large clinical cohorts.

Accordingly, we aimed to 1) identify characteristics associated with and 2) assess the impact of low ArTH on CPAP use among U.S. Veterans with OSA.
Methods: Demographics, comorbidities, polysomnographic measures and CPAP use were assessed in U.S. Veterans (n=975) enrolled in a multi-site observational cohort with mean follow-up of 5.5 years. In patients with OSA (apnea hypopnea index, AHI≥5/hour and recommended treatment) presence of low or high ArTH was estimated using previously validated polysomnographic predictors (AHI, nadir nocturnal oxygen saturation and fraction of hypopneas). Associations between low ArTH, demographics, comorbidities and polysomnographic measures were evaluated using univariate, and predictors of regular CPAP use were evaluated by multivariate logistic regression.
Results: Thirty eight percent of OSA patients exhibited a low ArTH. In bivariate analyses, the odds of exhibiting a low ArTH increased with advancing age and periodic leg movement index (PLMI), while odds of a high ArTH increased with obesity (body mass index, BMI≥30kg/m^2), non-white race/ethnicity and hypertension (p-value < 0.05). The odds ratio (OR) for regular CPAP use was markedly reduced in non-obese Veterans with low arousal threshold (OR [95%CI]: 0.38 [0.20,0.72]) as opposed to obese Veterans (1.01 [0.74,1.39]). In multivariate analyses, the interaction term of low ArTH with obesity, increasing age (per 10 years) and non-white race/ethnicity were associated with lower odds of regular CPAP use (ORs of 0.36 [0.19,0.68], 0.86 [0.75,0.97] and 0.68 [0.48,0.96] respectively), after adjustment for gender, sleepiness, AHI, hypertension and PLMI.
Conclusion: The impact of arousal threshold on CPAP use may not be uniform among all OSA patients. Only in the non-obese patients does a low arousal threshold seem to be associated with reduction of regular CPAP use. Similarly, despite exhibiting a higher arousal threshold, non-white race/ethnicity was associated with lower rates of regular CPAP use, suggesting alternate factors influencing CPAP use disparities in our cohort.
Support (If Any): to be reported.

0534

POSITIVE AIRWAY PRESSURE ABATES DROWSY DRIVING IN PATIENTS WITH SLEEP DISORDERED BREATHING IN A LARGE CLINIC BASED COHORT

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Introduction: Drowsy driving related accidents in Sleep Disordered Breathing (SDB) represent an important public health issue with a paucity of large clinic-based cohort data demonstrating impact of SDB treatment. We hypothesize that Positive Airway Pressure (PAP) will reduce self-reported near-accidents/accidents in well-phenotype patients in a large clinical cohort with SDB.
Methods: Questionnaire-based self-reported near-motor vehicle accidents/accidents scores of 1,995 patients with SDB who initiated PAP (1/1/2010–12/31/2014) were retrospectively analyzed. We examined changes in the proportion of near-accidents/accidents before and after PAP, stratified by adherence (usage ≥ 4 hours nightly ≥ 70% of the time). A multi-variable logistic regression model was used to examine the association of self-reported near-accidents/accidents after PAP initiation and ESS changes (and separately Patient Health Questionnaire-9 (PHQ-9))adjusted for age, gender, race, socioeconomic status, smoking, BMI, sleep duration, anti-depressants, co-morbidities (cardiac risk factors, cardiac disease, cancer, chronic renal failure, depression and stroke).
Results: Mean age 56.21±3.2 years, 45.7% female, and 76.0% Caucasian. In the entire cohort, PAP reduced near-accidents/accidents from 13.9% to 6.6% (p < 0.0001). In subgroups, self-reported near-accidents/accidents reduced from (14% to 5.3%, p < 0.001) in adherent patients versus 16.0% to 13.1% in non-adherent patients (p < 0.001). For each one-point improvement in ESS, the odds of self-reported near-accidents/accidents decreased by 8.0% (OR=0.92, 95% CI=0.88–0.96, p < 0.001). For each one-point increase in the baseline PHQ-9 score, the odds of reporting near-accidents/accidents increased by 6.0% (OR=1.06, 95% CI=1.03–1.10, p < 0.001).
Conclusion: Overall, PAP improved self-reported drowsy driving in patients with SDB in this large clinic based cohort with more pronounced findings in those adherent with PAP. Improvement in reported sleepiness was associated with less self-report of near-accidents/accidents supporting a correlation with sleepiness perception. Those with report of higher depressive burden appear to be more vulnerable to self-reported near-accidents/accidents.
Support (If Any): We acknowledge the Knowledge Program Data Registry of Cleveland Clinic, Cleveland, OH for providing the data used in this retrospective analysis. We further acknowledge the Neurological Institute Center for outcome Research and Evaluation (NICORE) Cleveland Clinic, Cleveland, OH for providing bio-statistical support for this study.

0535

OPTIMAL CPAP INTERFACE AMONG PATIENTS WITH OSA AND PTSD

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Introduction: Obstructive sleep apnea (OSA) patients with comorbid post-traumatic stress disorder (PTSD) generally have poor continuous positive airway pressure (CPAP) adherence. Recent literature has noted improved CPAP adherence and efficacy with nasal versus oronasal mask interfaces. We sought to determine if mask type impacted CPAP adherence in comorbid OSA/PTSD.
Methods: This is a subset analysis of a prospective, randomized, single blind, cross-over study comparing standard auto-set CPAP to auto-set CPAP with Sensawake. CPAP naïve patients with OSA and PTSD were enrolled and four weeks after randomization, patients crossed over to the other treatment group with final follow-up at eight weeks. Initial mask and any mask changes were recorded for comparison to adherence. All statistical analyses were performed using SPSS IBM 22.1 software program.
Results: We enrolled 41 patients with co-morbid OSA/PTSD who were initiating CPAP. Mean age, BMI and AHI were 40.7±8.0, 28.9±6.8 and 11.6±20.4 respectively. Average McChord and Epworth Sleepiness Scores (ESS) were 32.7±14.9 and 11.5±6.0 respectively. There were 30 patients with complete mask data, 17 (56.7%) started with a nasal mask (NM), 10 (33.3%) with a full face mask (FFM) and 3 (10%) with nasal pillows (NP). Two patients switched from a NM or NP to FFM, and two from FFM to NM or NP. After 4 weeks, patients who started with a FFM showed a trend toward using CPAP for a greater percentage of days (74.7 vs 55.9%; p=0.10), but there was no difference between initial mask types for hours/nights used (4.2 vs 4.0; p=0.75) or hours/total nights (3.6 vs 2.6; p=0.22). There was also no difference between changes in ESS (-2.0 vs -3.2; p=0.56), ISI (-2.6 vs -4.4; p=0.34) or FOSQ (+0.6 vs +3.5; p=0.26) comparing initial FFM vs nasal (NM or NP).
Conclusion: PTSD patients who start CPAP with a FFM showed a trend toward using CPAP for a greater percentage of nights. No other

outcomes showed a difference based on mask type, and it remains unclear which type of mask is optimal for patients with co-morbid OSA/PTSD.
Support (If Any): N/A.

0536

IMPROVED COMPLIANCE IN PATIENTS DIAGNOSED WITH OSA AND CO-MORBID PTSD THROUGH A NEW CPAP DELIVERY PLATFORM

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Introduction: Post Traumatic Stress Disorder (PTSD) has been associated with co-morbid obstructive sleep apnea (OSA). Treatment of OSA in these patients is often complicated by poor compliance with continuous positive airway pressure (CPAP). Sensawake is a new, wake-sensing CPAP algorithm that lowers pressure when wake is detected. We compared CPAP with and without Sensawake among patients with OSA and PTSD. The primary outcome was CPAP adherence at four and eight weeks. Secondary outcomes assessed subjective sleep symptoms.
Methods: This is a prospective, randomized, single blind, cross-over study comparing standard auto-set CPAP to auto-set CPAP with Sensawake. We enrolled patients with OSA and PTSD who were CPAP naïve. Four weeks after randomization, patients crossed over to the other treatment group with final follow-up at eight weeks. Patients completed clinical sleep questionnaires at baseline and follow-up. Variables were defined using mean and standard deviation and median with interquartile range as appropriate. All statistical analyses were performed using SPSS IBM 22.1 software program.
Results: We enrolled 66 patients with PTSD who were initiating CPAP for OSA for the first time. 41 subjects had completed the study protocol. Comparing Sensawake to the control group, there were no significant differences in mean age (41.2±8.5 vs 41.6±7.4), BMI (28.6 vs 29.6), AHI (18.9 vs 18.8) and ESS (10.9 vs 11.0) at baseline. After 4 weeks of therapy, the ESS (-3.0 (-1.8 - -4.1); p<0.001), ISI (-4.0 (-2.8 to -5.2); p<0.001) and FOSQ-10 (+2.6 (0.9 to 3.1); p=0.003) showed significant improvement in both groups. At 4 weeks there was no significant difference in CPAP adherence measured by percentage nights used (62.7 vs 61.1; p=0.83) in Sensawake versus control. However adherence in patients randomized to Sensawake was significantly higher in hours/nights used (4.6 vs 3.3; p=0.02), and showed a trend toward being higher in hours/total nights (3.3 vs 2.2; p=0.07). At 4 weeks the average AHI on CPAP (4.1 vs 5.5; p=0.38) was not significantly different in Sensawake vs control.
Conclusion: Adherence with Sensawake is significantly better when compared to standard therapy. Sensawake improves sleepiness and sleep related quality of life, and normalizes AHI.
Support (If Any): N/A.

0537

DURATION OF CPAP USAGE AND DAILY FUNCTIONING

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Introduction: Evidence suggests that, to maintain treatment effects, CPAP needs to be used every night. However it is not known the nightly duration of CPAP use required to normalize functioning. This study aimed to evaluate dose-response relationship between improvement of daily functioning and CPAP usage.
Methods: This study included 109 patients with mild to moderate OSA who used active CPAP in previously-performed RCT. Five patients are excluded from the study due to technical failures in measuring CPAP compliance. Patients used 8 weeks of active nasal CPAP, and completed the Functional Outcomes of Sleep Questionnaire (FOSQ) at baseline and after 8 weeks of CPAP treatment. To examine the relationship between CPAP duration and outcome, a piecewise regression analysis was performed. This analysis estimates separate dose-response relationships of participants with mean CPAP use below a specified threshold (first segment) and above a specified threshold (second segment).
Results: Changes from baseline to 8-week in FOSQ total score by CPAP use was positive for the 17 subjects with the lowest CPAP use category. The mean(SD) improvement was 1.05(2.19) with p=0.06. However, the mean changes were nearly equal to zero for those with mean use for the 37 subjects with >2-<4 hrs and for the 14 subjects with use >=4 to <5 hrs. The first category with a statistically significant improvement was among the 24 subjects with mean use >=5 to <6 (p=0.01) with a mean(SD) increase of 1.34(2.37) point from pretreatment baseline to Week 8. Mean improvements increased in a roughly linear way for higher use categories. Among the 10 subjects with mean use for >=6 to <7 hrs, the mean (SD) improvement was 2.52 (2.87) with p=0.02. Similarly, among the 7 subjects with mean use for >=7 hrs, the mean (SD) improvement was 3.25 (3.257) with p=0.01. Expected change is positive with at least 3.7 hours use. The predicted improvement does not reach the mean improvement of 0.90 points until mean CPAP use reaches at least 4.7 hours.
Conclusion: Our analyses suggest that a greater percentage of patients will achieve normal functioning with longer nightly CPAP duration.
Support (If Any): R01HL076101.

0538

CPAP TREATMENT IMPROVES LAPSE COUNT ON PSYCHOMOTOR VIGILANCE TASK TESTING IN PATIENTS WITH OSA: RESULTS OF A PILOT STUDY

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Introduction: Obstructive sleep apnea (OSA) is known to cause sleep fragmentation and hamper daytime performance. While patients with OSA often report a subjective improvement in daytime alertness with continuous airway pressure (CPAP) treatment, it is unclear if such therapy produces an objective increase in daytime vigilance. As part of a larger study, we compared the number of lapses (lack of response to visual stimulation for 500 msecs or longer) during psychomotor vigilance task (PVT) testing in patients with OSA before and after CPAP therapy to determine whether there was improvement in vigilance.
Methods: Sixty-nine adult patients (72.5% male; mean age 49.9 years, SD ±12.3) determined to have OSA by virtue of an apnea-hypopnea index [AHI] >5/hr on their diagnostic sleep study (mean AHI 41.9/hr, SD ±37.1) performed a ten-minute PVT test before and after adequate use of CPAP for a minimum of one month. Adequate CPAP use was defined as compliance of more than 4 hours per night for a minimum of 70% of nights, averaged over the preceding 30 days, and with an average residual AHI of <5/hr during that time period. The number of lapses before and after CPAP treatment was recorded and compared. A paired t-test was used to look for a significant difference in the mean number of lapses.
Results: There was a small but significant improvement in the mean number of lapses on PVT testing (1.9 post-treatment vs. 2.9 pre-treatment) in patients with OSA treated adequately with CPAP for at least a month (p=0.03).

Conclusion: Our pilot data suggest that treatment with CPAP improves daytime vigilance in patients with OSA. This has important implications in the management of patients with OSA, particularly those in whom sustained concentration is an essential employment skill, such as commercial drivers. Larger studies that explore the best predictors of improvement in PVT performance with CPAP treatment in patients with OSA are awaited.
Support (If Any): N/A.

0539

EVALUATION OF AN INNOVATIVE HEADGEAR DEIGN FOR A POSITIVE AIRWAY PRESSURE INTERFACE SYSTEM: A COMPARISON OF THE IMPACT OF 12 AND 15MM INTERNAL DIAMETER TUBING

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Introduction: Positive Airway Pressure (PAP) therapy is an effective means to treat sleep disordered breathing (SDB). The mask is an important component of the therapy experience and mask issues are identified as barriers to acceptance of therapy. To enhance comfort and stability of the mask, a design with tubing incorporated into the headgear was developed. The tubing is available with 12 and 15mm internal diameter. The aim of this trial was to test impact of 12mm compared to the 15mm internal diameter tubing on therapy and subjective preference.
Methods: In this prospective, randomized crossover study, participants received auto CPAP therapy with one headgear tubing configuration for a 10-day period and then crossed over to the other. Subjective aspects of comfort were measured with a 0 - 10 cm visual analog scale (VAS). Efficacy and pressure data generated by the PAP were analyzed.
Results: Forty-one compliant PAP participants diagnosed with Obstructive Sleep Apnea were enrolled. The mean age was 55.5 ± 12 years and a majority were male (63%). Although statistically different, there were minimal differences in AHI (2.6 ± 1.3 vs. 2.8 ± 1.4, p=0.043) [12mm vs 15mm tubing, respectively]. Differences in the average PAP pressure were not significant (7.7 ± 2.4 vs. 7.8 ± 2.5, p=0.29). According to the subjective preference VAS scores, the overall comfort rating was higher with the 12mm diameter tubing (9.2 ± 1.5 versus 8.4 ± 2.0, p=0.026). Participants felt that the ability to move was greater (9.2 ± 1.5 vs 8.4 ± 1.5, p=0.032) and rated flexibility of the system higher with the 12mm versus the 15mm tubing. (9.7 ± 0.7 versus 8.3 ± 2.1, respectively, p=0.001) The majority of patients preferred the 12mm tubing (56.7% vs 13.3 %).
Conclusion: Therapy was comparable between the 12mm and 15mm diameter tubing. Participants rated aspects of comfort higher with the 12mm tubing. These results suggest that the use of a smaller size tube may positively affect therapy. Future research is needed to evaluate the long term impact of the smaller diameter tubing on adherence.
Support (If Any): Philips Respironics.

0540

THE EFFECT OF CUSTOM FACE MASK ON THERAPEUTIC CPAP PRESSURE

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Introduction: The purpose of this study was to investigate the effect of therapeutic CPAP pressures when patients were fabricated a Custom Face Mask (CFM), which is used in combination therapy to treat OSA in patients who presented to a dental sleep center. The CFM is a custom CPAP face mask that is fabricated from an impression of the face and is then connected to the post attached to an oral appliance. This strapless CPAP face mask features a CPAP interface with mandibular stabilization.
Methods: A retrospective chart review of 35 CFM patients on combination therapy from 2006–2012 was conducted in 2015 to determine changes in therapeutic CPAP pressures when patients used the CFM in combination therapy.
Results: Average CPAP Pressures BEFORE CFM: 14cm H2O (+/- 4); Average CPAP Pressures AFTER CFM: 13cm H2O (+/- 3);Average Reduction in CPAP pressures (n=15): 4.3cm H2O; Average Increase in CPAP pressures (n=12): 1.6cm H2ONo change in CPAP pressures (n=8) The reason the 12 patients who had an increase in CPAP pressures (and the 8 patients with no change), is most likely that the OSA disorder may have actually become worse and the CFM is helping to keep these patients in effective therapy with the higher pressures. These patients were also on the higher end of BMI compared to the ones who had reduction in CPAP pressures. The other possibility is that these patients were under-titrated to begin with (intolerance of high pressures) and now they are able to tolerate these higher therapeutic pressures with the CFM thus allowing CPAP therapy to be effective.
Conclusion: The Custom Face Mask should be considered for patients that require high therapeutic CPAP pressures in order to resolve OSA. The CFM is able to handle high pressures, because it has a secure CPAP interface (made from an impression of the face) and by its direct attachment to an oral appliance, providing mandibular stabilization and advancement.
Support (If Any): None.

0541

ACCEPTANCE AND IMPACT OF TELEMEDICINE IN PATIENT SUB-GROUPS WITH OBSTRUCTIVE SLEEP APNEA: ANALYSIS FROM THE TELE-OSA RANDOMIZED CLINICAL TRIAL

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Introduction: The Tele-OSA study reported the impact of two telemedicine mechanisms (OSA web education [Emmi, Emmi Solutions Inc] and CPAP tele-monitoring with automated patient feedback [U-Sleep; ResMed Corp]) on CPAP adherence. This study specifically analyzes patient sub-groups regarding telemedicine acceptance and effectiveness.
Methods: Tele-OSA was a 4-arm randomized trial conducted at Kaiser Permanente sleep center (Fontana, CA) in patients referred for suspected OSA; 3-month CPAP adherence was the primary outcome. Results showed: 1) Tele-monitoring improved Medicare compliance (69.6% vs. 57.5%; p<0.01); 2) Web-education did not impact compliance but improved show-rates to their diagnostic appointment (68.7% vs. 62.7%; p=0.02). We evaluated patient sub-groups based on gender, age, OSA severity, and whether web-education was viewed.
Results: 1,455 subjects (49.0% male, 49.1 ± 12.5 years, AHI 22.7 ± 23.9) were enrolled; 556 prescribed CPAP.

Web-education Acceptance—726 received web-education, only 242 (33.3%) viewed the program. Gender nor age impacted view rates. Those that viewed had better: 1) appointment show-rates (91.7% vs. 57.1%, p<0.001); 2) CPAP Medicare compliance (75.7% vs. 63.6%, p=0.06) especially those ≥55 years old.

Tele-monitoring Acceptance—Of 263 patients in tele-monitoring groups, 22 (8.4%) declined feedback messaging. No patients requested discontinuation of messaging during follow-up.

Age—Adherence was better in the "elderly" (55+ years; n=501) than the "middle-aged" (35–55; n=715) and "young" (18–35; n=239); (average minutes on all days 279.1±137.2 versus 239.7±145.9 and 217.9±147.6; both p<0.01). Furthermore, tele-monitoring improved adherence in the "middle-aged" (262.5±138.9 vs. 214.2±150.0 minutes, p<0.01) and "elderly" (314.8±121.5 vs. 252.2±142.5 minutes, p<0.001) but not the "young" (212.2±135.0 vs. 221.9±157.4 minutes, p=0.79).

Gender—Gender did not impact adherence (men 258.0±139.1 vs. women 246.9±150.9 minutes, p=0.38) nor web-education view rates. Furthermore, the impact of tele-monitoring was similar in men and women.

OSA severity—319 (41.3%) had mild OSA, 199 (25.7%) moderate, and 255 (33.0%) severe. Tele-monitoring improved adherence in moderate/severe OSA (288.2±132.0 vs. 238.1±149.0 minutes; p<0.001) but not mild OSA (249.8±141.9 vs. 220.4±146.7 minutes; p=0.18).

Conclusion: CPAP tele-monitoring with patient feedback messaging has high acceptance while effectiveness was primarily in moderate/severe OSA. While web-education program view rates were lower than expected, viewing status may predict future CPAP adherence.

Support (If Any): ASMF Strategic Research Grant 104-SR-13 & ResMed Corp.

0542

A RETROSPECTIVE ANALYSIS OF ADHERENCE TO PAP THERAPY WITH A PATIENT MANAGEMENT SERVICE

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Introduction: Maximizing adherence to Positive Airway Pressure (PAP) is a challenge. Patient engagement, management by non-physicians, the use of technology and motivational enhancement can have a positive impact on adherence to PAP therapy. A structured Patient Adherence Management Service (PAMS) leverages DreamMapper, a mobile application, tailored patient messaging, and motivational techniques to improve adherence to continuous positive airway pressure therapy. Data from a large cohort of patients receiving the service were compared to a sample of patients undergoing treatment without the service.

Methods: In this retrospective analysis, all patients had at least 90 days of data recorded in a secured data base (EncoreAnywhere, Philips Respironics, USA). Patients in the PAMS program were matched to a group of patients not supported by the PAMS program based on set-up date, gender, and the presence of modems. All data were collected between May 2013 and August 2016. In each group (PAMS and Standard Care (SC)), 8939 patients were included. Therapy data (adherence, leak, AHI_{flow}) were analyzed using Independent-Samples t-test. The proportion of patients meeting Centers or Medicare Services (CMS) adherence criteria at 30 and 90 days were analyzed using Fisher's Exact Test.

Results: Adherence at day 90 was 5.2±2.1 and 3.9±2.8 hours for the PAMS and SC groups, respectively (p < 0.001). The percent of days with use for the PAMS group was 81.4±23.4 and 63.9±35.3 for the SC group (p < 0.001). At 30 days of treatment, 50.1% in the SC group and 75% in the PAMS group met CMS Adherence Criteria (p < 0.001). At 90 days, 62.4% (SC) and 89.5% (PAMS) met CMS Adherence Criteria (p < 0.001).

Conclusion: In this analysis, the PAMS group consistently demonstrated greater nightly hours of use and a greater proportion met CMS adherence requirements at 30 and 90 days.

Support (If Any): Philips Respironics.

0543

CPAP ADHERENCE IN VETERANS WITH OBSTRUCTIVE SLEEP APNEA (OSA) EVALUATED IN INDIVIDUAL VERSUS GROUP CLINIC VISITS

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Introduction: The prevalence of sleep disorders is very high among veterans. To improve access for veterans suspected of sleep disordered breathing, we developed a group (intake) clinic. The purpose of our study was to compare CPAP adherence between patients seen in group clinics and patients seen in individual clinic visits, with a pre-specified hypothesis that the objective compliance with CPAP therapeutic recommendations would be similar.

Methods: We reviewed records of new, consecutive patients seen at the Atlanta Veterans Affairs (VA) Sleep Clinic starting 7/1/2015. In the intake clinic, veterans suspected of having OSA were seen by a sleep clinician as part of a group assessment and educational activity. The other patient cohort was seen in traditional individual clinic visits. We reviewed 50 consecutive patients from each cohort who were diagnosed with OSA after a sleep study and were initiated on CPAP therapy. Most recent CPAP adherence was determined using a cloud-based system. CPAP compliance data was not available in 4 patients from the intake and in 3 patients from the individual clinic cohort.

Results: 93 veterans were included in the analyses. They were mostly male (90.3%) and African-American (69.2%); 24.2% were Caucasian. Mean age was 53.8 years and mean BMI was 31.57. There were no significant differences between the two cohorts in demographic characteristics or Epworth Sleepiness Scale scores at initial visit (mean score 14.09 vs. 14.27 respectively, p>0.05). Most recent CPAP download (mean 281 days±104 days) showed no significant difference between the intake and individual cohorts in percentage of nights CPAP was used (mean 37.37% of nights used vs. 33.35% respectively, p>0.05), in percentage of nights CPAP was used four or more hours (mean 23.15% vs. 23.40% respectively, p>0.05), in the average time CPAP was used (211 minutes on nights CPAP was used vs. 214 minutes respectively, p>0.05).

Conclusion: There was no significant difference in CPAP adherence between veterans with OSA seen initially in group clinics as compared to individual clinics. We recommend further development and increased utilization of group clinics at VA facilities in order to shorten wait times for initial evaluation for OSA.

Support (If Any):

0544

A BRIEF SURVEY PREDICTING CONTINUOUS POSITIVE AIRWAY PRESSURE ADHERENCE

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Introduction: The CPAP non-adherence has been found that is a complex clinic problem associated with multiple factors. According to the theories of Reasoned Action and Interpersonal Behavior in social psychology, an individual's past habitual behavior and behavior intention on a future behavior are the most important factors determining the future behavior. We hypothesized that a patient's past sleep habit (PSH) and behavioral intention (BI) on CPAP therapy predict the patient's CPAP adherence. We developed a brief PSH-BI survey to exam this hypothesis.

Methods: 94 consecutive patients who were newly diagnosed OSA from October 2015 to May 2016 in our sleep center completed the

brief survey before receiving their CPAP devices. 72 of 94 participants repeated the survey after they used their CPAP devices for 30 - 90 days. 94 data of CPAP adherence were downloaded from each participant's CPAP device.
Results: Using the enter method of multiple regression analysis, we found from: (1) the survey of pre-CPAP therapy, the level of PSH-BI explained a significant amount of the variance in CPAP adherence, R^2 = .066, R^2 adjusted = .046, F(2, 91) = 3.27, $\rho < .05$. Although the level of PSB did not significantly predicted CPAP adherence (β = -.071, t(91) = -.688, ns), the level of BI significantly predicted CPAP adherence (β = .249, t(91) = 2.456, $\rho < .05$); (2) the survey of post-CPAP therapy, the level of PSH-BI explained a significant amount of the variance in CPAP adherence, R^2 = .213, R^2 adjusted = .190, F(2, 69) = 9.34, $\rho < .01$. Both levels of PSB and BI significantly predicted CPAP adherence (β = -.262, t(69) = -2.268, $\rho < .05$; β = .381, t(69) = 3.561, $\rho < .01$, respectively).
Conclusion: A patient's behavioral intention on CPAP therapy played a key role of predicting a short and long term CPAP adherence.
Support (If Any):

0545

THE RELATIONSHIP OF HYPOPNEA APNEA RATIO (HAR) TO EFFECTIVE POSITIVE AIRWAY PRESSURE FOR OBSTRUCTIVE SLEEP APNEA HYPOPNEA SYNDROME

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Introduction: The pathophysiology of apneas is distinct from that of hypopneas. Apneas reflect static obstruction with absent flow, while hypopneas reflect dynamic obstruction with decreased flow. We propose that hypopneas and respiratory-effort related arousals (RERAs) are eliminated with lower positive airway pressure (PAP) than apneas, and both higher HAR and higher RAR (RERA+hypopnea/apnea ratio) are associated with lower optimum PAP due to a lower critical closing pressure (Pcrit).
Methods: We performed a retrospective chart review in a sample of 150 consecutive adult patients with obstructive sleep apnea hypopnea syndrome (OSAHS), defined by a total Respiratory Disturbance Index (tRDI) of ≥ 5 apneas, hypopneas, and RERAs per hour of sleep. Polysomnography was scored using AASM 2016 Version 2.3 guidelines using both option 1a (tRDI) and 1b (apnea hypopnea index [AHI]) criteria. Polysomnographic data were collected; HAR and RAR were calculated. The primary outcome was a correlation between HAR and RAR and optimum PAP, where HAR and RAR were the main independent variables, and the level of optimum PAP was the main outcome variable. Data were analyzed using a 2-tailed Student's t-test for continuous variables. The level of statistical significance was defined as $p < 0.05$.
Results: Among 76 men and 74 women aged 54.7 ± 14.2 years with a mean body mass index (BMI) of 37.6 ± 11.5 kg/m^2 and a mean AHI of 30.2 ± 31.3, optimum PAP was significantly lower with higher HAR ($p = 0.037$) and higher RAR ($p = 0.00002$). In addition, hypopnea index, AHI, tRDI, and BMI also had a significant direct association with PAP ($p < 0.001$), while the oxygen saturation nadir had a significant inverse association ($p < 0.001$). Apnea index and optimum PAP were not significantly related. We also observed a significant association between BMI and both HAR ($p < 0.0001$) and RAR ($p < 0.001$).
Conclusion: OSAHS with a preponderance of hypopneas and paucity of apneas requires a lower level of PAP, suggesting a distinct pathophysiology of hypopnea-predominant OSAHS with lower Pcrit.
Support (If Any): None.

0546

USE OF WIRELESS MODEM TECHNOLOGY FOR CPAP TREATMENT OF OSA IN VETERANS WITH TBI AND PTSD

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Introduction: Initiation and adherence to positive airway pressure (PAP) therapy for obstructive sleep apnea (OSA) can be challenging, especially among Veterans with neuropsychiatric conditions such as traumatic brain injury (TBI) and post-traumatic stress disorder (PTSD). We hypothesized that wireless modems with telehealth follow-up would improve initiation and adherence to PAP therapy in these populations.
Methods: Participants were consented from the VA Portland Health Care System Sleep Disorders Clinic over 18-months during the overnight sleep study. Midway through the study, the clinic changed from usual care—a clinic visit at 3 months after machine issue—to wireless modems with PAP therapy plus telephone follow-up at 9 days, 4 weeks, and 3 months after machine issue. Symptom data were assessed at baseline, 3, and 6 months using validated questionnaires on insomnia (ISI) and mood (PHQ-9, PCL-5).
Results: Among 603 Veterans consented, 82.8% were diagnosed with OSA. Some receiving PAP therapy had no evidence of initiating use ("non-users": 23.2% usual care versus 11.3% modems). Those with PTSD and comorbid TBI+PTSD were more likely to be non-users ($X^2 = 9.52$, $P < 0.05$). Adherence to therapy at 3 months was not significantly different between TBI, PTSD, or TBI+PTSD versus neither condition, and was not significantly different between modem and usual care. There was not a significant difference in symptom severity at 3 or 6 months between modem and usual care. Insomnia and depression were significantly worse at 3 and 6 months in those with untreated OSA compared to those on PAP therapy (ISI: $t = 2.07$, $P < 0.05$; PHQ-9, t=2.83, $P < 0.01$).
Conclusion: Our data suggests greater initiation of PAP therapy using modem technology with telehealth compared with usual care. Veterans with PTSD and TBI+PTSD are more likely to be non-users compared to those without PTSD. Early interventions addressing barriers to adherence in those with PTSD may be warranted. Trajectory and regression analyses of other factors that affect adherence are ongoing.
Support (If Any): VA Nursing Postdoctoral Fellowship-KBW; Sigma Theta Tau-Beta Psi-KBW; VA CDA-MML; Portland VA Research Foundation- MML, YB; NIH EXITO Institutional Core-MML, DP.

0547

THE IMPACT OF SEDATIVE HYPNOTIC MEDICATION ON COMPLIANCE IN PATIENTS WITH PTSD AND OSA WHO ARE TREATED WITH CPAP THERAPY

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Introduction: Patients with Post Traumatic Stress Disorder (PTSD) frequently have co-morbid obstructive sleep apnea (OSA). Patients with comorbid PTSD/OSA have poor compliance with CPAP and worsened clinical outcomes. Previously published data from our lab has shown that non-benzodiazepine sedative hypnotics (NBSHs) improve CPAP compliance. However, the effect of NBSH on CPAP adherence in patients with co-morbid PTSD has never been tested.
Methods: This is a subset analysis of a prospective, randomized, single-blind, cross-over study comparing standard auto-set CPAP to

auto-set CPAP with the Sensawake comfort feature added. Patients diagnosed with OSA and reporting a history of PTSD who were CPAP naïve were approached for enrollment. Four weeks after randomization, patients crossed over to the other treatment group, with final follow-up at eight weeks. Data on NBSH use chronically, during the initial PSG, or during follow-up was abstracted. All statistical analyses were performed using SPSS IBM 22.1 software program.

Results: We enrolled 41 patients with co-morbid OSA/PTSD who were initiating CPAP for the first time. Mean age, BMI and AHI were 40.7 ± 8.0, 28.9 ± 6.8 and 11.6 ± 20.4 respectively. Average McChord and Epworth Sleepiness Scores (ESS) were 32.7 ± 14.9 and 11.5 ± 6.0 respectively. During the diagnostic PSG and CPAP initiation 16 (57.1%) and 13 (40.6%) patients received a NBSH, either eszopiclone or zolpidem. Use of a NBSH, whether for PSG or CPAP initiation, did not affect adherence at 4 weeks measured by percentage nights used (57.6 vs 64.9 (p=0.54) and 62.8 vs 62.0 (p=0.94)), hours per night used (4.3 vs 3.8 (p=0.45) and 4.8 vs 3.8 (p=0.16)) or hours used per night (2.7 vs 2.9 (p=0.80) and (3.2 vs 2.9; p=0.70) respectively. After 4 weeks of therapy, the ESS (-3.0 (-1.8 - -4.1); p<0.001), ISI (-4.0 (-2.8 to -5.2); p<0.001) and FOSQ-10 (+2.6 (0.9 to 3.1); p=0.003) showed significant improvement, but NBSH use, either during PSG or at CPAP initiation, did not affect the magnitude of improvement.

Conclusion: Initial data from our study shows that for patients with comorbid OSA/PTSD, NBSH use does not affect CPAP compliance of symptomatic improvement.

Support (If Any):

0548

EPWORTH SLEEPINESS SCALE SCORE CHANGES IN RESPONSE TO SLEEP DISORDERED BREATHING TREATMENT WITH POSITIVE AIRWAY PRESSURE IN A LARGE CLINIC BASED COHORT

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Introduction: Excessive Daytime Sleepiness (EDS) in Sleep Disordered Breathing (SDB) represents a clinically relevant, specific phenotype which modifies the relationship of clinically important outcomes. We leverage a well-phenotype large clinical cohort to address the hypothesis that Positive Airway Pressure (PAP) reduces propensity of dozing in moderate to severe SDB more so than mild SDB.

Methods: Questionnaire-based Epworth Sleepiness Scale (ESS) scores of 2,211 patients with SDB who initiated PAP (1/1/2010–12/31/2014) were retrospectively analyzed. Paired and two sample t tests were used to evaluate ESS changes with PAP stratified on PAP adherence (≥ 4 hours nightly ≥ 70% of the time). Post-PAP ESS scores were estimated using multi-variable linear regression models adjusted for pre-PAP score, age, gender, race, socioeconomic status, smoking, BMI, sleep duration, anti-depressants, co-morbidities (cardiac risk factors, cardiac disease, cancer chronic renal failure, depression and stroke). Statistical interactions of Patient Health Questionnaire-9 (PHQ-9), BMI and ESS were examined.

Results: Mean age was 56.2 ± 13.2 years, 45.7% females, and 76.0% Caucasian. Overall, ESS scores improved after PAP (2.4 (4.3), p < 0.01). Patients with baseline ESS score ≥ 10 had ESS improvement compared to < 10 (4.3 versus 0.7, p < 0.001). Patients with severe SDB had significant improvement in unadjusted ESS scores (2.7 versus 2.1, p=0.025). ESS improved by 2.7 (4.2) in those with meeting objective adherence criteria versus 1.9 (4.0) in the non-adherent group. Model adjusted ESS improved by 0.48 points (p=0.023) in patients with severe SDB versus mild SDB. Among patients with severe depressive symptoms, higher BMI was associated with higher post-PAP ESS score.

Conclusion: PAP therapy is associated with improved EDS in this large clinic-based cohort with findings most pronounced in those with more severe SDB, with baseline hypersomnia and adherent to PAP. Higher depressive symptoms burden and obesity were associated with resistance to PAP hypersomnia responsiveness.

Support (If Any): We acknowledge the Knowledge Program Data Registry of Cleveland Clinic, Cleveland, OH for providing the data used in this retrospective analysis. We further acknowledge the Neurological Institute Center for outcome Research and Evaluation (NICORE) Cleveland Clinic, Cleveland, OH for providing bio-statistical support for this study.

0549

PATIENT EXPERIENCE WITH ADAPTIVE SERVO-VENTILATION SERVO-VENTILATION

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Introduction: A large proportion of patients with longstanding heart failure have central sleep apnea, and experience disturbed and unrefreshing sleep from prolonged hypoxemia. Adaptive servo ventilation (ASV) was demonstrated to eliminate obstructive and central sleep apnea, correct hypoxemia, and improve cardiac function and exercise capacity. However, a recent prospective trial showed that ASV was associated with an increase in mortality among subjects with chronic severe heart failure with reduced ejection fraction. Despite recommendations of caution in its use, many patients choose to continue to use ASV. This study examines patient experience with ASV in an academic medical center after warnings about ASV safety.

Methods: Upon publication of ASV safety concerns, letters were sent to all patients in our clinic prescribed BiPAP Auto-SV or BiPAP Auto-SV Advanced, asking them to schedule an appointment to discuss their use of ASV. A 10-question survey was also sent to patients. Deaths were reported by responses sent by family members or caretakers if applicable.

Results: Of 52 surveys sent, nine (17.3%) were completed and returned. Two of the nine subjects (22.2%) were deceased. Four of the seven living respondents (57.2%) had used ASV for greater than 5 years. Five of seven patients (71.4%) had previously used CPAP, of whom 3 reported that CPAP was "not as good as ASV". The other two were unsure if they preferred CPAP or ASV. All seven living respondents indicated that they sleep better with ASV and benefit from it. Six of seven (85.7%) indicated that they would not discontinue ASV despite reviewing safety alert letters, while one respondent was "unsure". The most common reason for being unlikely to stop ASV was "sleeping better since starting ASV" (57.1%), followed by "cannot sleep without it" (28.6%) and "it is helping with my health overall" (28.6%). One responded "not concerned enough about the warning".

Conclusion: Our patients have a favorable subjective experience with ASV, to the extent that patient-perceived benefits resulted in continued adherence despite warnings of possible adverse consequences.

Support (If Any): Not applicable.

0550

DESCRIPTION OF THE ADAPTIVE SERVO-VENTILATION SAFETY RECALL AT A SINGLE ACADEMIC CENTER

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Introduction: Adaptive servo-ventilation (ASV) is a PAP modality prescribed for central sleep apnea (CSA). A safety notice was issued in 2015 for patients with congestive heart failure (CHF; ejection fraction [EF] ≤ 45%) and CSA treated with ASV based on the SERVE-HF study that found a 2.5% absolute increased risk of annual cardiovascular mortality in CHF-CSA patients on ASV compared to controls. Physicians were advised to discontinue ASV in these patients. This project was designed to evaluate the long-term mortality for CHF-CSA patients prescribed ASV.
Methods: After IRB approval, retrospective chart review was performed for CHF-CSA patients started on ASV 2006 -2015 at Mayo Clinic Arizona.
Results: Of 305 patients prescribed ASV, 23 patients were identified with an EF ≤ 45% and CSA (defined by an apnea-hypopnea index [AHI] ≥ 15/hour with > 50% central events). Mean age was 81 ± 11 years (96% male). Mean EF was 32.6 ± 13%. Mean AHI was 51 ± 20/hour with a CAI of 34 ± 18/hour. Mean follow-up from initial sleep evaluation was 3 ± 0.5 years. 16 (70%) have died (Mean EF 31 ± 10% and AHI 51 ± 20)). Causes of death were CHF(6), cancer (2), and unknown (8). Two were on ASV at time of death, 1 had stopped ASV, and ASV status was unknown in the rest. Of the 7 survivors, 1 elected to convert to CPAP after the safety notice, 2 remained on ASV, and 4 had no follow-up but were on ASV at last contact. Mean EF for those alive was 37 ± 16% and AHI 48 ± 21.
Conclusion: Our study shows a high mortality rate of 70% for patients with EF ≤ 45% and CSA prescribed ASV. Given the small number of patients, absence of a control group, and high age of our cohort, it is unclear whether ASV use was associated with death in our cohort.
Support (If Any):

0551

BILEVEL PAP EXPERIENCE IN A COMMUNITY SLEEP CENTER

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Introduction: Bilevel titration in OSA is used for patients with CPAP intolerance, or for incomplete correction with maximal CPAP pressure. We present our one year experience with BiLevel use in a community sleep lab.
Methods: Retrospective data evaluation of all Bilevel patients. Patients undergoing re-titration were excluded from the study. Variables measured included demographics, comorbidities, baseline RDI and titration RDI, use of supplemental oxygen, type of device and interface, presence of leaks, patient's subjective sensation of sleepiness (ESS), average REM percentage, and time spent under 90% and 88% of oxygen saturation. Patients were subdivided into four subgroups based on lowest achieved RDI: Excellent with RDI < 5, Good RDI < 10, Fair RDI < 15, and Poor with RDI > 15.
Results: Of the 133 patients who underwent Bilevel titration, 73 (55%) had excellent RDI, 25 (19%) good RDI, 14 (10%) fair RDI, and 21 (16%) had a poor RDI. In comparison to the excellent RDI group, patients in the poor RDI group had higher overall post RDI and ESS, arousal index, oral leaks, treatment emergent events and central apnea index. They had lower sleep efficiency and spent more time under O2 saturation of 88% (24% vs 17%). Although they had a higher percentage of patients with no leaks, they still had an overall higher percentage of oral leaks. No difference was noted with device type or interface used.
Conclusion: 1. 16% of patients did not achieve effective pressure on the first night of titration. 2. As a group they had lower sleep efficiency, higher arousal index, and spent increased time under 88% oxygen saturation. 3 . Oral leaks may have played a role. 4. Would analyse if ineffective EPAP played any role.
Support (If Any): None.

0552

"CMS SCORING OF TITRATION STUDIES LEADS TO INADEQUATE CPAP RX"

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Introduction: For simplicity & to comply with CMS requirements for reimbursement, most sleep labs have switched from AASM-scoring rules to CMS-scoring for all their studies, including Home Studies. This practice understates the Cpap level required to eliminate sleep-disordered breathing, & leads to inadequate Cpap therapy. On baseline PSG's and Home studies such scoring may also deprive patients of needed Cpap therapy.
Methods: 39 patients underwent Cpap-Titration PSG's, & Cpap level to control OSA was determined by both CMS and AASM-scoring & titration guidelines, of 5 board-certified Professors of Sleep Medicine at an academic sleep center.
Results: 29 of the 39 Titrations were deemed "adequate", both by the interpreters understanding of the AASM AND CMS-scoring guidelinesIn the "adequate" group, AASM-scored Cpap levels ranged from 10–20 cm, while the CMS-scored group were considerably lower, ranging from 4 to 18 cm. Mean AASM-scored Cpap level was 14 cm, while CMS-scored Cpap level was 8. If the CMS scoring was used to prescribe Cpap rx, the cpap level would have averaged 6 cm lower than required to control Hypopneas with arousal AND RERA's, ignored in CMS scoring. Range was 2–14 cm higher by AASM than CMS-recommended cpap.
But, In the one quarter of the patients who were in the "optimal', Cpap levels were quite similar by either scoring method.
Conclusion: In conclusion, If the minority of patients in whom an optimal pressure with 15 minutes supine-REM cannot be identified, then AASM guidelines should always be used to titrate an adequate Cpap level to provide control of Sleep-Disordered Breathing. Moreover, on baseline PSG's and Home studies such CMS-scoring with AHI<5, this may also deprive patients of needed Cpap therapy, despite comorbidities, symptoms, & prior helpful Cpap therapy
Support (If Any):

0553

THE EFFECT OF COMPLIANT CPAP USE ON WEIGHT LOSS

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Introduction: Obstructive sleep apnea (OSA) is a condition characterized by repetitive episodes of upper airway collapse during sleep. The effects of intermittent hypoxia and re-oxygenation may provoke multiple pathological cascades, leading to an association between OSA with obesity, metabolic syndrome, and cardiovascular disease.

Sleep fragmentation, which exists in OSA, leads to elevation of pro-inflammatory cytokines and catecholamines, which are associated with increased visceral fat production and BMI.OSA is treated with continuous positive airway pressure (CPAP). Patients who are compliant with CPAP have improved hypoxia and decreased risk of cardiovascular events. This study evaluated the relationship between weight change and CPAP therapy. Our hypothesis was that compliant CPAP therapy would improve the metabolic derangements in OSA, leading to weight loss.

Methods: A chart review of newly diagnosed OSA patients over a six-month period was conducted. Subjects were followed for two years and divided into compliant and noncompliant groups. Compliance was defined as CPAP use for at least four hours per night or 70% duration. Co-morbid conditions commonly affecting weight, including COPD, DM, CHF, and active cancer, were recorded. Participation in a weight loss program and the severity of OSA defined by the apnea-hypopnea index were also recorded. The primary outcome was the overall change in weight after one and two years. Secondary outcomes were the effects of age, sex, co-morbid conditions, concomitant weight loss programs, and OSA severity on weight changes.

Results: No baseline demographic differences were found between the compliant and noncompliant groups. There was no significant mean weight change between the groups at one or two years. There was no difference in the number of subjects who lost weight between the two groups at one year (40% vs. 47%, respectively) or at two years (41% vs. 50%, respectively). There were no differences between the groups in co-morbid conditions (55% vs. 58%, respectively) or those who participated in weight loss programs (8 vs. 4, respectively).

Conclusion: CPAP may not directly lead to weight loss. However, effective therapy should lead to better sleep, thus minimizing fluctuations in cytokines and improving metabolic derangements and general health.

Support (If Any): None.

0554

PSG AND CPAP USE BEFORE AND AFTER BARIATRIC SURGERY: A FIVE YEAR COHORT STUDY

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Introduction: Studies have showed that nearly 100% of morbidly obese men and 60–70% of women have obstructive sleep apnea (OSA). A polysomnography (PSG) study is used to establish the diagnosis and parameters for continuous positive airway pressure (CPAP) therapy. PSG is commonly recommended prior to bariatric surgery to assess for the presence of OSA and possible anesthetic complications. After surgery patients are to continue CPAP until a repeat sleep study is done to re-evaluate the need for CPAP. Currently there are not many studies that look at the prevalence of CPAP in the pre/post-op period in minority patients in an urban tertiary care center.

Methods: Observational cohort study of morbidly obese patients who had polysomnography (PSG), received diagnosis of OSA and were prescribed CPAP treatment prior to bariatric surgery. Follow-up was done at 5 years post procedure.

Results: From 2010–2011, 121 patients had PSG prior to bariatric surgery at Brookdale Hospital. 100 patients were female and 21 were male. 70 of patients were black, 42 patients were Hispanic, and 8 were other ethnicities. 61 patients used CPAP consistantly prior to surgery. In the group using CPAP average age was 36.7 years and BMI was 49.8. The non-compliant group had an average age of 39.7 years and BMI of 48.0. None of the patients in the study had immediate complications post-surgical procedure. After 5 years, 15 patients continued to use CPAP and 2 patients in this group had a repeat PSG after surgery. Chi-squared and student t-test were used to analyze sex, age, ethnicity, BMI and there were no statistically significant differences between the two groups.

Conclusion: Our study showed that there was no correlation between OSA and post-op complications which calls into question the need for PSG prior to bariatric surgery. Roughly half of the patients were compliant with CPAP prior to surgery and only 2 patients followed up for a repeat PSG. Possible reasons for lack of compliance with therapy include nasal discomfort, cost and lack of knowledge. More studies need to be done regarding the utility of PSG before and after bariatric surgery.

Support (If Any): None.

0555

A STUDY OF THE IMPACT AND MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA IN THE POSTMENOPAUSAL WOMEN

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Introduction: Menopause is a universal event in midlife, occurring around the age of 50 years. It is associated with physical, psychosocial, sexual and vasomotor symptoms. The prevalence of Obstructive Sleep Apnea (OSA) increased about four fold in postmenopausal women. The management of menopause has changed dramatically due to the controversy of hormone replacement therapy (HRT). It became more challenging in primary care delivery with non-drug therapy for menopause. In this study, we investigate the management of OSA and its impact in the postmenopausal women.

Methods: Postmenopausal women were screened for OSA. Patients with HRT were excluded. Co-morbidities were recorded. The menopause symptoms were measured with a 29-item menopause-specific validated instrument (MENQOL) that evaluated the effect on 0 to 6 Likert scale. Forty-one patients without CPAP had mean age [±SD], 62 ± 9; BMI 34.9 ± 7.5; AHI, 16.4 ± 12.4; RDI, 30.3 ± 14.7. MENQOL vasomotor domain (sum of 3 items), 5.3 ± 5.4; physical (sum of 16 items), 45 ± 19.5; psychosocial (sum of 7 items), 15 ± 9.7; sexual (sum of 3 items), 5 ± 6.2; Total, 70.5 ± 33.8. Fifty patients who received CPAP treatment had mean age, 65 ± 9; BMI, 34.9 ± 7.6; length of treatment (months), 23 ± 28 (1–120); MENQOL vasomotor, 4.8 ± 5; physical, 34 ± 20.3; psychosocial, 10 ± 8.3; sexual, 2.5 ± 4.5; Total, 51.6 ± 32. Difference and association between the two groups were examined using independent t- test and Pearson correlation respectively with IBM SPSS. A P-value < 0.05 was considered statistically significant.

Results: In group with no CPAP, Pearson correlation analysis showed the vasomotor domain correlated with age (P=0.024) and psychosocial with BMI (P=0.004). MENQOL was not correlated with AHI or RDI. In group with CPAP, MENQOL was not correlated with the length of CPAP treatment. The CPAP group, as compared with no CPAP, had greater reduction in MENQOL Total (P = 0.008), psychosocial (P=0.014), physical (P=0.009), and sexual (P=0.032). No correlation was observed between MENQOL and co-morbidities such as hypertension, diabetes mellitus II, chronic pain, depression, and hypothyroidism.

Conclusion: Menopause symptoms in physical, sexual and psychosocial domains in patients with OSA were significantly improved after

CPAP treatment. Screening and management of OSA should be recommended to menopause patients who are not under HRT.
Support (If Any): OU-HCOM.

0556

A NOVEL MOUTHPIECE DEVICE DESIGN FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: Continuous positive airway pressure (CPAP) devices are considered as the first line therapy for obstructive sleep apnea syndrome (OSAS). However, there is an increasing tendency to use oral appliance as an alternative treatment due to poor patient compliance of CPAP devices. The most commonly used techniques to evaluate the efficacy of the novel oral appliances in the treatment of obstructive sleep apnea syndrome (OSAS) are magnetic resonance image segmentation of upper airway structures and polysomnographic variables. This study aims to evaluate the efficacy of a novel mouthpiece device on patients with OSAS by the comparison of oropharyngeal volume and polysomnographic variables with and without the device. The proposed mouthpiece device design increases intraluminal pressure by using patients' own breath while reshaping the lower jaw and tongue position.
Methods: Each patient (targeted n=8) underwent magnetic resonance imaging (MRI) of the upper airway during wakefulness at baseline and with the novel mouthpiece device. Since the proposed novel mouthpiece device design allows patient to breathe orally, the oropharyngeal volume change has been evaluated instead of the velopharyngeal volume. The oropharyngeal volumes of the participants have been reconstructed as 3D models from the acquired MRI images.Afterwards, each patient attended the sleep laboratory (Kozyatagi Acibadem Hospital, Istanbul, Turkey) on two nights with and without the novel mouthpiece device for full diagnostic polysomnography.
Results: The results (current n=5) show that the use of proposed device enlarged the oropharynx volume 75% on average while reducing the apnea hypopnea index by 60% on average. On the other hand, the polysomnographic variables have been significantly improved by the use of novel mouthpiece device. The oxygen desaturation index reduced 54% on average. Lowest oxygen saturation values improved 6.5% on average.
Conclusion: The clinical results show that the proposed mouthpiece design offers a promising alternative oral appliance for OSAS patients.
Support (If Any): -

0557

THE ROLE OF NIGHTLY ZOPICLONE ON OBSTRUCTIVE SLEEP APNEA SEVERITY AND SYMPTOMS IN PEOPLE WITH LOW TO MODERATE RESPIRATORY AROUSAL THRESHOLDS: A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED TRIAL

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Introduction: Single-night studies indicate that hypnotics can worsen obstructive sleep apnea (OSA) in some people and reduce OSA severity in others. However, clinical trial data beyond night 1 is lacking. Accordingly, this study aimed to determine the effects of 1 month of nightly zopiclone on OSA severity and next day sleepiness and alertness in people predicted to yield a reduction in OSA severity with zopiclone (ACTRN12613001106729).
Methods: Screening polysomnography (PSG) quantified the respiratory arousal threshold (nadir epiglottic pressure prior to arousal) and nadir SaO_2 in 69 individuals. 30 eligible OSA patients (AHI =22.4 ± 11.3 events/h sleep) with a low to moderate respiratory arousal threshold (0 to -25cmH_2O) and nadir SaO_2 ≥75% then underwent PSG on three occasions at baseline, night 1 and night 30. Participants received either nightly zopiclone (7.5 mg) or placebo during the 30 day trial according to a double-blind, randomized, parallel design. Subjective sleepiness (ESS and KSS) and next day alertness during a 30 minute driving simulator task (AusEd) were performed at each visit.
Results: The mean reduction in AHI from baseline on night 30 was 5.9 ± 10.2 during zopiclone vs. 2.4 ± 5.5 events/h sleep during placebo (p=0.2). The change in nadir SaO_2 was also not different between zopiclone and placebo (-0.9 ± 3.2 vs. -0.1 ± 5.6 %, p=0.6). Similarly, neither the change in ESS (-1.3 ± 2.7 vs. -0.2 ± 2.4), KSS (0 ± 1.8 vs. 0 ± 1.7) or steering deviation (0.3 ± 4.4 vs. 3.9 ± 10.3 cm) during the AusEd driving task from baseline to night 30 significantly differed between zopiclone vs. placebo (p>0.05).
Conclusion: One month of nightly zopiclone does not worsen OSA severity, daytime sleepiness or simulated driving performance in OSA patients with low to moderate respiratory arousal thresholds who do not have major hypoxemia at baseline. These findings challenge previous assumptions about the role of hypnotics in these patients.
Support (If Any): National Health and Medical Research Council of Australia (1042493).

0558

DRONABINOL REDUCES AHI AND DAYTIME SLEEPINESS IN PATIENTS WITH MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: There remains an important unmet need for fully effective and acceptable treatments in OSA, and at present there are no approved drug treatments. We previously published findings from a small-scale clinical pilot study showing promise for the nonselective cannabinoid agonist dronabinol as a potential OSA pharmacotherapy. Here, we present initial findings of the PACE (Pharmacotherapy of Apnea by Cannabimimetic Enhancement) trial, a fully-blinded two-center Phase II randomized placebo-controlled trial of dronabinol in patients with OSA.
Methods: By random assignment, 56 adult subjects with BMI<45, Epworth Sleepiness Scale (ESS)>7 and PSG-documented AHI between 15 and 50 received either placebo (N=17), 2.5mg (N=19) or 10.0mg (N=20) of dronabinol daily, one hour before bedtime for 6 weeks. Repeat in-laboratory PSG followed by maintenance of wakefulness (MWT) testing was completed every 2-weeks during the treatment period. At each visit, the ESS and Treatment Satisfaction Questionnaire for Medications also were completed.

Results: Overall, baseline AHI was 26.0±11.6(SD), MWT latency was 19.9±12.0 min, BMI was 33.8±5.4 kg/m^2 and these were equivalent among all treatment groups. ESS and Age differed slightly among placebo, 2.5mg and 10mg treatment groups: ESS=11.5±3.8, 10.1±3.7, 13.7±3.7 (p=0.01); Age=58.8±6.1, 52.7±7.7, 54.7±7.0 (p=0.04), respectively. In comparison to placebo, the end of treatment changes in AHI were -13.2±4.0 (p=0.001) and -9.7±4.1 (p=0.02) for the 10 and 2.5mg dronabinol groups, respectively. ESS did not change significantly with treatment in the placebo or 2.5mg groups, but decreased by 4.0±0.8 (p=0.0001) units for subjects receiving 10mg dronabinol. There were no significant changes in MWT latency or BMI with treatment in any group. The above conclusions were not altered after controlling for baseline ESS and Age. Subjects receiving 10mg dronabinol also expressed the greatest overall satisfaction with treatment (p=0.02).
Conclusion: These findings support the therapeutic potential of cannabinoids in patients with OSA. In comparison to placebo, 6 weeks of treatment by 10mg/day dronabinol was associated with lower AHI, improved subjective sleepiness and greater overall treatment satisfaction, but objective sleepiness did not improve. Larger scale clinical trials will be necessary to clarify the best potential approach(es) to cannabinoid therapy in OSA.
Support (If Any): National Institutes of Health UM1HL112856.

0559

OBSTRUCTIVE SLEEP APNEA AND SEROTONIN REUPTAKE INHIBITORS IN PEOPLE WITH AND WITHOUT EPILEPSY

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Introduction: Obstructive sleep apnea (OSA) is common, and demonstrates greater prevalence in people with epilepsy (PWE). Untreated OSA is associated with elevated morbidity and mortality. Experimental evidence suggests that reduced serotonin may be involved in the pathophysiology of OSA and seizures. However, it remains unclear whether increasing serotonin levels ameliorates OSA, and whether PWE, who already demonstrate serotonergic deficiency at baseline, would respond similarly to those without epilepsy. The goal of this study was to determine whether serotonin reuptake inhibitors (SRI) affect OSA severity, and whether a different response to SRIs exists between PWE and people without epilepsy.
Methods: This was a retrospective chart review at a university hospital of subjects ≥18 years of age evaluated for OSA between 2011–2016. Epilepsy and OSA were diagnosed as per the 2014-International-League-Against-Epilepsy and International-Classification-of-Sleep-Disorders-3 criteria, respectively. Subjects were dichotomized by the presence (+SRI) or absence (-SRI) of a SRI. Outcome was measured by OSA severity (mild:AHI 5–14;moderate:AHI 14–29;severe:AHI≥30). Baseline characteristics included age, gender, body-mass-index(BMI), epilepsy, and medical/psychiatric comorbidities. Pearson's Chi-square and t-tests were used as appropriate. Logistic regression analysis controlled for covariates, and p<0.05 was considered significant.
Results: Ninety-eight subjects were diagnosed with OSA, mean age=60.92 years, mean BMI 30.38. At baseline, hypertension (OR:3.860,p=0.049) and depression (OR:6.612,p=0.010) were more common in +SRI; otherwise, there were no significant differences. Compared to -SRI, +SRI was less likely to have severe OSA in unadjusted (OR:0.207,p=0.008) and adjusted analysis (OR:0.164,p=0.004), controlling for significantly different baseline covariates (hypertension, depression), and epilepsy (OR:0.005,p=0.159). Epilepsy was independently associated with decreased OSA severity, regardless of SRI status, hypertension and depression.
Conclusion: Serotonin reuptake inhibitors are associated with reduced OSA severity in people with and without epilepsy. Independently, people with epilepsy demonstrate lower OSA severity. This suggests that drugs which enhance serotonin may ameliorate OSA severity, and warrants further investigation as an alternative treatment for OSA.
Support (If Any): Not applicable.

0560

EFFECTS OF MEDICAL THERAPY ON MILD OBSTRUCTIVE SLEEP APNEA IN ADULT PATIENTS

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Introduction: An array of medical treatments are available for adults with obstructive sleep apnea (OSA). Although montelukast and intranasal steroids have demonstrated efficacy in the treatment of mild OSA in children, this has not been tested in adults with mild OSA. The aim of this study was to evaluate the response of mild OSA in adults to combined therapy with montelukast and intranasal steroids.
Methods: Adults with mild OSA, defined as an AHI under 10 events/hour on a standard NPSG, older than 21 years-of-age were recruited to a prospective, randomized trial. All participants obtained a pre-treatment polysomnogram and completed an Epworth questionnaire. Patients were treated for 6 weeks with montelukast and fluticasone or received placebos. Epworth Sleepiness Scores were obtained at 6-weeks and 12-weeks post-treatment, and a repeat sleep study was obtained at the time of the second follow-up visit.
Results: Twenty-six patients were recruited, 13 in each group. The mean age of patients in the treatment and placebo groups were 58.3±10.3 and 54.8±14.1 years-old (*P*=0.487), respectively. There was no significant difference in the number of patients in each group reporting nasal congestion (*P*=0.186), rhinitis (*P*=0.666), or snoring (*P*=0.177). There was no difference in the pre-treatment Epworth score (0.077), BMI (*P*=0.173), or apnea-hypopnea index (AHI) (*P*=0.535). There were significantly more females in the treatment group (*P*=0.05). No changes were demonstrated in follow-up sleep parameters for patients given placebos. The post-treatment sleep study for patients in the treatment-arm demonstrated a significant increase in total sleep time (*P*=0.02) and percent time in REM sleep (*P*=0.05). Although the 6-week follow-up Epworth scores for patients that received medical therapy were not significantly different from pre-treatment scores, there was a decreasing trend (7.8 to 6.3, respectively, P=0.37).
Conclusion: Although intranasal steroids and montelukast did not cause a decrease in the AHI of adult patients with mild OSA, the total sleep time and percent REM sleep significantly improved. Subjective symptomatic improvement described by patients could be explained by the observed changes in sleep parameters. Larger prospective studies are needed to better define the effects of these medical therapies on adult patients with OSA.
Support (If Any):

0561

UPPER AIRWAY STIMULATION FOR OBSTRUCTIVE SLEEP APNEA: COMBINED NORTHEAST OUTCOMES

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Introduction: Obstructive sleep apnea (OSA) is associated with cardiopulmonary disorders such as hypertension, cardiac arrhythmias, and heart failure. Continuous positive airway pressure, oral appliances,

and surgeries to alter upper airway anatomy, are currently in use to treat OSA. However in some patients, these treatments are either ineffective or fail due to inadequate adherence. The hypoglossal nerve stimulation (HNS) system has been shown to reduce airway collapse and improve sleep measures. This multicenter study aims to review preoperative characteristics, somnography outcomes, quality-of-life measures, compliance, complications, and effects on cardiopulmonary morbidity in patients with HNS implantation.

Methods: Patients with moderate to severe OSA who have failed traditional interventions and exhibit anterior-posterior velopharyngeal airway collapse on drug-induced sleep endoscopy (DISE) underwent HNS implantation. Demographics, cardiopulmonary comorbidities, Epworth Sleepiness Scores (ESS), and polysomnography measures were collected preoperatively. Postoperatively, device titration parameters, compliance, repeat polysomnography, tongue protrusion patterns, ESS, cardiopulmonary conditions, and complications were assessed. A nonparametric Wilcoxon signed-rank test was used to compare pre- and postoperative Apnea-Hypopnea Index (AHI).

Results: Twenty-seven patients (5 female, 22 male) from Middlesex Hospital and New York Presbyterian Hospital underwent HNS implantation between December 2014 and September 2016. Mean age was 53.4 ± 8.2 years. Mean preoperative body mass index was 28.5 ± 3.5 kg/m^2. Postoperative AHI was significantly reduced (44.8 ± 16.8 to 6.3 ± 8.8, p<0.001). Of the 27 patients, 14 (51.9%) achieved cure AHI < 5. Twenty-three (85.2%) achieved an AHI < 15. Mean compliance was 50.3 ± 9.2 hours/week. There was a low rate of complications: one patient had syncope on postoperative day two, two reported persistent pain at the first postoperative visit, one patient developed a hypertrophic scar, and there was one case of mild tongue paresis, which resolved spontaneously.

Conclusion: Preliminary data show that HNS is a safe procedure associated with improved OSA outcomes. Efforts are ongoing to examine the influence of airway collapse pattern, device titration, and tongue protrusion on device efficacy. As patients are followed for multiple years, the effect of HNS on cardiopulmonary comorbidities will be further assessed.

Support (If Any): N/A.

0562

DURABILITY OF STIMULATION THRESHOLDS AND THERAPY PROGRAMMING AT 48-MONTHS OF UPPER AIRWAY STIMULATION FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Upper airway stimulation (UAS) is a safe and effective therapy for CPAP-intolerant patients with obstructive sleep apnea (OSA). Long-term management of therapy programming is dependent on stimulation threshold stability. We present changes of stimulation threshold during 48-months after implantation.

Methods: In the Stimulation for Apnea Reduction (STAR) trial, 126 participants with moderate to severe OSA received an implantable neurostimulation system (Inspire Medical Systems, Minneapolis, MN), with a p programmable stimulation amplitude (range of 0.0V to 5.0V in 0.1V increments), pulse width (default = 90μSec), rate (default = 33Hz) and electrode polarity. Patient-specific stimulation thresholds were categorized as sensation threshold - when stimulation is first felt, functional threshold - when bulk anterior tongue motion was achieved, and sub-discomfort - the highest comfortable amplitude while awake. Participants were given an initial control range during an acclimatization period one month post-operatively. Following acclimatization, programming titration and optimization were achieved within the first year. Stimulation thresholds were collected every 6 months to assess stability.

Results: A total of 93 participants completed the 48-month follow-up visit post-implant. The 48-month sensation (ST), functional (FT), and sub-discomfort (SD) thresholds were: 0.9 ± 0.5, 1.5 ± 0.7 and 2.2 ± 0.9 volts, which remained unchanged after the 24 months. In patients with alike electrode polarity (n=68), the 48-month mean stimulation amplitude was 1.9 ± 0.7 volts. When comparing stimulation amplitude for 48-months to 30-months, there were no significant differences (p values = 0.17).

Conclusion: Conclusions: UAS stimulation thresholds remain stable after 4 years of follow-up. Changes in stimulation thresholds when compared to Month-1 can be attributed to the initial acclimatization phase, and do not have an impact on clinical management of patients (amplitude changes of 0.1 to 0.2 volts on average). Stimulation thresholds and stimulation amplitude remain stable when compared over the previous year. Stimulation amplitude continues to be stable after 4 years of follow-up suggesting that long-term clinical management of UAS patients can be managed by follow-up visits every 6–12 months. Stimulation amplitude continues to be programmed within the therapeutic amplitude range established by initial titration during attended polysomnography at 2-months.

Support (If Any): Study was sponsored by Inspire Medical Systems.

0563

UPPER AIRWAY STIMULATION FOR OBSTRUCTIVE SLEEP APNEA: OBJECTIVE AND PATIENT REPORTED OUTCOMES AFTER FIVE YEARS OF FOLLOW-UP

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Introduction: Upper airway stimulation has been shown to be safe and effective in participants with moderate-to-severe OSA in a large cohort study (STAR Trial) after one year and three years of follow-up. In this report, we aimed to assess the objective and patient reported outcomes after five-years of follow-up.

Methods: A total of 126 participants received an implanted upper airway stimulation system (Inspire Medical Systems, Minnesota, USA) in a prospective phase III trial. The co-primary outcomes were Apnea Hypopnea Index (AHI) and 4% Oxygen Desaturation Index (ODI). The secondary outcome measures included the following patient reported outcomes: Epworth Sleepiness Scale (ESS) and the Functional Outcomes of Sleep Questionnaire (FOSQ). The results are presented as mean ± standard deviation unless otherwise specified.

Results: As of December 15, 2016, a total of 52 of the 126 implanted participants have completed the on-going five-year follow up. The BMI remained unchanged from baseline of 28.4 ± 2.6 to 28.2 ± 2.3 at five years. The AHI was reduced from 30.6 ± 8.1 to 14.0 ± 18.4 (p<0.001) with median AHI reduced from 30.2 to 7.5 from baseline to five-year. The ODI was reduced from 28.9 ± 12.0 to 11.0 ± 17.1 (p<0.001) with median ODI from 25.4 to 4.9. The ESS was reduced from 11.6 ± 5.0 to 6.6 ± 4.5 (p < 0.001) and FOSQ was increased from 14.3 ± 3.2 to 17.6 ± 3.1 (p < 0.001). The patient reported nightly use at five years was 82% for the cohort.

Conclusion: Upper airway stimulation maintained a sustained benefit on OSA severity (AHI and ODI) and patient report outcome measures (ESS and FOSQ) after five years of follow-up.

Support (If Any): Inspire Medical Systems.

0564

IMPACT OF HYPOGLOSSAL NERVE STIMULATION ON HEART RATE VARIABILITY: THE STAR TRIAL

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Introduction: Obstructive sleep apnea is characterized by cyclic oscillations in autonomic nervous system activity which elicits surges in nocturnal blood pressure and heart rate. Spectral analyses of heart rate variability (HRV) can provide information related to autonomic cardiovascular function during sleep. Hypoglossal nerve stimulation represents a novel therapy for the treatment of moderate-severe obstructive sleep apnea; however, data concerning impact on autonomic dysfunction with this therapy have not been published.

Methods: As part of the Stimulation Therapy for Apnea Reduction (STAR) trial, a subgroup of responders (n=46) were randomized to therapy withdrawal or therapy maintenance 12 months after surgery. In this study, polysomnogram (PSG) data from each patient were obtained from the baseline PSG, 12-month therapy PSG, and 13-month PSG (withdrawal or maintenance). The electrocardiogram signal was used to examine comprehensive measures of heart rate variability including: standard deviation of the R-R interval (SDNN), ratio between low frequency and high frequency power of R-R interval (LF/HF) and phase-rectified signal averaging (PRSA). HRV analysis was performed by sleep stages (N1/N2 and REM) using 5-minute non-overlapping epochs. Paired t-test was used to compare SDNN, LF/HF and PRSA from baseline to 12-months for all patients and 12-month therapy PSG to 13-month PSG data in the withdrawal group.

Results: Thirty-two participants had complete data sets and were included in this analysis. Half (16/32) were randomized to the therapy withdrawal group. SDNN analysis demonstrated significant improvement from baseline to 12-month PSG in both N1/N2 (0.066 ± 0.26 vs 0.055 ± 0.26, p=0.01) and REM (0.067 ± 0.023 vs 0.057 ± 0.025, p=0.04), while LF/HF and PRSA did not show differences between baseline to 12 months. In the therapy withdrawal group, no significant changes in SDNN were seen between month 12 and 13 for N1/N2 sleep (n=14, 0.051 ± 0.022 vs 0.050 ± 0.012, p=0.75) or REM sleep (n=13, 0.058 ± 0.026 vs 0.052 ± 0.019, p=0.17).

Conclusion: Hypoglossal nerve stimulation therapy improves heart rate variability based on SDNN but not LF/HF and PRSA. The improvement in SDNN was not impacted by a 1 week withdrawal period. Larger, prospective studies are required to improve our understanding of the effect of hypoglossal nerve stimulation on autonomic dysfunction in OSA.

Support (If Any): None.

0565

THE IMPACT OF UPPER AIRWAY STIMULATION ON THE REM AHI

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Introduction: The burden of obstructive sleep apnea (OSA) in REM sleep, as opposed to NREM sleep has been independently associated with hypertension and metabolic risk. These observations are relevant to treatment. A significant number of patients, treated with positive pressure therapy discontinue therapy after the initial 3 -4 hours of use, leaving the time when REM sleep is most prominent (the last third of the sleep period) untreated. Upper Airway Stimulation (UAS) via unilateral implantation of a phasic hypoglossal nerve stimulation device is an alternative for treating moderate to severe OSA. The reported nightly use (subjective and objective) is closer in duration to the total sleep time. The primary aim of this report was to assess the impact of UAS on REM OSA in the Stimulation Therapy for Apnea Reduction (STAR) Trial cohort at 36 months.

Methods: Participants (n=116) were enrolled in a multicenter prospective phase III trial evaluating the efficacy of UAS for moderate to severe OSA. Polysomnography (PSG) was performed at baseline, 12 months and at 36 months' post implantation of the UAS system (Inspire Medical Systems, Minnesota, USA). Attended PSG assessed the overall apnea hypopnea index (AHI) in addition to the AHI in REM and NREM. Self-reported nightly adherence data were collected.

Results: Of 126 enrolled participants, 116 (92%) completed 36-month follow-up evaluation per protocol; 98 participants additionally agreed to a voluntary 36-month PSG. UAS reduced the AHI from 32 ± 18.5 at baseline to 15.3 ± 16.1* and 11.3 ± 13.8* at 12 and 36 months, respectively. A similar effect of UAS was observed on the NREM and REM AHI: Baseline REM AHI 28.9 ± 17.4 to 14.7 ± 16.1* (12 months) and 7.7 ± 12.8* (36 months); Baseline NREM AHI 32.3 ± 12.6 to 15.3 ± 16.8* (12 Months) to 11.5 ± 14.3* (36 months). Self-report nightly device usage was 81%. *$p < 0.05$.

Conclusion: UAS effectively treats the REM AHI, that may be an important independent mediator of cardiovascular and metabolic risk. This therapy is associated with a high level of self-reported nightly usage.

Support (If Any): Inspire Medical Systems, Minnesota, USA.

0566

DRUG-INDUCED SLEEP ENDOSCOPY AND SURGICAL OUTCOMES: AN INTERNATIONAL, MULTICENTER COHORT STUDY

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Introduction: Successful surgical management of obstructive sleep apnea (OSA) is based upon determining the pattern of upper airway obstruction and design of a tailored treatment. Drug-Induced sleep endoscopy (DISE) is an evaluation using pharmacologic sedation designed to simulate natural sleep. DISE has shown promise in studies at single institutions or single interventions. The objective of this study was to examine the association between DISE findings and surgical outcomes across multiple institutions and surgical procedures.

Methods: This was a retrospective cohort study of adults who underwent surgery for obstructive sleep apnea, with preoperative recorded DISE video and both preoperative and postoperative sleep studies. Patients were excluded if they had a history of any prior hypopharyngeal surgery other than tonsillectomy. The preoperative recorded DISE videos were reviewed by 4 reviewers in a blinded fashion using the VOTE Classification.Surgical outcomes were defined by change in the apnea-hypopnea index and the commonly-used definition of surgical response. Multiple linear and logistic regression evaluated potential associations between preoperative DISE findings and surgical outcomes. These analyses were performed for the entire cohort and for subgroups defined by specific DISE findings and surgical interventions. Statistical adjustment was performed for demographic and specific physical examination findings.
Results: Fourteen institutions contributed a total of 628 study participants. Two DISE findings were broadly associated with poorer outcomes: complete concentric collapse related to the velum/palate and complete oropharyngeal lateral wall collapse. Soft palate surgery outcomes were better in cases with isolated soft palate obstruction. Multilevel surgery that matched multilevel obstruction on DISE improved outcomes in selected instances.
Conclusion: DISE may characterize specific patient subgroups that may not respond well to surgery. DISE may also improve the design of effective surgical treatment plans.
Support (If Any): This study was supported by grant 118-FP-15 from the American Sleep Medicine Foundation.

0567

DO POSITIONAL (PP) PATIENTS BECOME NON POSITIONAL PATIENTS (NPP) OVER TIME?

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Introduction: Positional Obstructive Sleep Apnea (OSA) patients (PP) present breathing abnormalities only or mainly in the supine posture (supine Apnea Hypopnea Index (AHI) at least double the lateral AHI) while Non-Positional patients (NPP) have many breathing abnormalities in the lateral and supine postures. Positional Therapy (PT) i.e., the avoidance of the supine position during sleep is the obvious treatment for PP. However, if over time most of PP converts into NPP, PT is not anymore the optimal treatment. The aim of our study was to assess this topic.
Methods: 81 consecutive adult PP (78% men, Age = 52.3 ± 10.3; AHI=22.9 ± 14.0, had two polysomnographic evaluations during a 6.5 years period
Results: 76 patients had complete data. 52 patients (68.4%) were still PP and 24 (31.6%) became NPP. AHI LAT, weight, BMI, AHI, Max Snore Loudness Left and Right were significantly higher in NPP than PP while Min SpO_2 in REM was significantly lower. 16 (66.7%) of NPP gained more ≥ 3 Kg vs.19 (36.5%) of PP (p=0.025). PP who became NPP showed a significant increase in AHI LAT vs. PP who remained PP (53.4 ± 23.3 vs. 14.1 ± 13.1, p<0.0001). Logistic Regression showed that AHI LAT was the only parameter that significantly predicts conversion from PP to NPP. For a PP each unit increase in AHI LAT augments a 13% chance to become NPP. Delta AHI LAT, OR = 1.135 (95% CI: 1.059 - 1.217, p < 0.001). Moreover, if AHI LAT increases more than 13 units, there is a 92% chance that a PP will become NPP. ROC 0.92 ± 0.04 (95% CI = 0.84 - 1.00, p<0.001).
Conclusion: After 6.5 years, most PP (about 70%) are still PP. These are good news, most PP can continue to use PT to overcome their breathing abnormalities during sleep. But for about 30% of PP, PT is not anymore the optimal treatment and CPAP is probably the best alternative. AHI LAT is the most sensitive parameter that will predict if a PP will convert into NPP. The identification of PP who may become NPP over time warrants further investigation.
Support (If Any):

0568

EFFECT OF VARYING DIET INTENSITIES ON WEIGHT LOSS INTERVENTION FOR OSA

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Introduction: Excess body weight is greatest risk factor for obstructive sleep apnea (OSA) and weight loss has been shown to be effective but few randomized controlled trials have compared different weight loss interventions. We compared low calorie diet (LCD), very low calorie diet (VLCD) and usual care groups that coincided with initiation of treatment for OSA.
Methods: Subjects were enrolled from a sleep clinic with the majority being newly diagnosed with OSA and just starting on positive airway pressure therapy. Criteria included BMI 30–50 kg/m2, AHI>5 and age 21–75 years. Patients were enrolled in a 3:3:2 allocation for both diets versus usual care. LCD 1200–1500 kcal/day, VLCD 500–800 kcal/day and usual care included weight loss encouragement. Repeat sleep study testing was performed at 3 months.
Results: The UC group lost an average of 4.9+/=7.4 lbs, the LCD group lost 21.1+/=13.3 lbs and the VLCD group lost 38.6+/=12.6 lbs at 3 months which corresponded to a 2.1, 8.7 and 14.3% decrease in weight with significant difference between all groups (p<0.05). the average AHI decreased by 15.7+/=15.7 in the UC group (p=0.355), 17+/=10.8 in the LCD group (p=0.024) and 6.3=/+5.6 in the VLCD group (p=0.015).
Conclusion: There was a clinically and statistically significant decrease in body weight and AHI that varied according to weight loss group with the greatest weight loss and largest decrease in AHI occurring in the VLCD compared to the LCD diet and usual care group. Despite the significant dietary restrictions of a very low calorie diet, many participants were able to comply with the diet and lose significant weight. Repeat testing at 6 months is planned as well as enrollment of additional research participants.
Support (If Any): KU School of Public Health Professions Research Committee.

0569

EFFECTS OF UPPER-AIRWAY STIMULATION ON SLEEP ARCHITECTURE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Selective upper-airway stimulation (UAS) is a novel therapy for patients with obstructive sleep apnea (OSA). The aim of this study was to compare changes in sleep architecture during the diagnostic polysomnography and the post-implantation polysomnography in UAS in patients with OSA.
Methods: Twenty-six patients who received a UAS device (Inspire Medical Systems) were included. Treatment outcome was evaluated two and three months after surgery. Data collection included demographics, body mass index (BMI), apnea hypopnea index (AHI), oxygen saturation and desaturation index (ODI), Epworth Sleepiness Score (ESS), arousal parameter and sleep patterns.
Results: The mean age was 60.2 years, 25 patients were male, one patient was female. Mean BMI was 29.0kg/m^2. The mean

pre-implantation AHI of 33.9/h could be reduced to 9.1/h at 2 months post-implantation (p<0.001). The amount of time spent in N1-sleep could be reduced from 23.2% at baseline to 16.0% at month 3 post-implantation. The amount of time spent in N2- and N3-sleep did not change during the observation period. A significant increase of the amount of REM-sleep at month 2 (15.7%) compared to baseline (9.5%; p=0.010) could be observed. A reduction of the number of arousals and the arousal index could be observed.

Conclusion: In conclusion, significant changes in sleep architecture of patients with OSA and sufficient treatment with UAS could be observed. A reduction of the amount of time spent in N1-sleep could be caused by treatment with UAS and the rebound of REM-sleep, observed for the first time in a study on UAS, is also a potential marker of the efficacy of UAS on sleep architecture.

Support (If Any): -

0570

INFLUENCE OF GENDER ON THE EFFECTIVENESS OF POSITIONAL THERAPY IN THE TREATMENT OF PATIENTS WITH POSITIONAL OBSTRUCTIVE SLEEP APNEA

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Introduction: While age, BMI and disease severity (apnea-hypopnea index [AHI]) have all been shown to be important factors in predicting the presence of positional obstructive sleep apnea (OSA) and the effectiveness of therapy, no prior study has looked at the influence of gender. The aim of the study is to compare the effectiveness of positional therapy in male and female patients with positional OSA. We hypothesized that therapy would be equally effective in the 2 groups.

Methods: Thirteen male (aged 51 ± 13 years, BMI 31 ± 6 kg/ m^2) and 25 female (aged 48 ± 12 years, BMI 30 ± 5 kg/ m2) patients were included. All of the patients had positional OSA (non-supine AHI < 5 events/hr) on a baseline polysomnogram. Patients then underwent a treatment night polysomnogram using the Zzoma® Positional Device.

Results: The baseline AHI in male patients (AHI 11 ± 4, supine AHI 27 ± 16, non-supine AHI 3 ± 1 events/hr) was similar to that in female patients (AHI 13 ± 6, supine AHI 33 ± 20, non-supine AHI 2 ± 2 events/hr) (p = 0.22). When compared to baseline, there was a similar decrease in the AHI with positional therapy in the male (AHI 2 ± 2 events/hr, p<0.0001) as compared to the female (AHI 3 ± 2 events/hr, p<0.0001) patients (p = 0.91). When compared to baseline, there was no change in total sleep time or sleep efficiency in the male (335 ± 59 to 300 ± 68 min, p = 0.13, and 82 ± 9 to 78 ± 15 %, p = 0.37, respectively) and female (337 ± 54 to 331 ± 47 min, p = 0.28 and 87 ± 12 to 87 ± 11, p = 0.91, respectively) patients. There was a similar non-significant increase in the lowest oxygen saturation during the night in the male (85 ± 5 to 87 ± 4 %, p = 0.32) and female (86 ± 4 to 89 ± 4 %) patients.

Conclusion: Positional therapy appears to be equally effective at normalizing sleep disordered breathing in male and female patients with positional OSA.

Support (If Any): None.

0571

OPIOIDS AND SLEEP APNEA: ANTAGONISM OF REMIFENTANIL-INDUCED RESPIRATORY DEPRESSION BY CX1739 IN TWO CLINICAL MODELS OF OPIOID INDUCED RESPIRATORY DEPRESSION

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Introduction: Annually, U.S. pharmacies dispense nearly 250 million prescriptions for opioid pain relievers. While opioids are useful and effective analgesics, they produce unwanted side effects, including opioid induced respiratory depression (OIRD), which resulted in over 30,000 deaths in 2014. The OIRD produced by opioids is most sensitively detected during sleep and is manifested as apnea/hypopnea, or central sleep apnea (CSA). Approximately 2% of the 51 million U.S. surgery patients and 40 - 50% of patients on chronic opioid therapy for pain management have CSA, which is the major risk factor for opioid overdose and lethality. An unmet medical need exists for an agent that can antagonize OIRD without compromising the analgesic effects of opioids. We herein describe the results of a phase IIa clinical trial that evaluated the ability of CX1739 to overcome OIRD.

Methods: Randomized, Blinded, Placebo-controlled, Cross-Over with Acute Dose Escalation of CX1739; 4 Weekly visits; 2 protocols for remifentanil: a. REMI-Bolus evaluated respiratory parameters in an opioid overdose model, using a bolus of remifentanil (1 mcg/kg) to achieve significant respiratory depression; b. REMI-Infusion evaluated respiratory, pain, and pupilometry measures using an infusion of remifentanil to achieve a steady state blood concentration of approximately 2 ng/ml with 50% respiratory rate depression as a model of OIRD produced oral opioid treatment for chronic pain.

Results: The results of the REMI-Infusion analysis demonstrate that, compared to placebo, CX1739 (300 mg or 900 mg) significantly reduces OIRD under steady-state opioid concentrations. The remifentanil effects on analgesia, pupillography and BIS were not altered. The results of the REMI-Bolus analysis demonstrate that CX1739 does not prevent rapid respiratory depression after intravenous, bolus injection of remifentanil. Administration of CX1739 at an acute dose up to 900 mg was safe and the adverse event profile is comparable to placebo.

Conclusion: This proof-of-concept trial provides evidence to explore the use of the ampakine CX1739 in the prevention of opioid induced respiratory depression, particularly in patients receiving sub-acute, post-surgical intravenous opioid treatment as well as in oral opioid treatment for chronic pain, where OIRD often presents as central sleep apnea.

Support (If Any): RespireRx Pharmaceuticals

0572

DIET, EXERCISE AND ARMODAFINIL FOR OBSTRUCTIVE SLEEP APNEA (OSA) PATIENTS UNABLE TO TOLERATE STANDARD TREATMENTS (DEAR): A RANDOMIZED, PARALLEL-GROUP, FACTORIAL TRIAL

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Introduction: In sleepy, overweight OSA patients unable to tolerate standard treatments we hypothesized that a wakefulness promoter,

armodafinil, would improve daytime sleepiness (specifically AusED driving simulator steering deviation) over placebo while undergoing one of two diets (Australian Guide to Healthy Eating (AGHE) or Low GI High Protein (LGHP)) which would result in equivalent dual-emission x-ray absorptiometry (DXA)-measured fat loss.

Methods: Overweight patients (BMI>27kg/m^2) with at least moderate OSA (AHI>15) who had rejected CPAP or MAS and had no major comorbidities were randomized concurrently to one of two 6-month diets (LGHP/AGHE) with follow-up to 12-months and 150mg armodafinil or matching placebo daily for the first 6-months.

Results: 113 patients were randomized with 6-month data for 87(77%) and 12-month data for 84(74%). Steering deviation was improved on armodafinil over placebo at 3-months (n=90, 12.7cm, 95%CI 4.3–21.1, p=0.003) but this was not sustained to the primary timepoint of 6-months (5.1cm, 95%CI -3.4–13.5, p=0.238). Patients on armodafinil lost more fat than those on placebo at 6-months (2.4kg, 95%CI 1.0–3.7, p=0.001). There was greater fat rebound at 12-months after ceasing armodafinil such that there was no difference between drug groups at that timepoint. Other measures of neurocognitive performance, subjective sleepiness and quality of life were not different between the groups. Patients in both diet groups lost fat by 6-months (LGHP 4.9kg, 95%CI 3.6–6.2, AGHE 4.3kg, 95%CI 3.0–5.6) and sustained this to 12-months (LGHP 4.2kg, 95%CI 2.9–5.6, AGHE 3.9kg, 95%CI 2.6–5.3). There was no difference between the groups in fat lost at 12-months (AGHE lost 0.5kg more 95%CI -2.1-1.1, p=0.541) but this was not statistically equivalent. AHI was reduced by 4/hour overall at 12-months with no difference between diet groups.

Conclusion: Driving simulator performance was better on armodafinil over placebo at 3-months but this was not sustained to 6-months. The negative result at 6-months may be due to underpowering or a learning effect which took longer to develop on placebo. Both diets resulted in fat loss on DXA scan with greater fat lost on armodafinil.

Support (If Any): Teva-Cephalon provided in-kind support (armodafinil and placebo), but had no involvement in study design, analysis or reporting.

0573

A SURVEY TO ASSESS PATIENTS' INTEREST IN THE DIDGERIDOO AS AN ALTERNATIVE THERAPY FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Adherence to standard therapy for obstructive sleep apnea (OSA) (e.g. positive airway pressure [PAP]) is low. New alternative therapies for OSA could be beneficial to patients who are nonadherent. In a prior clinical trial, didgeridoo therapy improved OSA outcomes, but few studies have replicated these findings. A large trial to test the efficacy of the didgeridoo is needed. As part of a feasibility/pilot study to prepare for a large trial, we measured the level of interest in a didgeridoo instructional program among patients with OSA.

Methods: We mailed 344 surveys to patients (aged ≥ 21 years) at a Veterans Affairs Medical Center who were nonadherent to PAP therapy over the prior 12 months as part of the recruitment phase for an instructional program using the Asate didgeridoo. The survey included items assessing attitudes towards OSA, PAP, and alternative therapy for OSA, as well as the Epworth Sleepiness Scale (ESS). We examined frequencies for items assessing dissatisfaction with PAP, difficulty using PAP, perceptions that treating OSA is important, and level of interest in a didgeridoo program, as well as the distribution of the ESS.

Results: We received surveys from 56 individuals (response rate: 16%; 97% male). Of 56 participants, 15 (27%) indicated that they were currently dissatisfied with their OSA treatment, 67% reported difficulty using PAP, and 77% believed that treating OSA is important to their health. Mean ESS score was 10.9 (SD: 4.7). Two-thirds of respondents (67%) expressed interest in participating in a didgeridoo program, and 68% indicated they would practice the didgeridoo.

Conclusion: We found that over 2/3 of OSA patients who are nonadherent to PAP therapy are interested in participating in a didgeridoo program. Given this high level of interest, further research is needed to determine the role, if any, of the didgeridoo in management of OSA.

Support (If Any): University of California Los Angeles, Department of Medicine. Geriatric Social Work Education Consortium. Geriatric Research Education and Clinical Centers.

0574

SLEEP-REPOSITIONING IS A REQUIRED COMPONENT IN MAKING NASAL EPAP EFFECTIVE IN CONTROLLING OSA

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Introduction: Current Obstructive Sleep Apnea (OSA) treatments include PAP therapies, oral appliances, and surgical approaches. Non-supine sleep repositioning is often encouraged as an adjunctive measure. As compliance with CPAP/BIPAP remains poor, nasal expiratory positive airway pressure (EPAP) offers benefits of simplicity and convenience. The aim of this study is to determine if nasal EPAP in combination with non-supine sleep position is an effective therapy for patients with mild-severe OSA who have failed traditional treatments.

Methods: Forty two participants, aged 18 and older, were recruited from an independent sleep center. Initial apnea-hyponea index (AHI's) were verified by original sleep studies. After instruction on use of nasal EPAP and one month of documented use, a validation polysomnogram was completed with nasal EPAP recording both supine & nonsupine AHI. Mean, median, and interquartile range were used to assess the change in AHI's. Genders were compared using mean change in AHI and a linear regression model (R^2 = 0.04) allowed correlation of change in AHI to weight. Mean ESS scores were compared before and after intervention. The AASM titration guidelines provide the basis for classification of response to treatment.

Results: Study population: 37.5% severe OSA, 42.5% moderate OSA, 15% mild OSA, and 5% with primary snoring. The mean change in AHI was -22.4 +/- 21.4. The median was -18.15 with interquartile range of -34.3 to -7.1. The average AHI improved by 19.3 +/- 22.7 in women and 25.0 +/- 20.4 in men (p = 0.42). On average, the AHI improved by 0.55 for each increase in BMI (p = 0.24). Mean initial ESS 9.8 and post intervention ESS 7.6. With intervention, 80.9% had optimal to good control of OSA. Supine position did not provide adequate control on Nasal Epap alone, similar to oral appliance therapy without side-sleeping.

Conclusion: This study provides evidence that nasal EPAP requires non-supine sleep position to be an effective treatment for mild-severe OSA in those who have failed traditional treatments.

Support (If Any):

0575

ATTITUDES TOWARDS ACCEPTANCE OF OBSTRUCTIVE SLEEP APNEA THERAPY USING UPPER AIRWAY MUSCLE TRAINING

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Introduction: Attitudes towards acceptance of obstructive sleep apnea therapy using upper airway muscle training
Methods: 158 consecutive newly diagnosed OSA patients were recruited to complete a self-administered questionnaire, including assessment of their interest towards UAMT, anticipated ability to complete such therapy, as well as information about factors that could influence these attitudes. Socio-demographic information and sleep recording data were also obtained.
Results: The majority of patients were interested in such program (82.9%) and mentioned their anticipated ability to complete it 1 hour/day for 1 month (72.1%), especially if applied later only 2–3 times/week (82.9%). 55.0% of them indicated that requirements of training schedule and duration might influence their choice. Patients with low Socioeconomic status (SES) or female gender were more prone to complete such program 2–3 times/week when compared to those with high SES or male subjects ($p<0.05$). Multivariate analysis revealed that age (OR: 1.04, 95% CI: 1.01–1.07; $P=0.02$) was an independent determinant for interest to complete UAMT therapy. ODI (OR: 0.95, 95% CI: 0.94–1.00; $P=0.04$) predicted preference for UAMT over the overnight-used conventional devices.
Conclusion: This study demonstrates that the majority of OSA patients are interested in UAMT therapy, suggests their anticipated ability to complete it, along with a preference over conventional therapies. Attitudes towards such therapy are sensitive to factors such as gender, age, severity of OSA and SES level
Support (If Any): None.

0576

SELECTIVE UPPER AIRWAY STIMULATION IN OBSTRUCTIVE SLEEP APNEA: GERMAN POST MARKET STUDY - 12 MONTHS FOLLOW-UP

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Introduction: Selective stimulation of the hypoglossal nerve is a new implanted therapy for obstructive sleep apnea (OSA) with proven efficacy in well-designed clinical trials. The aim of the study is to obtain additional safety and efficacy data on the use of selective upper airway stimulation during daily clinical routine.
Methods: A multi-center, prospective study under a common implant and follow up protocol took place in 3 German centers (Mannheim, Munich, Luebeck). All patients who received an implant of upper airway stimulation ("UAS", Inspire Medical Systems, USA) was enrolled in this trial (apnea-hypopnea-index (AHI) ≥ 15/h and ≤ 65/h & BMI<35kg/m^2). Before surgery, and at 6 and 12 months after surgery, a two-night home sleep test was performed. Data regarding the safety and efficacy were collected.
Results: From July 2014 through October 2015, 60 patients were implanted with an average age of 56.8 ± 9.1 and BMI of 28.8 ± 3.6. The average usage time of the therapy was 5.7 ± 2.1 h/night at 12 months. The median AHI reduced from 26.7/h to 9.4/h, the Epworth Sleepiness Score reduced from 13 to 6, and Functional outcome of sleep questionnaire improved from 13.3 to 17.5, all significant changes from baseline to 12 months. In none of the patients, was a revision surgery necessary.
Conclusion: Selective upper airway stimulation is a safe and effective therapy for patients with OSA and represents a powerful option for surgical treatment of OSA.
Support (If Any): This clinical trial was sponsored by Inspire Medical Systems (USA).

0577

PATIENT OUTCOMES AND THERAPY ADHERENCE OF UPPER AIRWAY STIMULATION FOR TREATMENT OF OSA: PRELIMINARY RESULTS FROM THE MULTI-CENTER ADHERE REGISTRY

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Introduction: Upper airway stimulation (UAS) is an FDA-approved treatment for obstructive sleep apnea (OSA) in patients who cannot adhere to positive airway pressure (CPAP or Bilevel). Controlled clinical trials utilizing UAS have demonstrated a reduction of OSA severity and improvement in patient-reported outcomes. A registry of UAS patients will provide insight into these areas in a real-world setting. We hypothesized that 1) UAS would reduce the AHI to < 10 events/hour over a 12 month period; 2) it would normalize the Epworth Sleepiness Scale scores; and 3) patients would use it for over 6 hours/night.
Methods: The Adherence and Outcome of UAS for OSA (ADHERE UAS) is an international registry of consecutive patients who have received an implanted UAS system (Inspire Medical Systems, USA). It collects baseline, outcome and adherence data. Outcome measures include the pre- and post-implant AHI and the Epworth Sleepiness Scale (ESS) score. The post-implant AHI is measured during the in-lab polysomnographic (PSG) titration study and at 12-months with PSG or home sleep testing. The Registry is intended to enroll 2,500 patients.
Results: As of Dec 15, 2016, 86 participants enrolled in the registry. The mean age was 61.1 ± 11.1 years (84% male) and mean BMI was 29.5 ± 3.7 kg/m2. The AHI was reduced from 38.0 ± 14.2 to 5.1 ± 8.8 and 6.1 ± 4.7 events/h at the titration and 12-month visits respectively ($p<0.001$ for both visits vs. baseline). After the titration, 69%, 85% and 92% of participants had an AHI of ≤ 5, ≤10, and ≤15 respectively. The ESS changed from 11.5 ± 6.3 to 6.5 ± 4.5 and 6.1 ± 4.1 at the titration and final visits, respectively. Therapy adherence was 6.4 ± 1.8 and 6.1 ± 2.1 hrs/night at the titration and the 12-month visits.
Conclusion: Upper airway stimulation reduced OSA severity, and improved daytime sleepiness. Therapy adherence remained high after 12 months among the registry participants who previously could not adhere to CPAP.
Support (If Any): Support for this study provided by Inspire Medical Systems.

0578

PREDICTORS OF SUCCESS FOR OSA TARGETED HYPOGLOSSAL NEUROSTIMULATION

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Introduction: Targeted Hypoglossal Neurostimulation (THN) is a novel treatment for OSA that aims to stimulate selective tongue

muscles using a 6-contact cuff, placed around the hypoglossal nerve trunk. Selective stimulation and cycling between contacts is used to minimize risk of neuromuscular fatigue. From earlier safety and feasibility trials, **predictors of success (POS) criteria** were retrospectively identified based on BMI, AHI, AHI and oxygen desaturation parameters. These POS criteria are currently utilized in the THN3 pivotal trial. In this study we validated the POS criteria in a cohort of patients implanted outside of trial in multiple centers internationally.
Methods: Thirty patients with moderate to severe OSA were implanted with ImThera Medical's aura6000® THN Sleep TherapyTM System from 2013–2016. Preoperative sleep testing consisted of either attended polysomnographic or home testing. Stimulation parameters were set during polysomnography at 1 month post implantation with subsequent therapy initiation. AHI outcome was assessed using sleep testing at 3–6 months, and at 12 months and analyzed against the POS criteria. Predictors criteria included BMI< 35 kg/M2, AI< 30, AHI< 65 and < 15 oxygen desaturations/hour of >10%. Patients were classified as responders if they demonstrated a reduction in AHI of at least 50% and an AHI < 20.
Results: At baseline, the mean Body Mass Index (BMI) was 27.3 (range 21.0–35.4), Apnea Hypopnea Index (AHI) was 50.0 (range 25–106), and Oxygen Desaturation Index (ODI) was 47.8 (range 4.6–83.0). Outcome data was available for 18 patients. Mean AHI decreased from 50.0+/-21.9 to 19.3 +/-16.0 at 3–6 months and to 17.8+/-15.6 at 12 months ($p < .001$) with 78% (14/18) responders. For patients meeting POS' criteria (n=12) mean AHI decreased from 38.7+/-11.7 to 12.5+/-11.2 at 3–6 months and to 11.3+/-11.9 at 12 months ($p < .001$) with 92% (11/12) responders. Additional data will be incorporated.
Conclusion: THN therapy POS criteria correlated with a high rate of successful outcome in a multicenter patient cohort.
Support (If Any): ImThera Medical.

0579

HYPOGLOSSAL NERVE STIMULATION: A HIGHLY EFFECTIVE, LOW MORBIDITY ALTERNATIVE FOR TREATMENT OF OBSTRUCTIVE SLEEP APNEA IN SELECT CPAP-INTOLERANT PATIENTS

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Introduction: Obstructive Sleep Apnea is an increasingly prevalent medical condition with deleterious effects on both patient health and quality of life. While the current gold standard of OSA treatment, continuous positive airway pressure (CPAP), is highly effective, current estimates of patient compliance are between 40–60%. Additionally, traditional surgical treatment of OSA is associated with significant morbidity and inconsistent results. The effectiveness of treatment of select CPAP-intolerant patients with hypoglossal nerve stimulation has been demonstrated in the multi-institutional Stimulation Treatment for Apnea Reduction (STAR) trial. We report the outcome measures and therapy adherence data in a cohort of patients treated with hypoglossal nerve stimulation post-FDA approval.
Methods: An institutional review board-approved, retrospective review of cases performed by a single surgeon at an academic medical center was performed. The first 25 cases treated with hypoglossal nerve stimulation therapy were included. Patients were selected based on the criteria established by the FDA in their approval of the Inspire® device. Data collected included demographics, body mass index (BMI), apnea-hypopnea index (AHI), device usage (hrs/week), procedure- and therapy-related complications, and length of hospitalization after procedure.
Results: Mean age was 67.6 ± 8.9 years, with 40% female. Mean BMI was 27.8 ± 2.9 kg/m^2. Mean AHI (38.5 ± 18.6 to 6.5 ± 13.2; $P < .0001$) decreased significantly. Eighty-three percent of patients (21/25) achieved a treatment AHI <5 while 96% (24/25) achieved a treatment AHI <10. The mean device use was 49.5 ± 10.4 hours/week. Ninety-two percent of patients were discharged on the day of surgery (23/25). No major adverse events occurred.
Conclusion: In appropriately selected CPAP-intolerant patients, hypoglossal nerve stimulation therapy results in significant improvement in objective OSA measures, and is associated with low morbidity and high therapy adherence. These results further validate the current patient selection criteria for the use of hypoglossal nerve stimulation in the treatment of OSA.
Support (If Any): None.

0580

COMPLIANCE TO UPPER AIRWAY STIMULATION THERAPY: A SINGLE UNIVERSITY-BASED CENTER EXPERIENCE

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Introduction: CPAP is the first line treatment modality for patients with obstructive sleep apnea (OSA). Many studies define CPAP compliance as 4 hours per night for 5 days a week (20 hours per week) and cite adherence rates varying from 20–80%. Upper airway stimulation (UAS) has been shown to be a successful alternative. We hypothesize that UAS will be well tolerated by those undergoing treatment, allowing for greater adherence to therapy when compared to published CPAP data.
Methods: Our institutional algorithm for management of patients undergoing UAS implantation is to activate the stimulator 1 month after implantation and perform a titration PSG at 2 months postoperatively. Patients are seen at 6 and 12 months after implantation for followup. We reviewed our database of patients undergoing UAS since the onset of our program in 2014. We collected demographic data, pre and post-operative PSG data, and data from the UAS programmer which stores information on usage of the device. We collected usage data at the time of the titration PSG and the most recent followup appointment.
Results: To date, we have performed 66 UAS implantations. 50 of these patients have undergone a postoperative titration PSG. The cohort consists of 31 men and 19 women. The mean age was 61.1 years with a standard deviation of 11.6. Usage data were available at the time of titration PSG on 50 patients and the mean usage was 48 hours per week with a standard deviation of 14.3. The compliance rate was 94% as 47 of the 50 used the device for more than 20 hours per week. Followup (post-titration) usage data were available on 24 patients, for whom the mean usage was 40.3 hours per week with a standard deviation of 13.1. This was collected at a mean of 185.2 days since implantation. The compliance rate was 96% as 23 of the 24 used the device for more than 20 hours per week.
Conclusion: UAS is an innovative addition to the treatment repertoire for select patients with OSA. It is tolerated by those undergoing treatment allowing for high adherence to therapy.
Support (If Any): None.

0581

OUTCOMES FOR A LARGE COHORT OF PATIENTS UNDERGOING UPPER AIRWAY STIMULATION THERAPY: THE JEFFERSON EXPERIENCE

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Introduction: Upper airway stimulation (UAS) is a novel technique of treating select patients with obstructive sleep apnea (OSA) unable to tolerate CPAP. Current outcome studies consist of the STAR clinical

trial publications and small volume institutional outcomes. We present the largest single institution outcome study to date and hypothesize that we will confirm the STAR trial results in a clinical setting.
Methods: We reviewed our database of patients undergoing UAS since the initiation of our program in 2014. We collected demographic data including age, gender, BMI, and Epworth sleepiness score (ESS) results. We also reviewed pre and postoperative polysomnography (PSG) data including AHI, and O_2 nadir. Lastly we calculated rates of surgical success, and patients reaching a postoperative AHI less than 15, 10, and 5. Surgical success was defined as a drop in postoperative AHI of 50% and to a value less than 20. Lastly, we recorded surgical complications.
Results: We have performed 66 UAS implantations. 50 of these patients have undergone a postoperative titration PSG. The cohort consists of 31 men and 19 women. The mean age was 61.1 years with a standard deviation of 11.6. The mean preoperative AHI, O_2 nadir, and ESS scores were 34.4, 81.4, and 10.6 with a standard deviation of 21.2, 6.9 and 6.9 respectively. The mean postoperative AHI, O_2 nadir, and ESS scores were 6.5, 88.5, and 6.2 with a standard deviation of 11.4, 3.5, and 3.4 respectively. The postoperative values were all significantly improved from preoperative. The success rate was 89.8%. The percent of patients reaching a postoperative AHI less than 15, 10, and 5 was 93.9%, 83.7%, and 65.3% respectively. Untoward outcomes included 1 temporary hypoglossal nerve paresis, no wound infections, no bleeding requiring return to the operating room, no hematoma formation, and 1 implant removal at the patient's request.
Conclusion: UAS is an innovative addition to the treatment repertoire for select patients with OSA unable to tolerate CPAP. Initial findings show it to be a successful method of controlling upper airway obstruction and apnea. Our outcome data are very similar to those obtained in STAR trial.
Support (If Any): none.

0582

PATIENT OUTCOME OF UPPER AIRWAY STIMULATION FOR OBSTRUCTIVE SLEEP APNEA: RESULTS FROM A NON-ACADEMIC HOSPITAL SETTING

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Introduction: Upper Airway Stimulation (UAS) is an FDA approved treatment option for patients with moderate-to-severe obstructive sleep apnea (OSA) who could not adhere to continuous positive airway pressure (CPAP). Previous studies have shown UAS reduced apnea-hypopnea index (AHI) in controlled clinical trials and from academic institutions. We report patient outcomes and therapy adherence of UAS in a non-academic hospital and clinic setting.
Methods: Consecutive implants completed at a community hospital between January 2015 to April 2016 are included in this report. All patients underwent baseline polysomnography (PSG) recording and drug-induced sleep endoscopy (DISE) prior to the implant. All patients returned for standard post-implantation titration PSG at a community sleep clinic to validate and adjust the stimulation setting for optimal response. Results were in mean ± SD, and pre- and post-implant data were compared using a paired student t-test.
Results: Results Patients undergoing UAS implant were overweight (BMI of 27.7±4.6, and ranged from 21.6 to 36.6 kg/m2) and middle aged (61.7±12.3 years), and had severe OSA (AHI of 33.9±16.4 events per sleep hour). The AHI from the entire night of the titration study was 15.7±11.1 ($p<0.01$, compared with baseline), and the treatment AHI from the sleep period when the optimal setting was programed was 1.6±2.1 ($p<0.01$, compared with baseline), with all 16 of 16 patients with treatment AHI < 10, and 14 of 16 with AHI < 5. After an average follow up of 95±32 days, the average usage was 6.9±2.0 hours per night. The Epworth sleepiness scale reduced from 13.5±5.5 to 6.9±6.1.
Conclusion: Patients who elected to receive UAS implant surgery at a non-academic hospital and followed at a sleep clinic showed significant reduction in OSA severity and a strong adherence to treatment. These results support that UAS can be successfully implemented as a valid treatment option for OSA in non-academic hospital and clinic settings.
Support (If Any): Inspire Medical Systems.

0583

COMPARING UPPER AIRWAY STIMULATION TO UVULOPALATOPHARYNGOPLASTY; A SINGLE UNIVERSITY EXPERIENCE.

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Introduction: Uvulopalatopharyngoplasty (UPPP) is a surgical option for patients with obstructive sleep apnea (OSA) unable to tolerate CPAP. A new alternative for select patients with OSA is upper airway stimulation (UAS). We compare outcomes of a cohort of patients undergoing UAS to UPPP.
Methods: We collected data on patients undergoing UAS and expansion sphincteroplasty (ES), a variation of UPPP. We included demographic and pre and postoperative polysomnography data in the analysis. We then compared the UAS and ES cohorts. We calculated the proportion of patients reaching a postoperative AHI less than 15, 10, and 5. We defined surgical success as a postoperative AHI less than 20 with a 50% decline from baseline.
Results: The ES cohort consisted of 33 patients, including 28 males and 5 females. Demographics and preoperative mean data were: age 43.48, BMI 29.6, ESS 10.69, AHI 36.47, O2 nadir 82.63, with standard deviations of 11.74, 4.49, 4.42, 20.01 and 5.37 respectively. Postoperative mean data were: AHI 13.47, O_2 nadir 84.84, ESS 7, BMI 29.92, with standard deviations of 18.74, 5.48, 5.81, and 4.59 respectively. There was a 63.64% success rate with 75.76%, 54.55% and 36.36% of patients reaching a postoperative AHI less than 15, 10, and 5 respectively.

The UAS cohort consisted of 54 patients, including 35 males and 19 females. Demographics and preoperative data were: age 61.46, BMI 29.41, ESS 10.55, AHI 34.65, O2 nadir 81.47, with standard deviations of 11.26, 3.59, 4.09, 20.38, and 6.81 respectively. The mean postoperative data were: AHI 6.44, O2 nadir 88.19, ESS 5.54, BMI 29.29, with standard deviations of 10.92, 3.41, 3.26, and 3.72 respectively. There was a 90.74% success rate with 92.59%, 81.48% and 70.37% of patients reaching a postoperative AHI less than 15, 10, and 5 respectively.

We found a significant difference in age, preoperative AHI, postoperative AHI, postoperative O_2 nadir, surgical success, and patients reaching an AHI less than 10 and 5.
Conclusion: UAS is a new surgical option for select patients with OSA showing comparable or more favorable outcomes than a cohort of patients undergoing UPPP.
Support (If Any): none.

0584

IMPACT OF HYPOGLOSSAL NERVE STIMULATION ON EARLY PATIENT REPORTED OUTCOMES: THE CLEVELAND CLINIC EXPERIENCE

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Introduction: Hypoglossal nerve stimulation (HNS) represents a novel neurotherapeutic modality for obstructive sleep apnea (OSA)

treatment. Although data support long-term benefit and durability of HNS on patient reported outcomes (PRO), the effect on depression and insomnia indices remains unclear. We postulate an early improvement of PRO including standard depression and insomnia scores in response to HNS.

Methods: A 1-year retrospective review of OSA patients undergoing HNS was performed (November 2015-November 2016). Baseline to 1-month changes in polysomnographic indices (apnea hypopnea index (AHI), oxygen saturation (SaO2) nadir) and PRO (Epworth Sleepiness Scale (ESS), Functional Outcomes Sleep Questionnaire (FOSQ), Insomnia Severity Index (ISI) and Patient Health Questionnaire-9 (PHQ9)) were examined. Wilcoxon signed rank sum test was used to examine changes from baseline to 1-month follow up. Spearman correlation was used to evaluate the relationship of change in AHI and change in PRO. SAS version 9.4 (The SAS Institute Cary, NC) was used for analyses.

Results: Baseline characteristics of 20 patients include age 62.9+/-8.7 years, body mass index (BMI) 27.5+/-2.3 kg/m^2, 35.0% female, AHI median [IQR] 37.1 [28.5,46.6] and SaO2 nadir 84.0 [78.5,87.5]. The AHI, ESS, and PHQ9 scores were significantly reduced after HNS implantation compared to baseline, (-28.1[-37.8,-25.4], -4.0[-5.0,-4.0], -4.0[-6.0,-0.50], respectively, all $p<0.008$), while the change in O2 nadir (6.0[4.0,10.5], $p<0.001$) and FOSQ (2.0[1.00,3.5], $p=0.005$) increased. Although not statistically significant, changes of ESS (correlation (95% confidence interval) 0.42, -0.15,0.99), ISI (0.47, -0.19,1.00) and PHQ9 (0.15, -0.60,0.89) had positive correlation with change of AHI while correlation with FOSQ (-0.31, -0.98,0.36) was negative.

Conclusion: Our results confirm prior findings of HNS improvement of self-reported dozing propensity and sleepiness impact on quality of life. New findings are early clinically significant improvement in depression scores and trend for improvement in insomnia symptoms. Larger-scale and longer-term studies are needed to examine extent and sustainability of HNS effects in OSA on depression and insomnia symptoms.

Support (If Any): none.

0585

DRUG INDUCED SLEEP ENDOSCOPY; PREDICTIVE OF SUCCESS FOR ORAL APPLIANCE THERAPY IN TREATING OBSTRUCTIVE SLEEP APNEA

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Introduction: Oral appliance therapy (OAT) can be an effective option for patients with obstructive sleep apnea (OSA) who are unable to tolerate CPAP. We hypothesize that patients undergoing drug induced sleep endoscopy (DISE) who show improvement in the cross sectional area at the level of the velum and/or oropharynx with a jaw thrust will benefit the most from OAT.

Methods: A retrospective review was carried out of all patients referred for a sleep surgery evaluation secondary to an inability to tolerate CPAP. We included those patients who underwent DISE (DISE group) between January 2014 and June 2016, received OAT based off recommendations made by DISE findings, and had a follow-up polysomnogram (PSG) with use of OAT. A control group was designed by selecting a sample of patients undergoing PSG with OAT in place who had not undergone prior DISE (no DISE group). The two cohorts were compared to evaluate the hypothesis.

Results: We found 15 patients fitting inclusion criteria for the DISE group and 19 patients in the no DISE group. There was no difference between the DISE and no DISE cohorts with respect to mean age, gender, pre OAT BMI, post OAT BMI, or pre OAT PSG characteristics including; AHI, O_2 Nadir, or Epworth sleepiness score. There was a significantly increased number of patients in the DISE group reaching an AHI less than 5 with OAT therapy ($p=0.0473$). In addition, the mean AHI with OAT treatment was lower in the DISE group and this approached significance ($p=0.0809$)

Conclusion: Patients showing increased airway dimensions at the level of the velum and/or oropharynx with a jaw thrust may benefit the most from OAT. The use of DISE to identify this subset of patients is helpful in optimizing outcomes with OAT.

Support (If Any): none.

0586

MEAN APNEA HYPOPNEA DURATION, A PREVIOUSLY UNRECOGNIZED IMPORTANT FACTOR FOR THE EVALUATION OF UPPER AIRWAY SURGERY

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Introduction: Upper airway surgery (UAS) is capable to improve AHI. However, many obstructive sleep apnea (OSA) patients remain to exhibit poor AHI but good subjective symptoms (ESS etc) improvement after surgery. Whether this is due to the improvement of mean apnea/ hypopnea duration (MAD) remains unclear.

Methods: We performed a prospective clinical trial of OSA patients who underwent UAS (119 cases, 54 nasal surgery and 65 UPPP) from 2013 to 2016. Preoperative and post-operative polysomnography (PSG), ESS, blood lipid and coagulation parameters were compared before and 6 months after surgery. Patients failed to have an improvement of AHI (change of AHI≤25%) after surgery were included and divided into two groups according to the length of ΔMAD (the difference of MAD between pre- and post-surgery).

Results: When all patients failed surgery as one group, (52 cases, 36 nasal surgery and 16 UPPP), AHI had no significant improvement, but MAD was significantly decreased (from 27.7±6.12 to 23.5±5.45 seconds, $p=0.02$). In long ΔMAD group (n=26, ΔMAD≥4.1 seconds), arousal index(from 36.2±13.9 to 29.4±12.7, $p=0.03$), percentage of time with oxygen saturation below 90%(CT90)(from 10.5±3.67 to 6.3±1.54, $p<0.01$), ESS(from 12.5±4.77 to 6.8±2.33, $p<0.01$), serum platelet counts (from 249.7±54.2 to 240.3±47.1, $p=0.02$), Fibrinogen levels (from 264.3±61.0 to 253.2±47.8, $p=0.04$), and lipoprotein a (from 18.8±5.3 to 14.2±6.4 $p=0.03$) decreased, and N3 duration(-from 43.7±23.1 to 57.3±24.2, $p=0.02$) increased. In short ΔMAD group (n=26, ΔMAD<4.1 seconds), only ESS score had significant improvement (from 11.7±5.06 to 8.7±4.07, $p=0.03$). Both two groups had no AHI improvement. We also found that MAD was moderately correlated with N3 duration ($R=0.327$, $p=0.02$) and CT90 ($R=0.293$, $p=0.03$).

Conclusion: Beside frequency (AHI), UAS can also decrease severity (MAD) of sleep breathing events and may affect sleep structure, blood oxygen, blood lipid and coagulation parameters. Relying exclusively on AHI in evaluating success of surgery may underestimate the beneficial physiological effects.

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0587

WHERE DOES PHASE1 SLEEP SURGERY INCLUDING GENIOGLOSSUS ADVANCEMENT ENLARGE THE AIRWAY?

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Introduction: CPAP and OA are typical conservative treatments for Obstructive Sleep Apnea (OSA), but decreased adherence can be a problem for using each device. Therefore, we suggest Sleep Surgery (SS) as an alternative treatment for OSA. SS is performed in two phases according to the Stanford protocol. Phase1 is performed on the soft tissues (nasal cavity, pharynx, tongue). The effects of Phase1 are evaluated by Polysomnography (PSG) and CT imaging, and if insufficient, Maxillomandibular advancement (Phase2) is suggested. Genioglossus Advancement (GA) enlarges the pharyngeal airway by traction of the genioglossus and geniohyoid muscles. We investigated where the pharyngeal airway is enlarged by Phase1 including GA.
Methods: We enrolled 22 OSA patients who were diagnosed by PSG and consented to CT imaging at the Ota Memorial Sleep Center before and after Phase1 including GA. Cases where AHI decreased by more than 50% after surgery and became 20/h or less were included in the effect group, and the other cases were included in the non-effect group. The pharyngeal airway measurement sites were the second cervical vertebra (SCV) area (Superior, Median and Inferior) and the Base of the Epiglottis. The anteroposterior and lateral diameters were measured and compared.
Results: There were 6 cases in the effect group and 16 cases in the non-effect group, and the overall success rate was 27%. The anteroposterior diameters of both groups were not changed, but the lateral diameter was expanded significantly in all of the SCV area of the effect group.
Conclusion: This study confirmed that expansion of the pharyngeal airway was not in the anteroposterior diameter, but the lateral diameter was increased by Phase1 including GA. However, the overall success rate was low, and the number of cases needs to be increased in the future to decide on indications and to devise improved techniques for surgery.
Support (If Any): 0

0588

RELATIONSHIP BETWEEN PHARYNGEAL VOLUME AND APNEA HYPOPNEA INDEX AFTER MAXILLOMANDIBULAR ADVANCEMENT SURGERY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: The obstructive sleep apnea (OSA) is a progressive disease and that is gaining great attention of the health area due to the serious co-morbidities associated to it. Several works in the literature have pointed maxillomandibular advancement (MMA) as the most effective surgical treatment for OSA, with success rates of 96 to 100, but there are important aspects in the evaluation of this surgery that need to be further clarified. The objective of this study was to assess the volumetric anatomical changes of the pharynx after MMA surgery and its repercussions in Apnea Hypopnea Index (AHI).
Methods: Thirty-two patients with a polysomnographic diagnosis of OSA participated in the study and where submitted to polysomnography (PSG) and image acquisition by Computed Tomography (CT). Polysomnography and CT were performed preoperatively (T0) and six months after MMA (T1). The pharyngeal air space of the region between the hard palate and he base of the epiglottis was divided into a retropalatal (RP) region and a retrolingual (RL) region. The comparison between preoperative and postoperative data was performed using Student's t-test for paired samples (paired t-test).
Results: Postoperative CT showed a mean volumetric increase of 37,6% in the RP region and of 38% in the RL region. The mean value of preoperative AHI was 34,5 events per hour of sleep, presenting a significant ($p<0,001$) reduction to 10,5 events after surgery. When analyzing the percentage differences medias (100*(T1-T0)/T0), the AHI presented a reduction of 63,5% in the post-operative period.
Conclusion: Considering the patients analyzed in this study, the MMA generated a significant increase of the pharyngeal volume in both the RP and RL regions and these morphometric changes presented an important impact on the AHI reduction after the surgery. These findings may contribute to a better understanding of the high rates of success of this surgery for the treatment of OSA.
Support (If Any): This study was funded by the government of the State of São Paulo through the São Paulo State Research Foundation (FAPESP - 2014/02175-5)).

0589

MAXILLOMANDIBULAR ADVANCEMENT VERSUS MULTI-LEVEL SURGERY FOR PATIENTS WITH SEVERE OBSTRUCTIVE SLEEP APNEA INTOLERANT OF CPAP - A META-ANALYSIS AND COST EFFECTIVENESS ANALYSIS

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Introduction: Obstructive sleep apnea (OSA) is associated with significant morbidity and mortality. Conventional OSA therapy entails lifelong positive airway pressure (CPAP), unfortunately adherence rates are poor. We explore the cost-effectiveness of maxillomandibular advancement (MMA) in those intolerant of CPAP.
Methods: We compare the cost-effectiveness of MMA in those with severe OSA intolerant of CPAP compared to a no-treatment strategy, multilevel surgery (MLS), or a phased protocol (PP; MLS followed by MMA for those without surgical success) using a lifetime semi-Markov OSA model that accounts for observed increased cerebro/cardiovascular events and motor-vehicle collisions. We perform a meta-analysis to determine surgical success rates in middle-aged men with severe OSA.
Results: We identified 32 MMA studies (212 subjects) reporting short-term pooled success and cure of 73.7% and 16.7% for middle-aged men with severe OSA with prior MLS surgery and 87.4% and 31.0% for those without prior surgery. In middle-aged men with severe OSA, 42 MLS studies (569 subjects) report short-term success and cure of 64.6% and 12.8%. The annual surgical success decay-rate was 2.5% for MMA (from 10 long-term studies) and 8.6% for MLS (11 studies). Compared with the no-treatment strategy, MLS adds 0.93 quality adjusted life years (QALYs) for an increase of $17,544

(discounted 2016 dollars) with an incremental cost-effectiveness ratio (ICER) of $18,924/QALY for a 50-year-old severe OSA male intolerant to CPAP. Compared to MLS, MMA adds an additional 1.09 QALYs at an incremental increase of $25,945 (ICER $23,865/QALY). The MLS and MMA strategies dominate the PP strategy. Versus no-treatment, the MLS and MMA strategies are cost-effective over a wide range of parameter estimates. The cost-effectiveness of MMA versus MLS is sensitive to the cure and success rates of surgery as well as decay of these rates over time. PP is no longer dominated when MLS costs <$15,000, MLS success (or cure) rates >88% (or >42%) or MMA success (or cure) rates <85% (or <23%).
Conclusion: Both MLS and MMA appear cost-effective in middle-aged men with severe OSA intolerant of CPAP. Further research is warranted to better define surgical candidacy as well as short and long-term surgical outcomes.
Support (If Any):

0590

ESTHETIC OUTCOMES OF COUNTERCLOCKWISE MAXILLOMANDIBULAR ADVANCEMENT FOR MIDDLE AGED CHINESE SEVERE OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: Maxillomandibular advancement (MMA) is an effective alternative way to treat severe obstructive sleep apnea (OSA). However, the convex facial profiles of Chinese patients significantly limit its promotion. In order to gain enough upper airway enlargement without esthetic disaster, we added counterclockwise rotation of maxillomandibular complex in the routine MMA. For the severe OSA is life threatening and the psychological status changes by aging, it is important to conclude a surgical criteria for middle aged patients. In this study, we investigated the esthetic outcomes of counterclockwise maxillomandibular advancement (CMMA) in middle aged patients, which will be important for making surgical decision.
Methods: 16 severe OSA patients accepted CMMA aged from 40 to 60 were enrolled in this study. None of them took the advice of orthodontic treatment around surgery. The patients were followed up for 6 to 12 months and underwent physical measurement, facial photographic assessment, cephalometry, polysomnography (PSG) and Epworth sleepiness scale (ESS). Patients were asked to score their satisfaction of facial changes by 5 points Likert scales. 30 medical students were invited to blindly evaluate the pre- and postoperative aesthetic appearance by a 10-point visual analogue scale. Cephalometric changes before and after surgery were also analyzed.
Results: After CMMA, the apnea-hypopnea index (AHI) decreased from 56.2±14.4 to 11.2±5.8 (P<0.001), minimum SpO_2 (pulse oxygen saturation, %) increased from 76.9±9.1 to 87.9±5.5 (P<0.001), and ESS decreased from 12.8±2.0 to 7.3±1.7 (P<0.001). The cephalometric measurement showed that although maxilla and mandible protruded and the occlusal plan decreased after MMA, the facial convexity angle, aesthetic plan were not getting worse. The 5 points Likert scales revealed 14 patients (87.5%) were satisfied or very satisfied with their facial changes. The esthetic scores from the medical students indicated that 10 of 16 patients (62.5%) were significantly higher postoperatively, and 1 patient (6.3%) was less attractive because of maxilla protrusion.
Conclusion: CMMA provides a possible way to achieve a balance between OSA release and facial appearance for middle aged OSA patients in China.
Support (If Any): The authors acknowledge the financial support from the Science and Technology Commission of Shanghai Municipality (16140903900).

0591

PHYSICAL EXAM FINDINGS AS PREDICTORS OF CLINICAL OUTCOMES IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA TREATED WITH MANDIBULAR ADVANCEMENT DEVICE

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Introduction: Mandibular advancement devices (MAD) are an alternative to positive airway pressure (CPAP) in the treatment of obstructive sleep apnea (OSA). Predictors of efficacy of MAD have been associated with young age, lower BMI, supine dependent apnea, and female sex. This study aims to evaluate the oropharyngeal characteristics of patients with OSA as potential predictors of response to MAD.
Methods: This study recruited adult patients that were found to have OSA as defined by apnea-hypopnea index (AHI) ≥5/hr. Patients were outfitted with Somnodent device through a single provider. Patients were excluded if they had a history of severe cardiac or pulmonary disease, a contraindication to MAD, combined MAD and CPAP therapy, psychological incapacity, were lost to follow up, or had missing data. Primary outcomes were clinical global impression of change (CGI-c), Epworth sleepiness score (ESS) and change in AHI.
Results: 77 patients were initially recruited, however 37 met inclusion criteria. The average age was 55 (29–78) years, with 54% male and BMI 31 (25–43) $kg.m^{-2}$. Baseline AHI was 14 (6–64) events/hr; mean asleep SaO2 was 94% (91–98) and nadir SaO2 was 83% (57–94). There was a significant decrease in AHI by 9 events/hr with MAD (p=0.0216). Baseline and post treatment ESS were 9 (0–19) and 5 (0–16), respectively (p<0.0001). CGI-c was markedly improved in subjects with Mallampati 1–3 compared to Mallampati 4 (p<0.01). There was no correlation between mandibular protrusive range or incisal opening with the outcome measures.
Conclusion: In this exploratory study there were significant improvement in ESS and AHI with oral appliance therapy. Improvement in CGI was primarily seen in patients with Mallampati score of <4. Mandibular protrusive range and incisal opening were not predictive of response to MAD. In conclusion, patients with OSA and Mallampati score of <4, independent of mandibular protrusive range or incisal opening, are likely to benefit from oral appliance therapy.
Support (If Any): None

0592

DENTAL SIDE EFFECTS OF LONG TERM OBSTRUCTIVE SLEEP APNEA THERAPY. A 10 YEAR FOLLOW UP STUDY

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Introduction: Obstructive sleep apnea Syndrome (OSAS) is a sleep related breathing disorder. OSAS is characterized by repetitive obstruction of the upper airway during sleep. Patients are usually treated with either Continuous Positive Airway Pressure (CPAP) or oral appliance

therapy. The objective of this study is to evaluate changes in dental occlusion, which are associated with long-term oral-appliance and CPAP therapy.

Methods: 29 OSAS patients using an anterior traction oral appliance and 34 patients using CPAP therapy, were evaluated.[1] Data was analyzed at baseline, two year and 10 year follow-up. Changes in dental occlusion were manually analyzed from dental plaster casts using a digital sliding caliper.

Results: At 2 year follow-up, oral appliance therapy resulted in significant dental changes as compared to CPAP therapy. Overjet and overbite decreased on average with 1.5 mm (sd. ±1.5mm) and 1.2 mm (sd ±1.1mm), respectively. The anterior-posterior change in occlusion was significantly larger in the oral appliance group (−1.3 ± 1.5 mm) as compared to the CPAP group (−0.1 ± 0.6 mm). Both groups showed a significant decrease in number of occlusal contact points in the (pre)molar region. After 10 years follow-up, higher significant changes were seen in overjet and overbite, but also in anterior-posterior change and in the number of contact points in the (pre)molar region. Definitive analysis are currently conducted and will follow.

Conclusion: This study confirms that oral appliance and CPAP therapy changes dental occlusion significantly. These changes appear more pronounced with an anterior traction oral appliance as compared to CPAP therapy.

Support (If Any): -

0593

DIFFERENCES IN PREDICTED THERAPEUTIC OUTCOME AND OPTIMAL PROTRUSION POSITION OF ORAL APPLIANCE DETERMINED DURING PSG WITH REMOTELY CONTROLLED MANDIBULAR POSITIONER BETWEEN CANADIAN AND CHINESE OSA PATIENTS

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Introduction: In-lab mandibular protrusive titration using a Remotely Controlled Mandibular Positioner (RCMP, MATRx, Zephyr sleep technologies, Calgary, CDN) has been found to predict the success rate of oral appliance (OA) in obstructive sleep apnea (OSA) and reliably determine the Optimal Protrusive Position (OPP) for participants predicted to be therapeutically successful with oral appliance therapy in these patients. The aim of this prospective pilot study was to compare OA success rate and OPP using in-lab RCMP manual titration performed in Canadian (Quebec, Canada) and Chinese (Shenyang, China) OSA patients.

Methods: Seventeen untreated Canadian and 9 Chinese OSA patients were recruited (inclusion criteria: age: 20–75 years, AHI:15–50/h; BMI < 40 kg/m^2). In each center, manual RCMP titration was performed during an in-lab sleep study using a same procedure that had been previously reported.

Results: Anthropometric features and OSA severity didn't differ between Canadian and Chinese subjects. The resting occlusal position of lower mandible (determined by the scales on RCMP trays) was lower in Chinese patients than in Canadians (3.91 ± 1.95 mm vs. 9.76 ± 2.22 mm, p ❙ 0.01, independent t-test), with similar maximal mandibular advancement level (17.24 ± 1.51 mm vs. 17.14 ± 1.55 mm, $p > 0.05$). The predicted success rate according to the RCMP titration tended to be lower in Canadians (41%) than in Chinese (78%) ($p = 0.07$, chi-square test). Among patients with predicted success, the mean OPP was 94.6 % ± 11% of maximal protrusion in Canadians, which tended to be higher than its value in Chinese subjects (81.1% ± 13% of maximal protrusion; $p = 0.08$).

Conclusion: According to in-lab RCMP titration, Chinese OSA patients appear to be more prone to benefit from OA treatment than Canadians, with lower level of optimal mandibular advancement.

Support (If Any): RCMP device was provided by Zephyr sleep technologies, Calgary, CDN).

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0594

PREDICTORS OF SUCCESS FOR ORAL APPLIANCE (OA) THERAPY IN OBSTRUCTIVE SLEEP APNEA (OSA) PATIENTS BASED ON INITIAL CRANIOFACIAL CHARACTERISTICS

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Introduction: The aim of this investigation was to explore hard and soft tissue cephalometric predictors for the success of oral appliance therapy, in patients with varying severity of OSA.

Methods: A review of 108 consecutively treated patients with OSA was performed at the Dental Sleep Medicine Clinic at Tufts University School of Dental Medicine. Fifty-two subjects, all treated with OA therapy were included. Our predictive factors included BMI, age, gender, mandibular plane angle (MP), vertical distance between MP and the most superior point of the hyoid bone (MP-H), ANB angle (ANB), soft tissue ANB angle (S.T. ANB), anterior-posterior upper lip position (UL-VL), anterior-posterior lower lip position (LL-VL), and anterior-posterior soft tissue chin position (C-VL). Treatment success was defined in three ways: 1. At least 50% reduction in initial AHI, 2. Residual AHI ≤ 10 after treatment, and 3. Residual AHI ≤ 5. A multiple regression model was developed to study the effect of various variables on success. The level of statistical significance was set at 0.05.

Results: No statistically significant differences were found between subjects with mild, moderate and severe OSA (P>0.05). BMI (median= 28.3, IQR = 5.9) was weakly correlated to AHI ($rs = 0.28$, $P = 0.045$). OA therapy resulted in 51.9%, 55.7% and 30.7% successful outcomes, using the first, second and third methods of defining success, respectively. MP and C-VL were positively associated with treatment success (AUC_{MP}= 0.67 and $AUC_{C\text{-}VL}$= 0.71).

Conclusion: A weak positive correlation was found between BMI and OSA severity. The MP and C-VL were significantly correlated to the outcome of OA therapy, but showed a weak to moderate predictability for the success of OA therapy. The results should be interpreted with caution and their clinical significance should be investigated in future studies.

Support (If Any): N/A.

0595

OUTCOMES OF ORAL APPLIANCE THERAPY FROM FIVE DENTAL SLEEP MEDICINE PRACTICES

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Introduction: Oral appliance therapy (OAT) is now a first line treatment for obstructive sleep apnea (OSA). Since OAT is gaining

momentum as a treatment choice among patients with OSA, it is important to verify effectiveness of therapy in a variety of clinical practices. We report outcomes from five dental sleep medicine practices across the continent.

Methods: Five dental sleep medicine practitioners shared data on consecutive patients receiving OAT for OSA. Descriptive statistics report the combined response to OAT. Differences between practices were measured using t-test or chi square as appropriate.

Results: Among the practices, patient characteristics differed by age (mean±SD of youngest group 55 ± 14 vs oldest 63 ± 13 years, p=0.004), body mass index (lightest group BMI 55 vs heaviest 62 kg/m^2, p=0.03), degree of daytime sleepiness (Epworth score 7.4 vs 10.3, p=0.049) and diagnostic apnea-hypopnea index (AHI 17 vs 31 events per hour, p=0.02). Prior use of airway pressure therapy differed among the groups (least use 55% of patients vs most use 80%, p=0.001). Response rates to OAT did not differ between practices (p=0.10). For the entire group (n=232), OAT improved AHI a mean of 15.8 ± 16.3 events/hour. Of the entire group, 95% of cases improved and 53% had complete resolution of OSA by AHI. For severe cases, normalization of AHI occurred in 28%, moderate 44%, and mild 74%. If treatment success is defined as achieving AHI less than 15 and improving symptoms, 79% of severe cases were successfully treated. Home sleep tests were the baseline diagnostic procedure in 22% of cases but after treatment, HST was the diagnostic procedure in 64% of cases.

Conclusion: Across a broad geographic array of dental sleep medicine practices, OAT improves OSA in the vast majority of cases and provides complete resolution of disease in half, despite differences in patient characteristics at the time of presentation for care.

Support (If Any): None

0596

MEXICAN MANDIBULAR ADVANCEMENT SPLINT FOR THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: In this research we propose the use of a personalized Mandibular Advance Splint made in Mexico (MAS-MEX), which according to its action mechanism and effective durable material, allows to reduce therapeutic costs in the control of OSAS.

Methods: We selected 60 patients diagnosed with OSAS using portable sleep monitoring type II, who met the medical and dental inclusion criteria for the placement of an MAS-MEX.

Once the MAS-MEX was carried out, the effects and benefits of this alternative treatment were explained.

Clinical follow-up was performed every 15 days and three months after placement and the efficacy of MAS-MEX was evaluated by portable sleep monitoring type II.

Statistical analysis was performed using Student's T test of dependent samples to compare means of respiratory values between the pre and post treatment records to determine the source of the significance ($p \leq 0.05$).

Results: We identified a significant reduction in Apnea Hypopnea Index (23.56 to 4.35 ev / hr), snoring index (157.85 to 31.52 ev / hr), increase SaO2 (89.72% to 91.48%), Epworth sleepiness scale (14.9 to 4.3 pts), as well as significant changes in subjective assessment of the patient and of the couple.

Conclusion: The present research promotes in Mexico, a new prototype of oral devices for the control of OSAS.

A lower cost, allows a greater number of patients to benefit from this therapeutic alternative, which must be managed in a multidisciplinary manner for case selection and continuous monitoring during its use.

Support (If Any): No

0597

SURGICAL TREATMENT OF OBSTRUCTIVE SLEEP APNEA ON CARDIOVASCULAR OUTCOMES: A SYSTEMATIC REVIEW

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Introduction: Obstructive sleep apnea (OSA) is an increasingly prevalent clinical problem with significant effects on both personal and public health. Continuous positive airway pressure (CPAP) has demonstrated strong efficacy and low morbidity; however, long-term adherence rates approach 50%. Various surgical therapies are available for treatment of OSA. The effectiveness of these therapies is generally measured by polysomnographic and subjective variables; however, these outcome measures do not necessarily correlate with cardiovascular parameters. This systematic review examines the available cardiovascular data in the setting of surgical treatment of OSA.

Methods: A comprehensive search of the literature was performed using the databases of PubMed, Embase, SCOPUS, the Cochrane Library, BioMed Central, and Web of Science from inception to July 2016. Articles were included if they met the following criteria: (1) The sample population consisted of adults (age ≥18 years); (2) OSA was diagnosed by polysomnogram; (3) surgical intervention was performed for OSA; (4) subjects served as their own controls (pre-treatment vs. post-treatment) or were compared to a separate control group; (5) one or more physical or biochemical cardiovascular and/or cerebrovascular variables was measured pre-operatively and at ≥14 days post-operatively.

Results: Thirty-six articles were included with total subjects equaling 13,650. The majority of studies were case-series and cohort study design (42% and 44%, respectively) with a wide-ranging follow-up period (15 days-9 years). The following surgical interventions were examined: pharyngeal surgery (n=22), tracheostomy (n=10), maxillomandibular advancement (n=3), hypoglossal nerve stimulation (n=1). Nine studies examined blood pressure as the primary cardiovascular outcome with improvement (n=8), no change (n=1). Surgical treatment also showed positive effects on cerebrovascular accident rate, mortality, heart rate variability, flow-mediated dilation, C-reactive protein levels, intimal carotid artery thickness, cardiac arrhythmia, ejection fraction, pulmonary artery pressure, adiponectin and leptin.

Conclusion: Current data suggest that surgical treatment of obstructive sleep apnea provides improvement in a diverse set of cardiovascular endpoints. As the majority of studies represent low-level evidence, larger, prospective studies with more rigorous study design are required.

Support (If Any): None

0598

EVALUATION OF THE OVERALL CLINICAL EFFECTIVENESS BASED ON CARDIOVASCULAR EFFECTS OF A MANDIBULAR ADVANCEMENT SPLINT IN THE TREATMENT OF OBSTRUCTIVE SLEEP APNEA

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Introduction: In this prospective clinical trial we evaluated the cardiovascular effects of oral appliance therapy using a custom-made, titratable mandibular advancement splint (MAS) in patients with obstructive sleep apnea (OSA).
Methods: Forty-four patients were included after diagnosis of OSA (apnea/hypopnea index (AHI)>15/h sleep) on polysomnography (PSG) and treated with MAS (SomnoMed Flex, Somnodent, Australia, Crows Nest). At baseline and 6-month follow-up, participants underwent portable sleep monitoring (PSM), 24-hour blood pressure (BP) monitoring, a comprehensive 2D, Doppler and tissue Doppler echocardiography, and objective compliance measurement. Patients and their partner had to fill out a visual analogue scale (VAS) for snoring and the Epworth sleepiness scale (ESS) questionnaires.
Results: Up to this date, 17 out of 44 included patients completed the 6-month follow-up (age: 47 ± 9 years; 82% male; baseline AHI-PSG: 20 ± 4 events/hour; body mass index (BMI): 27 ± 5 kg/m^2; 24-hour systolic blood pressure (SBP): 129 ± 15 mmHg, 24-hour diastolic blood pressure (DBP): 77 ± 8 mmHg). A significant decrease in AHI-PSM (10 ± 8 to 5 ± 4 events/hour; p=0.015), VAS (6 ± 3 to 2 ± 2; p=0.000) and ESS (11 ± 5 to 8 ± 5; p=0.043) was observed after 6 months of MAS therapy as compared to baseline. Objective compliance measurement of MAS use, defined as the usage of the MAS divided by the total sleep time, was high at 92%. Taking into account an efficacy of 57% based on the difference in AHI under MAS and at baseline, the mean disease alleviation (MDA) was about 52%. A statistically significant increase in left ventricular ejection fraction (Simpson method) was observed, from 59 ± 7% to 63 ± 7% (p=0.018). At present no significant decrease in 24-hour blood pressure was noted.
Conclusion: The preliminary results of this ongoing clinical trial show a significant reduction in AHI, snoring and daytime sleepiness under MAS treatment for moderate to severe OSA. Although no significant effect on 24-hour blood pressure was noted yet, echocardiography showed a significant increase in left ventricular ejection fraction.
Support (If Any): -

0599

SLEEP APNEA SEVERITY IS ASSOCIATED WITH MOTOR RECOVERY AND PROCESSING SPEED IN ACUTE TBI REHABILITATION ADMISSIONS: A VA TBI MODEL SYSTEM STUDY

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Introduction: During a time of critical neural repair, significant proportions of persons with traumatic brain injury (TBI) undergoing neuro-rehabilitation have significant sleep disruption. Recent reports indicate up to 37% of consecutive TBI rehabilitation admissions have undiagnosed sleep apnea (SA) that may hinder neurologic repair due to hypoxemia and sleep disruption. To date, no study has examined outcomes associated with SA in early stages of TBI recovery.
Methods: This is a consecutive prospective observational cohort study with IRB-approved research participants part of the TBI Model Systems lifetime study and who received PSG during inpatient neurorehabilitation. The Functional Independence Measure (FIM, Cognitive and Motor Subscales) and Disability Rating Scale were rated on admission and discharge by clinical teams. A subset recovered sufficiently and underwent neuropsychological testing including measures of memory (CVLT-2) and processing speed (Trail Making Test).
Results: Sample (n=68) was primarily male (96%), white (87%), married (35%), with ≥ 12 years of education. The median age was 31 years (interquartile range [IQR], 25,50). The most common TBI mechanism was motor-related (68%) with most having a severe injury (Median Emergency Department Glasgow Coma Scale =3, IQR, 3,11). Half of the sample (43%) had SA that was primarily mild (62%) and obstructive type. Individuals were divided into SA severity groups based on AHI of ≤4 (none), 5–14 (mild), and ≥ 15 (moderate to severe). One-way between subjects ANOVA revealed group differences for FIM Motor (F, (2,64) = 3.86, p=.026) and Total scores (F, (2,64) = 3.18, p=.048) on rehabilitation admission. Post-hoc (Tukey) comparisons revealed worse scores for participants with moderate-severe SA compared to those with mild. SA severity was significantly correlated with processing speed (r=0.4, p=0.007) but not verbal memory during early TBI recovery.
Conclusion: Greater SA severity was significantly associated with lower motor functioning and slower processing speed during inpatient rehabilitation. Earlier detection of SA may improve rehabilitation outcomes following TBI.
Support (If Any): VA TBI Model Systems Program of Research, Subcontract from General Dynamics Information Technology (W91YTZ-13-C-0015), Defense and Veterans Brain Injury Center; Defense Health Agency (DHA); and Department of Veterans Affairs grants (1 I50 HX001233-01, W81XWH-13-2-0095).

0600

INTERACTION BETWEEN SEVERITY OF OBSTRUCTIVE SLEEP APNEA AND GENDER ON THE LEVEL OF HEMOGLOBIN

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Introduction: Obstructive sleep apnea (OSA) and gender are both associated with the level of hemoglobin (HB). Little is known

regarding the relationship between the severity of OSA and gender on the level of HB. We aimed to examine their interaction effects on the level of HB in this work.
Methods: A total of 859 participants with suspected OSA were included. All participants underwent overnight polysomnography (PSG) followed by examining the levels of hemoglobin and erythropoietin (EPO) in the morning.
Results: Of all patients, 626 (72.9%) had OSA (an apnea-hypopnea index (AHI)≥5/h); 306 (35.6%) were women (age 46.7±12.9 years, body mass index (BMI) 25.5±4.0 kg/m^2), 523 (64.4%) were men (age 45.0±11.7 years, BMI 26.2±4.1 kg/m^2). ANOVA analysis revealed a significant interaction between AHI and gender on HB after adjusting for age, BMI, current smoking, drinking, and percentage of time spent in sleep below 90% oxygen saturation ($F=6.87$, $p<0.01$). For men, there were no differences in the level of HB among three groups with different levels of AHI (< 5/h, habitual snoring; 5–30/h, mild-moderate OSA; ≥ 30/h, severe OSA). For women, the level of HB in patients with severe OSA was significantly higher than those with habitual snoring and mild-moderate OSA. A cumulative association with AHI level and HB was only obtained in women ($p<0.05$ for linear trend), not in men.
Conclusion: The results provide a novel evidence of mediated interaction between AHI and gender on the level of HB. The increasing severity of OSA is independently associated with a higher level of HB in women, but not in men.
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0601

DETECTION OF OBSTRUCTIVE SLEEP APNEA AND ASSESSMENT OF SLEEP AND MOOD SYMPTOMS IN ARRHYTHMIA CLINIC OUTPATIENTS

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Introduction: Obstructive sleep apnea (OSA) is a sleep disorder with serious cardiovascular consequences. OSA is associated with different types of arrhythmia. We aimed to determine (1) The percentage of patients with arrhythmia, not suspected/diagnosed with OSA, who have OSA; (2) The percentage of patients in outpatient arrhythmia clinics who show symptoms indicative of poor sleep, excessive daytime sleepiness, decreased alertness, fatigue and/or depression; and (3) If these symptoms predict the presence of OSA in these patients.
Methods: We recruited non-selected consecutive patients from three arrhythmia clinics. Patients with previously diagnosed and/or treated OSA were excluded. Validated screening tools were administered: (1) Epworth Sleepiness Scale (ESS); (2) Fatigue Severity Scale (FSS); (3) The Non-Restorative Sleep Scale (NRSS); (4) Insomnia Severity Index (ISI); (5) The Center for Epidemiological Studies-Depression Scale (CES-D); and (6) Toronto Hospital Alertness Test (THAT). Patients were diagnosed with OSA (AHI >5 /hour of sleep) by a home sleep study.
Results: We recruited 75 participants (72% Males). Mean age was 64. Mean BMI was 28 **kg**/m2. Twenty-seven percent had a BMI >30, and 7% had a BMI >35 **kg**/m2. Sleep related instruments showed: (1) Thirty-two percent of patients had an ESS score ≥8, which indicates a high level of daytime sleepiness; (2) Forty-seven percent showed a high level of fatigue as suggested by a FSS score >3; (3) Symptoms of non-restorative sleep were detected in 15% (NRSS score ≤46); (4) Seventeen percent had a CESD score ≥16, which is suggestive of depression; (5) Thirty-three percent had an ISI score suggestive of mild insomnia, 46% moderate insomnia, and 11% severe insomnia; (6) Four percent had a score <20 on THAT, which indicates decreased alertness. Eighty-five percent of patients were positive for OSA. A binary logistic regression analysis showed that only age and male gender were predictors of OSA ($p=0.002$, $p=0.014$ respectively).
Conclusion: Eighty-five percent of patients in general arrhythmia clinics have undetected obstructive sleep apnea. High scores suggestive of daytime sleepiness, fatigue, insomnia, depression, and poor sleep did not predict the presence of OSA. Sleep studies should be considered for detection of OSA in arrhythmia clinic outpatients.
Support (If Any):

0602

CENTRAL SLEEP APNEA IN THE ACUTE AND STABLE PHASES OF STROKE

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Introduction: Current literature supports the idea that Obstructive sleep apnea (OSA) is an independent risk factor for stroke. The AHA/ASA recommend a sleep study be considered in patients who suffer an acute stroke. Similar guidelines have not yet been established for central sleep apnea (CSA) in the context of an ischemic event. It has been postulated that CSA results after a stroke/TIA. We evaluated prevalence of sleep disordered breathing (SDB) in patients who suffered from stroke in the acute as well as stable phases, focusing on CSA.
Methods: Patients admitted to the stroke unit at our institution over a 22-month period, who underwent a portable sleep study (PST) in the acute phase of admission (ApneaLink Air, Resmed USA) and subsequently a polysomnography (PSG) in the stable phases. SDB was defined by an overall AHI of ≥5. Data collected included, sex, age, BMI, opiate use, presence of heart failure, and vascular territory involved.
Results: 47 patients met inclusion criteria. 36 (76.6%) patients who underwent a PST were diagnosed with OSA. 18 (38.3%) were positive for CSA. 12 (25.5%) were positive for CSB. Based on PSG results, OSA was diagnosed in 42 (89.4%) patients, CSA in 14 (29.8%), and CSB in 7 (14.9%).
Conclusion: PSG remains more sensitive for diagnosis of SDB, with PST more convenient as a screening method. The prevalence of CSA may be higher in patients suffering from an acute stroke/TIA than previously suspected. Whereas the prevalence of OSA increases with the more sensitive PSG, the prevalence of CSA decreases in the stable phase. Thus, we postulate that central events could represent a consequence of stroke/TIA. In most patients with CSA, stroke localized to the anterior circulation. No demographic information reached statistical significance, suggesting that those cannot be used in acute stroke patients to identify those who are at a higher risk of CSA. Given the overall high prevalence of CSA in the stroke population and lack of clearly identifiable risk factors, further studies into screening and treatment may be considered.
Support (If Any):

0603

SHORT SLEEP DURATION IS ASSOCIATED WITH AN INCREASED PREVALENCE OF HYPERTENSION IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Short sleep duration and obstructive sleep apnea (OSA) are both associated with an increased risk of hypertension. We aimed to explore whether polysomnography-determined sleep duration modifies the relationship between OSA and prevalent hypertension.
Methods: A total of 7048 patients with apnea-hypopnea index (AHI) ≥ 5/h were recruited into this study (84.7% males, mean age = 45.34±11.78 years). Hypertension was defined based either on direct blood pressure measures or on diagnosis by a physician. Patients with sleep duration ≤ 6 h were considered to be short sleepers. Logistic regression procedures were performed to determine the independent association between sleep duration and hypertension in patients with OSA.
Results: A 53.8% was found to have hypertension in total observed OSA patients. Considering patients with sleep duration more than 6 hours as reference (n=6032), the odds ratio (OR) (95% confidence intervals) for having hypertension was 1.54 (1.31–1.81) in short sleepers with OSA (n=1016) after adjustment for age, sex, body mass index, diabetes, current smoking, drinking, Epworth sleep scale, time in bed, sleep architecture, arousal index, AHI, and lowest-SaO_2. In stratified analyses, the association of hypertension with short sleep duration was seen among sexes, younger and older ages, and both obese and non-obese patients with OSA.
Conclusion: Both OSA and hypertension are age-related illnesses. It is important to note that the average age of patients in our study was approximately 10 years younger compared to most of similar observational studies in Caucasian patients. Through this large cross-sectional study in 7048 consecutive Chinese patients with unique age, we obtained that short sleep duration is associated with an increased prevalence of hypertension in patients with OSA.
Support (If Any): This research was funded by the National Basic Research Program of China (2015CB856406), the National Key Technology Research and Development Program of the Ministry of Science and Technology of China (2015BAI13B01), and the National Natural Science Foundation of China (81530002 & 81629002).

0604

NATIONAL PATIENT SURVEY OF EXPERIENCES WITH DIAGNOSIS AND MANAGEMENT OF SLEEP APNEA

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Introduction: Changes in health care delivery may impact the experiences of sleep apnea patients, influencing their understanding of their disease and treatment satisfaction. Quality of sleep apnea care delivered by primary care providers has been reported to be non-inferior to care provided by sleep medicine physicians when primary care providers are trained to be members of a "sleep medicine team." It is not known, however, how these findings generalize to other settings. We sought to identify current experiences of patients across the U.S, comparing satisfaction with education with type of provider.
Methods: Between 2015–2016, 341 patients with self-reported sleep apnea completed an on-line satisfaction survey via the web-based Sleep Apnea Patient Centered Outcomes Network portal (www.myapnea.org). Differences in responses by provider type were analyzed using chi-square tests.
Results: The sample was middle aged on average (57+12 years), 58% male, 89% Caucasian, and 86% had higher than high school level education. Almost twice as many respondents reported that they received information from a sleep physician (n=221) compared to a primary care physician, nurse practitioner or other provider (n=120). Respondents reported more positive experiences with sleep physicians compared to other clinicians for the following items: "improved their understanding of sleep apnea" (84% vs 67%, p<0.001); "always or usually explained things in a way they could understand" (68% vs 60%; p=.01); and for helping them "understand treatment options" (68% vs 58%; p=.059). Differences were not identified when sleep physicians were compared to other clinicians for always or usually: ensuring they "understood all the things they needed to do" (67% vs 69%); "spent enough time with them" (63% vs 66%); or provided help with "dealing with uncertainty" (53% vs 47%).
Conclusion: Across diverse settings, patients report that sleep medicine physicians offer added value in educating sleep apnea patients compared to primary care providers. However, regardless of provider type, a large proportion of patients report gaps in the education and support they receive. Further efforts to improve communications between patients and providers may improve patient understanding and outcomes.
Support (If Any): PCORI PPRN-1306–04344.

0605

CONTINUOUS POSITIVE AIRWAY PRESSURE TREATMENT MAY RESTORE OPTIC NERVE FUNCTION IN PATIENTS AFFECTED BY OBSTRUCTIVE SLEE APNEA

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Introduction: Obstructive sleep apnea (OSA) has been recently associated with optic nerve pathology; in particular, literature proposed the clinical and electrophysiological evidence of optic nerve damage in OSA patients. The aim of this study is to evaluate in patients affected by OSA the effect of continuous positive airway pressure (CPAP) treatment on the functional integrity of the visual system evaluated by means of visual evoked potentials (VEP).
Methods: We performed the electrophysiological study of visual system in a population of severe OSA patients at baseline and after 1 year of CPAP treatment. We distributed OSA patients in two subgroups on the basis of the compliance at the CPAP therapy. Compliance was measured by analyzing the software ventilator report; patients should use their device for at least 4 hours per night and for 5 days a week. To be included in the study, patients should not have visual impairment and systemic disorders with known influence on the visual system. VEP were elicited by a reversal pattern generated on a television monitor at low (55') and high (15') spatial frequencies stimulation.
Results: We enrolled 20 OSA patients. Ten patients showed a good compliance at CPAP therapy (OSA-CPAP+) and 10 patients presented an insufficient compliance at CPAP treatment (OSA-CPAP-). We documentyed the significant amelioration of latency and amplitude of VEP components in OSA-CPAP+ compared to OSA-CPAP-.
Conclusion: Taking into acocunt that OSA patients are affected by VEP alterations as documented by lower amplitude and longer latency of the P100 component, this study documented that CPAP treatment

significantly ameliorate VEP in OSA patients who show good compliance at CPAP treatment with respect to OSA patients who do not show adequate compliance at CPAP. Since VEP latency and amplitude pathological changes may be the expression of optic nerve dysfunction provoked by hypoxia, acidosis, hypercarbia and airway obstruction, frequently observed in patients with OSA, we hypothesize that correcting OSA condition by CPAP optic nerve function may be recovered in these patients. Therefore, CPAP treatment may restore the altered electrophysiological findings present in OSA patients if appropriately performed.
Support (If Any): none.

0606

WEARABLE INNOVATION IN SLEEP: DIAGNOSIS AND TREATMENT OF OBSTRUCTIVE SLEEP APNEA

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Introduction: According to the World Health Organization, Obstructive Sleep Apnea (OSA) affects more than 100 million lives worldwide, with a disturbing 80% of undiagnosed cases. For the diagnosis of OSA, Polysomnography (PSG) is considered the gold standard, however, the system is severely handicapped by its high cost (can exceed $10,000 per night along with cost of technicians and physicians), long wait times for scheduling (2–8 months), uncomfortable testing procedure, and unfamiliar testing environment. In this work, we aim at developing a low-cost, and easy to use home sleep testing device with minimum wire configuration and near clinical equivalence with the PSG system. Further, we are working towards the development of a mechanical simulator system to reverse the imminent OSA episodes based on the early prediction.
Methods: Our device includes a sleep pillow with the electronics embedded inside it. A reflective type poly plethysmography signal is measured from the neck which is used to compute the heart rate, breath rate and SpO2 signals. These signals are then used as an input to our novel prediction algorithm which can predict the apnea episodes 1–3 minutes ahead with more that 90% accuracy. Two mechanical motors are attached to the pillow which can simulate the neck muscle and reverse apnea episodes.
Results: We have begun human subject testing with elderly and obese OSA and healthy control. Our device can do real-time analysis and prediction continuously for 9 hours with great user comfort. Further, the breath rate and heart rate was calculated real-time and has an average difference of 2.27 bpm and 0.31 bpm respectively compared to the PSG system.
Conclusion: Our device is a stand-alone solution for real-time wireless OSA monitoring. Given the fact that OSA diagnosis by PSG at sleep centers can be really time-consuming and costly, our device being 10 times cheaper, comfortable and available for at home use on a daily basis can bring great value to the OSA market.
Support (If Any): This research was supported by NSF PFI-AIR-TT (National Science Foundation: Partnership for Innovation: Accelerating Innovation Research-Technology Transfer)

0607

OBSTRUCTIVE SLEEP APNEA ILLNESS PERCEPTION RELATIVE TO OTHER COMMON CHRONIC CONDITIONS

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Introduction: Obstructive sleep apnea (OSA) is a common chronic disease and highly prevalent in Veterans.. Better insight into illness perceptions can help us understand how patients cope with a chronic conditions like OSA and may predict treatment engagement.
Methods: Data from a completed clinical trial on Veterans with OSA was examined. Baseline Apnea-Hypopnea Index (AHI) was obtained from diagnostic sleep testing. The Brief Illness Perception Questionnaire (BIPQ) is designed to rapidly assess the cognitive and emotional representation of illness. It is an 8-item measure, each of which is rated on a ten-point Likert scale. Each item measures one dimension of illness perception. High scores (sum of items) indicates a more threatening perception of illness. The BIPQ was administered at baseline, 2-month and 4-month time points.
Results: 129 patients diagnosed with OSA were studied. The sample had a mean age of 52.7±14.5, mean AHI of 26.4±13.3 and mean BMI of 31.1±4.9. The mean BIPQ total score at baseline was 44.7±10.6. At baseline, each dimension had a mean of: consequence (6.8±2.4), timeline (6.9±3.0), personal control (4.6±3.0), treatment control (8.0±2.1), identity (7.4±2.4), illness concern (8.6±2.0), coherence (7.8±2.1), and emotional representation (6.3±3.0). Baseline AHI was correlated with personal control and treatment control ($r=0.22$ and $r=0.28$, respectively; $p<0.01$). BIPQ scores for OSA patients were higher on consequences (how much does OSA affect your life), identity (how much do you experience symptoms from your OSA), concern (how concerned are you about OSA) and emotional response (how much does OSA affect you emotionally) than for other common chronic conditions with significant comorbidities, including asthma, diabetes, and myocardial infarction.
Conclusion: The study shows elevated components of illness perceptions, particularly when compared to other common chronic conditions. These areas would benefit from additional education and support and could form the basis for an interventional program.
Support (If Any):

0608

ASSESSMENT OF OBSTRUCTIVE SLEEP APNEA IN PATIENTS WITHCHRONIC PAIN SYNDROME: HOW DOES PORTABLE RESPIRATORY RECORDING COMPARE TOPOLYSOMNOGRAPHY?

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Introduction: Obstructive Sleep Apnea (OSA) is a common condition seen in veterans with Chronic Pain Syndrome (CPS). Portable respiratory recording (PRT) is cheaper and more readily available than polysomnography (PSG). The validity of PRT in the diagnosis of OSA in patients with CPS is not well characterized.
Methods: Veterans with CPS admitted to a referral pain rehabilitation center underwent PSG along with supervised PRT in the sleep laboratory on presentation. Studies were scored independently by a blinded scorer using AASM scoring criteria, hypopneas were scored based on oxygen desaturation and arousal criteria in PSG while they were scored based on oxygen desaturation on PRT. Generated reports were compared for Apnea Hypopnea Index (AHI), Oxygen Saturation Nadir (OSN), Oxygen Desaturation Index (ODI), Time Supine (TS), and Mean Heart Rate (MHR) using mean, standard deviation and Parson Correlation Coefficient (PCC).
Results: Twenty-five veterans with CPS were enrolled (22 male, 3 females with an average BMI of 30.15). Average AHI was 23 +/-15 via PSG and 18.2 +/-16.5 via PRT, with PCC 0.69. Twenty three patients were found to have OSA based on PSG while nineteen patients were found to have OSA based on PRT. Ten patients had severe OSA based on PSG while four patients had severe OSA based on PRT. OSN was 86.1 +/- 22.8% via PSG and 85.8 +/-22.7% via PRT, PCC 0.54. ODI was 13.6 +/- 13.6 via PSG and 14.3 +/- 11.1 via PRT, PCC 0.82. TS was 192.7 +/- 109 min via PSG vs 223 +/- 124.4 min via PRT, PCC 0.81. MHR was 67.6 +/- 19.8 bpm via PSG vs 63.8 +/- 18.6 bpm via PRT, PCC 0.97. The results were not statistically significant.

Conclusion: The sensitivity and severity characterization of PRT is suboptimal when compared to the PSG gold standard with chronic pain. Oximetry and positional measurements are similar between PRT and PSG. Further analysis of PRT sensitivity based on patient characteristics may help identify more suitable candidates for PRT testing.
Support (If Any): None.

0609

RELATIONSHIP BETWEEN PAIN AND POLYSOMNOGRAPHIC MEASURES IN ADULTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: In severe OSA patients, CPAP therapy reduced pain sensitivity. However, in chronic pain patients, the presence of untreated OSA related to lower pain sensitivity. Also, in pediatric OSA patients, lower SpO2% nadir related to lower need for morphine following adenotonsillectomy. Opposing effects of sleep fragmentation and hypoxemia on pain perception in OSA were proposed. We collected pain measures in adult patients undergoing PSG for suspected OSA.
Methods: On the PSG evening, 49 patients (18-59y.o., 24 women, 27 minorities, no neurological or endocrine conditions) reported pain intensity (PI) and its functional effects (FE) for the preceding 6 months using Chronic Pain Grade Scale (CPGS), and for the preceding 24 hours using Brief Pain Inventory (BPI). A forearm pressure pain threshold (PPTh) was measured in the evening and the following morning. Backward regression was used to predict pain scores from sex, age, BMI, sleep efficiency, awakenings, arousal index, N1%, AHI, SpO2% nadir, time spent below SpO2 90% (TimeO2<90%), and desaturation index.
Results: Mean AHI=22.9±32.5. Lower SpO2% nadir predicted lower CPGS-PI (p=0.04), lower CPGS-FE (p=0.008) and lower BPI-PI (p<0.001). Longer TimeO2<90% predicted lower BPI-PI (p=0.02). Higher AHI predicted higher CPGS-FE (p=0.04). Evening PPTh showed greater pain tolerance with increased TimeO2<90% (p=0.04) and increased N1% (p=0.005). Morning PPTh showed greater pain tolerance with lower AHI (p=0.001), higher N1% (p=0.046) and higher arousal index (p=0.02).
Conclusion: More profound OSA-related oxyhemoglobin desaturation relates to lower long-term and short-term retrospective ratings of pain, and to higher pain tolerance on a psychophysical measure, suggesting pain-blunting effect of hypoxemia. Higher respiratory event frequency relates to higher long-term pain ratings and lower pain tolerance on PPTh, suggesting hyperalgesic effect. However, increased sleep fragmentation, as measured by N1% and arousals, appears to increase pain tolerance in OSA patients.
Support (If Any): None.

0610

SUBJECTIVE SLEEP QUALITY RELATES TO DEPRESSIVE SYMPTOMATOLOGY IN OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI) are common tools to assess sleep disturbance in various patient populations. However, PSQI was shown to relate to psychological variables rather than objective sleep measures in non-clinical samples, and ISI was related to symptoms of depression in OSA patients. We related PSQI and ISI to PSG variables and depressive symptomatology in patients undergoing OSA evaluation.
Methods: Forty-nine patients (18-59y.o., 24 women, 27 minorities, no neurological or endocrine conditions) completed PSQI (normal range PSQI<6), ISI (normal range: ISI<8), and Center for Epidemiologic Studies Depression Scale-Revised (normal range: CESD-R<16) on the evening of PSG. PSQI and ISI scores were regressed on sleep latency, sleep efficiency, awakenings, arousal index, N1%, N3%, REM%, REM latency, AHI, SpO2% nadir, time spent below SpO2 90%, desaturation index, and CESD-R. Age, sex and BMI were used as covariates wherever significant.
Results: Mean AHI=22.9±32.5; mean PSQI=8.0±3.3; mean ISI=10.9±5.8; mean CESD-R=10.6±9.1. Higher PSQI was related to higher REM% (p=0.02) and higher CESD-R (p=0.01). Higher ISI was related to higher CESD-R (p=0.01) and not to any PSG variables. In regressing CESD-R onto PSG measures, higher CESD-R related to longer REM latency (p=0.02), with no relationship to other variables.
Conclusion: On average, OSA patients reported disturbed sleep on PSQI and ISI, while depressive symptomatology was within normal limits. However, self-reported poor sleep related to depressive symptoms rather than objective measures of sleep disturbance and sleep disordered breathing. Generally sub-clinical CESD-R scores and the direct relationship between CESD-R and REM latency in this sample argue against endogenous depression. To the extent present, depressive symptoms in OSA patients may represent a negative cognitive style, which bears on the patient's subjective evaluation of their sleep.
Support (If Any): None.

0611

SLEEP STAGES, TOTAL SLEEP TIME, AND AROUSALS IN ACQUIRED BRAIN INJURY REHABILITATION PATIENTS WITH AND WITHOUT SLEEP APNEA

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Introduction: Sleep apnea (SA) is a sleep disorder with serious health consequences. SA is more prevalent in acquired brain injury (ABI) patients than in the general population. Yet, there is limited research characterizing sleep architecture in ABI patients with comorbid SA during acute recovery.
Methods: This was a retrospective analysis of ABI patients admitted for neurorehabilitation and referred for polysomnography (PSG). Of 197 patients referred, 138 received PSG, and 93 had valid results with >240 minutes of recorded sleep. ABI etiologies were traumatic (66.7%), stroke (23.7%), or other (9.7%). PSG parameters examined were: total sleep time (TST); % time in N1, N2, N3, and REM; and Arousal Index (AI). One-way ANOVAs were used to compare none/minimal SA (AHI<5, n=42), mild SA (AHI=5–14.9, n=30), and moderate-to-severe SA (AHI≥15, n=21).
Results: There were statistically significant group differences on TST (none/minimal M=362.3‡54.2; mild M=352.2±54.8; moderate-severe M=325.4±54.9, p<.045) and AI (none/minimal M=5.2‡4.1; mild

M=9.0±4.8; moderate-severe M=16.2±15.8, p<.002). Groups did not differ in %N1, %N2, %N3, or %REM.
Conclusion: PSG-based sleep architecture was disrupted in ABI patients with SA. Arousals and sleep time worsened with increased SA severity. Proportions of time spent in sleep stages deviated from healthy adults based on prior literature. Sleep disturbances including apneic events and altered sleep architecture should be addressed to prevent obstacles in the neurorestorative functions of sleep.
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0612

WHITE MATTER DIFFUSIVITY CHANGES WITH INTERMITTENT HYPOXEMIA IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Cerebral white matter is especially vulnerable to hypoxic damage, and thus, may be affected by nocturnal repetitive hypoxemia that is characteristic of obstructive sleep apnea (OSA). Mean diffusivity (MD) can serve as a marker of cerebral white matter integrity, and has been observed to decrease in the acute stage of an ischemic stroke and to increase in the chronic stage. Therefore, the association between MD and nocturnal hypoxemia severity was evaluated to understand how OSA affects the brain, and more specifically cerebral white matter integrity.
Methods: Sixty-six subjects (mean age: 65.1±6.2 y/o, 55–82 y/o) representing a wide spectrum of nocturnal hypoxemia underwent a polysomnographic recording and a magnetic resonance imaging session including a sequence of diffusion weighted imaging. The apnea-hypopnea index ranged from 0 to 67.3 events/hour of sleep. Minimal oxygen saturation (73–94%), sleep time with oxygen saturation <90% (0–95 min), and index of oxygen desaturation >3% (0–41 events/hour of sleep) were used to evaluate intermittent hypoxemia. Using Tract-Based Spatial Statistics within FSL, MD was estimated. Correlations adjusted for age were performed between intermittent hypoxemia and MD in all voxels of the white matter skeleton (p<0.05 corrected for multiple comparisons).
Results: The index of oxygen desaturation >3% correlated significantly with decreased MD in several white matter tracts. Most of these reductions were observed in the bilateral corticospinal tracts, bilateral fronto-parietal superior longitudinal fascicles as well as the corpus callosum. No association was found between the minimal oxygen saturation or sleep time with oxygen saturation <90% with cerebral white matter MD.
Conclusion: Decreased MD in several cerebral white matter tracts was associated with the index of oxygen desaturation. The frequency rather than the intensity of hypoxemia is associated with decreased MD, suggesting white matter alterations similar to what is observed acutely in ischemic injuries. The impact of this possible white matter damage on cognitive health in older individuals with OSA is currently being investigated.
Support (If Any): Canadian Institutes of Health Research (CIHR), Fonds de Recherche du Québec en Santé (FRQ-S).

0613

POLYSOMNOGRAPHICAL AND NEUROPSYCHOLOGICAL DIFFERENCES BETWEEN APOE4 AND NON-APOE4 GROUPS: A PRELIMINANARY STUDY

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Introduction: APOE-4 isoforms have been associated to sleep apnea and cognitive decay. The objective of the present study is to evaluate sleep and cognitive differences in sleep apnea patients with and without APOE4 allele by means of polysomnography and neuropsychological tests.
Methods: We selected twenty-one sleep apnea patients, 11 females and 10 males, aging 33–79 years from Sao Paulo Hospital sleep care unit. Patients underwent clinical interview, full night polysomnography, neuropsychological evaluation and APOE genotyping. Patients were classified in groups according to the presence APOE4 allele. Differences between groups were assessed by One-way ANOVA.
Results: Patients with APOE4 allele presented lower BMI, smaller neck and waist circumference, shorter REM sleep latency, and lower REM sleep respiratory disturbance index (REM RDI) (p<0.05). Patients with APOE4 allele presented higher retroactive interference mean (IDR) in Rey Auditory Verbal Learning Test (p<0.05).
Conclusion: Patients with sleep apnea and APOE4 allele differed from patients without APOE4 allele in biometrical, polysomnographic and neuropsychological parameters. Patients without APOE4 allele showed less favorable sleep apnea, biometric and neuropsychological characteristics. REM sleep RDI was higher in patients with APOE4 allele.
Support (If Any): FAPESP.

0614

IS OBSTRUCTIVE SLEEP APNEA RELATED TO NEUROPSYCHOLOGICAL FUNCTION IN HEALTHY OLDER ADULTS? A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Previous systematic reviews and meta-analyses have identified cognitive deficits in adults with obstructive sleep apnoea (OSA). However, quantitative analysis of the association between OSA and neuropsychological performance has not been conducted specifically in older adults, for whom there is a greater risk of cognitive decline.
Methods: We searched Medline, Embase and PsycINFo through August 2016 for studies describing associations between OSA and neuropsychological outcomes in people aged>50 years. Meta-analyses were performed on these studies for overall cognition and

within cognitive domains. Subgroup analyses were performed taking into account risk of bias and moderating differences in study design.
Results: 13 studies met eligibility criteria for analysis. A small negative association was found between OSA and all neuropsychological outcomes combined, g=0.16 (95% CI 0.02–0.29), and in memory and processing speed domains. Small case-control studies from sleep clinic populations observed the greatest associations, while larger cohort studies from community samples illustrated no association. Analysis accounting for publication bias resulted in a null overall association, g=0.01 (95%CI -0.14 to 0.16).
Conclusion: Associations between OSA and cognition in later life are highly variable and the findings differ based on study type and setting. It appears some older adults may be at risk of cognitive impairments attributable to OSA; however, the risk of bias renders the current evidence inconclusive. Further comprehensive research is warranted in older clinically diagnosed OSA patients as well as those already experiencing neuropsychological impairment and who may be regarded at higher risk of further cognitive decline.
Support (If Any): N/A.

0615

CONTINUOUS POSITIVE AIRWAY PRESSURE IMPROVES ARTERIAL STIFFNESS AND ENDOTHELIAL PROGENITOR CELLS (CD34+ CELLS)

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Introduction: Obstructive Sleep Apnea (OSA) is an independent risk factor for cardiovascular diseases, mediated in part by endothelial dysfunction. It has been reported that OSA patients have increased endothelial oxidative stress, inflammation, and reduced endothelial repair capacity. Continuous Positive Airway Pressure (CPAP) is the mainstay of OSA treatment, and has been shown to decrease cardiovascular disease (CVD) risk. Circulating endothelial progenitor cells (EPCs) are intrinsic to vascular repair and regeneration, and help to maintain endothelial integrity. Arterial stiffness (AS) is an established predictor of endothelial health and CVD risk. Here, we studied the effect of CPAP treatment on EPCs and AS in OSA patients.
Methods: 8 patients with moderate to severe OSA were enrolled. Pulse Wave Velocity (PWV), a measure of AS, and EPCs (CD34+) were assessed at baseline, and after 3 months of treatment with CPAP. The Wilcoxon Signed Rank Test was used to test changes in measurements per day of CPAP > 4hr (median of 48 days).
Results: Arterial stiffness, measured by PWV, was improved with CPAP treatment ($p = 0.008$). Although no statistically significant change was noted in EPC colony forming units, the percent of CD34+ cells (relative to total mononuclear cells) increased after treatment ($p = 0.05$). Additionally, in targeted gene expression analysis, a trend towards increased gene expression was noted for eNOS (endothelial nitric oxide synthase) and CXCR4 (a receptor for SDF1A, a known chemotactic factor for EPCs).
Conclusion: An improvement in arterial stiffness, along with an increase in CD34+ cell numbers most likely explains the cardiovascular risk reduction post CPAP therapy. While a larger cohort is needed to elucidate the specific molecular mechanisms involved in this process, this pilot study serves to introduce potential key players.
Support (If Any): N/A.

0616

A PERCEPTIVE IMPAIRMENT IN OSA PATIENTS ASSESSED BY MEANS OF A VISUAL SEARCH TASK

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Introduction: A relevant daytime consequence of Obstructive Sleep Apnea (OSA) is the negative impact on neurocognitive function, ranging from psychomotor performance to executive functioning. In spite of a huge amount of evidence regarding cognitive impairment, little is known about the effect of OSA on sensory processes. In the present research visual perception of OSA patients was assessed by means of a visual search paradigm.
Methods: 19 OSA patients (mean age: 47.42 ± 10.79, 16 males; Apnea/Hypopnea Index (AHI): 47.87 ± 24.67) and 19 age-matched healthy controls (HC) participated in the study. After a nocturnal cardiorespiratory monitoring patients performed a visual search task in which they had to detect the presence/absence of a target (letter T) embedded in the 50% of trials into a set of distractors (letters Os, Xs, or Ls). Target's salience and distractors' numerosity were manipulated as independent variables, whereas accuracy and reaction times (RT) were recorded as dependent variables.
Results: Data generally confirmed the typical effects of visual search: RT increased with distractors' number and decreased with targets' salience. OSA patients exhibited significantly slower RT in comparison with HC. This result indicates an overall perceptual deficit that consists in a harder extraction of relevant information from noise. Neither patients' age nor the objective clinical indices (such as AHI and excessive daytime sleepiness) were associated with RT.
Conclusion: This study demonstrates the existence of a deficit involving basic mechanisms of visual processing in OSA patients. This impairment seems to be not explainable by OSA severity, but ascribable to the disorder per se.
Support (If Any): None.

0617

BED PARTNER APNEA ANXIETY - HIGH IN CHEYNE-STOKES RESPIRATION & OBSTRUCTIVE SLEEP APNEA

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Introduction: Bed partners are a long-suffering, under-researched population whose observations form an essential part of the clinical assessment of sleep breathing disorders. Concerns regarding key symptoms (snoring, restlessness, apnoea) in different sleep breathing disorder types has not been systematically compared. **Aim:** Compare bed partner concerns, sleep disruption before and after treatment, hypothesizing that apnea anxiety would be highest in Cheyne-Stokes Respiration (CSR) partners c.f. simple snorers and obstructive sleep apnea (OSA).
Methods: Consecutive partners of patients completed an in-house questionnaire, Generalized Anxiety Disorder (GAD7), Epworth Sleepiness Score (ESS), Sleep quality, level of concern regarding snoring, apnea and restlessness (Likert scale). Defined OSA (AHI>10/hr), Snoring without OSA (AHI≤10/hr). CSR partners were prospectively and retrospectively recruited. Repeat measures 4 weeks post treatment.
Results: Of 73 couples screen, 30 formed study group comprising 16 OSA, 9 snorers, and 5 CSR. Most partners (19/30) strong proponents of referral. Partners of OSA patients were equally concerned about

snoring & apnea c.f. CSR partner's whose primarily concern was apnea. In OSA CPAP improved bed partner sleep (pre- 58.1±26.5 and post 29.1±20.1, p = 0.004), reduced concern re/ snoring (pre-66.9±21.4, post 11.5±12.3, p <0.001), apnea (pre- 59.9±26.4, post 14.2±13.1, p <0.001), restlessness (pre 60.2±6.1, post 27.3±5.7, p = 0.001) & anxiety (baseline GADS-7 4.5±4.1, post 2.9±2.9, p = 0.150). Partners ESS reduced, but not significantly (pre 5.3±3.8, post 3.8±2.3, p = 0.143). Partners of CRS patients had higher concern re/ apnea (75.9±26.7) than OSA (59.9±26.4) & snorers (46.9±30.8). Treatment of CSR reduced anxiety (ns trend).

Conclusion: Bed partners are impacted by a range of adverse factors, particularly in the setting of OSA and CSR. Successful treatment improves partner sleep quality, anxiety concern re/ loud snoring, apnea & restlessness. Partner sleep apnea anxiety was greatest in CSR, moderate in OSA and lowest in simple snorers. These measures should be included when evaluating disease burden and treatment response.

Support (If Any): University of Otago - Deans Research Grant.

0618

PULMONARY OXYGEN UPTAKE ON-KINETICS DURING SUBMAXIMAL TREADMILL WALKING IN ADULTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Sympathetic nervous system hyperactivity in obstructive sleep apnea (OSA) may impair oxidative metabolism in skeletal muscle by limiting oxygen perfusion and diffusion through microcirculation which may exacerbate the onset of fatigue in these individuals. Oxygen consumption (VO_2) on-kinetics reflects the rapidity of the oxidative system to adjust to increased metabolic demand, and is implicated in fatigue. Adults with OSA commonly complain of fatigue while performing daily activities, but there is little to no understanding of the contributing underlying mechanisms. The purpose of this study is to characterize VO_2 on-kinetics during submaximal treadmill walking in adults with OSA, and to examine the mediating effects of OSA severity as measured by apnea-hypopnea index (AHI).

Methods: Participants performed a cardiopulmonary exercise test on treadmill for determination of peak VO_2 (VO_{2peak}) and anaerobic threshold (AT). Repeated bouts of a constant treadmill work rate corresponding to a VO_2 of 85% of measured AT were also performed. Indices of VO_2 on-kinetics include VO_2 amplitude (ΔVO_2), time constant (□) reflecting the adjustment time for oxidative metabolism, and transition constant (TC=ΔVO_2/mean response time) reflecting a normalized rate of VO_2 on-kinetics. Data were compared using Cohen's d.

Results: Eight volunteers participated [OSA: n=4, 53.5±7.2yrs, AHI=40.75±33.12; NO: n=4, 36.5±3.3yrs). VO_{2peak} and AT were significantly lower in OSA than NO (30.7±7.6 vs. 40.6±5.4 mL/kg/min, p=0.03 and 22.5±4.1 vs. 29.7±4.8 mL/kg/min, p=0.03 respectively*).*□ did not differ between OSA and NO (41.7±10.1 vs. 39.1±11.3 sec); however ΔVO_2 and TC were lower in OSA (888.2±410.2 vs. 1451.5±155.3 mL/kg/min and 17.6±8.1 vs. 27.5±8.5 mL/kg/min/sec). Moreover, OSA and AHI score had a large effect on ΔVO_2 and TC (for OSA d=1.5 and 1.2; and AHI score's d=2.4 and 2.9 respectively).

Conclusion: Our group of adults with OSA demonstrated reduced physical capacity as well as a decreased physiological capacity to consume oxygen per unit time. OSA severity (AHI) had a large effect on prolonging VO_2 on-kinetics, suggesting a slower oxidative response in meeting energy demands for submaximal activities in persons with more severe OSA. Overall, these results suggest a potential limitation in the peripheral musculature that may mediate the daytime fatigue in OSA.

Support (If Any):

0619

IMPACT OF OSA AND OSA-COPD OVERLAP SYNDROME ON NEUROCOGNITIVE OUTCOMES

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Introduction: OSA coexisting with Chronic Obstructive Pulmonary Disease (COPD), also known as the "Overlap Syndrome", is estimated to occur in 14% of the general adult population. Whether patients with Overlap Syndrome suffer from worse clinical outcomes is not known. We investigated the associations between clinical and neurocognitive outcomes in both OSA and Overlap Syndrome patients.

Methods: We prospectively recruited eligible older patients (age 60 years or older) from sleep and pulmonary clinics. Patients with moderate to severe OSA alone or with comorbid moderate to severe COPD (Overlap Syndrome) completed a battery of neurocognitive tests. Current smokers, patients with acute cardiac comorbidities and sedative use were excluded. Standardized scores were compared to a normal expected value of 100 for each cognitive test.

Results: Results are presented for 6 OSA patients (age 67±3 yr, BMI 35±5 kg/m^2, AHI 48±27/hr) and one patient with Overlap Syndrome (age 69 yr, BMI 27.4 kg/m^2, AHI 79.2/hr, GOLD class 2). Participants were evaluated in the following cognitive domains- OSA: Intellectual functioning: Wechsler Abbreviated Scale of Intelligence II, Full scale IQ, 107.0±17.9, p=ns;Verbal Memory: Hopkins Verbal Learning Test-Revised, (total recall) 94.8±12.2, p= ns; Wechsler Memory Scale IV— Visual Reproduction, Delayed 100.0±17.1, p=ns; Visual Reproduction, Immediate 112.2±13.7, p=0.08; Working memory, motor control: Digit Symbol Coding 93.8±7.8, p=ns; Psychomotor speed: Trails A 89.8±8.9, p=0.06; Attention and Executive function (Set Shifting): Trails B 91.8±12.2, p=ns; Executive function, Set Maintenance: Stroop color-word 95.7±3.5, p=0.03, Stroop color word interference 97.7±11.2, p=ns; Overlap Syndrome: Test results were above average (100) for all except the Digit Symbol Coding: 85.

Conclusion: Veterans with moderate to severe OSA performed in the low average to average range on cognitive testing. Additional data are required to explore specifically the impact of comorbid moderate to severe COPD and OSA on neurocognitive and other clinical outcomes.

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0620

DIFFERENCES IN THE DURATION OF OBSTRUCTIVE SLEEP APNEA EVENTS AMONG HIGHLAND TIBETANS AND HANS AND LOWLAND HANS AT LOW ALTITUDE

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Introduction: Duration of obstructive and mixed apneas increased with altitude descent was found in one small sample study (n=6) among mild-moderate patients with obstructive sleep apnea (OSA). But, there were no studies exploring whether highland native Tibetans and Chinese Hans present prolonged duration of OSA events at low altitude compare to lowland residents.

Methods: We retrospectively analyzed overnight polysomnography (PSG) records of 558 patients with OSA. The patients included 235 lowland Chinese Hans living at altitude below 1000 m, 181 highland Chinese Hans and 142 highland native Tibetans living at altitude above

3000 m. PSG examinations were carried out in Chengdu (altitude 500 m) after they arrived within 10 days.

Results: There were no significant differences in age, gender and apnea-hypopnea index (AHI) among three groups. No differences were obtained in the index (events/h) of central and mixed types of apnea events among three groups. The means of longest and average duration of obstructive apnea events were highland native Tibetan (80.9 ± 57.3, 26.3 ± 11.0 sec) > highland Chinese Hans (60.9 ± 38.5, 23.9 ± 9.0 sec) > lowland Chinese Hans (47.7 ± 24.2, 21.1 ± 6.0 sec). Percentage of number of patients with longest obstructive apnea events above 3 min reached at 5.6% in highland native Tibetans and 1.7% in highland Chinese Hans, whereas none in lowland Chinese Hans.

Conclusion: At low altitude, highland OSA patients had significantly prolonged duration of obstructive apnea events, particularly in the longest duration of apnea events, compared to lowland OSA patients. This may implicate that highland residents, especially for highland native Tibetans, may have aggravated OSA at low altitude in terms of the duration of OSA events.

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0621

ASSESSING HOW HOSPITAL READMISSIONS ARE AFFECTED BY OBSTRUCTIVE SLEEP APNEA SEVERITY AND THERAPY COMPLIANCE

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Introduction: Hospital readmissions are an important quality metric reported to the Centers for Medicare and Medicaid Services. Previous work from our group found that the presence of obstructive sleep apnea (OSA) correlates with increased risk of hospital readmission within 30 days. This project seeks to characterize the relationship between readmissions and the severity and treatment of OSA. A better understanding of this relationship could potentially be utilized to develop preventative measures and reduce readmission.

Methods: A retrospective review of all hospital discharges over a 24-month period (August 2011-July 2013) for a Department of Defense tertiary care hospital was conducted. Of 22,261 unique discharges, 5,299 patients had OSA based on ICD-9 codes. Of these patients with OSA, 565 were readmitted. From this group, 125 patients were randomly selected for further review. An additional age and gender-matched 125 patients with OSA that were not readmitted were selected for comparison. The groups were compared with parametric and non-parametric tests.

Results: For the 250 patients, ages ranged from 18 to 96 years (mean 63.2). Polysomnography data was found for 152 patients (77 readmitted and 75 non-readmitted). Based on the available polysomnography data, 67 readmitted and 66 non-readmitted patients met criteria for OSA. Apnea-hypopnea index ranged from 0 to 110.7 (mean 24.1) and 0.2 to 109 (mean 27.2) for the readmitted and non-readmitted groups respectively (p=0.48). Similarly, lowest oxygen saturations averaging 83.9 and 84.1 (p=0.88), and body mass index averaging 31.3 and 31.6 (p=0.67) were not statistically different. Inpatient (27.2% vs. 26.4%) and outpatient (38.4% vs. 37.6%) treatment rates were not different. Length of hospital stay (5.1 vs. 3.6 days in readmitted vs. non-readmitted) differed between the 2 groups (p=0.007).

Conclusion: While OSA is an independent risk factor for hospital readmission, OSA severity and treatment compliance did not differ between readmitted and non-readmitted patients. Of the factors studied, only length of stay during the original admission correlated with higher likelihood of readmission. Additional studies on hospital readmission in OSA patients are needed to determine if readmission rates can be improved through better recognition and treatment of OSA.

Support (If Any):

0622

POLYSOMNOGRAPHY VS CONSUMER DEVICES: COMPARING COMMON SLEEP INDICES

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Introduction: As public interest in health tracking technology increases, so too does the prevalence of commercially available consumer activity devices and apps utilising actigraphy. With the increase of the population's ability to access this technology, and limited research available on the concordance of these devices with polysomnography (PSG), the accuracy, specificity and sensitivity of the FitbitCharge HR device's common sleep indices were compared and evaluated against those of Level 1 PSG in participants with a diagnosis of respiration within normal limits and those with varying degrees of sleep-disordered breathing (SDB).

Methods: Analysis was performed on 41 participants (age, mean ± SD: 55 ± 14 years; BMI ± SD: 32 ± 6 kg/m^2). The different categories of SDB were classified upon AASM PSG guidelines and consequently broken up into normal respiration (AHI ≤ 5); mild OSA (AHI ≥ 5 but ≤ 14.99); moderate OSA (AHI ≥ 15 but ≤ 29.99); severe OSA (AHI ≥ 30.0). Full overnight PSG was performed (in accordance with AASM guidelines) in a laboratory setting and recorded concurrently with the consumer device. Primary outcome measures were limited to sleep-onset latency (SOL), total sleep time (TST), wake after sleep-onset (WASO) and sleep-efficiency (SE). Exclusion criteria were applied.

Results: These common sleep indices of Fitbit Charge HR were compared to similar indices of PSG using paired t-tests and Bland-Altman plots. Significant differences were seen in SOL for the participants within the category of respiration within normal limits, moderate OSA and severe OSA; WASO was significantly different in all categories; SE was significantly different in the category of moderate OSA; there were no significant differences in TST at any category.

Conclusion: Previous research has shown that actigraphy has high sensitivity in detecting sleep, but poor specificity in detecting wake in persons with respiration within normal limits. This poster shows that there was a significant difference in the participants with SDB in their SOL, SE and WASO but no difference in TST when comparing the FitbitCharge HR to PSG.

Support (If Any): -

0623

INCREASED RISK FOR CANCER IN YOUNG PATIENTS WITH SEVERE OBSTRUCTIVE SLEEP APNEA

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Introduction: An increase in cancer aggressiveness was reported in obstructive sleep apnea (OSA) animal models, and in sleep deprivation or insomnia. however, there is a need for clinical evidence supporting a direct correlation between OSA and cancer incidence. We sought to reveal whether OSA presence and severity is correlated with cancer incidence in a large homogenous patient cohort.
Methods: We analyzed a cohort of over 5000 concurrently enrolled patients, age over 18, with suspected OSA, from a tertiary medical academic center. Patients underwent whole night polysomnography and were classified for OSA severity according to the Apnea Hypopnea Index (AHI). Data on cancer incidence were obtained from the Israel National Cancer Registry. A multivariate Cox proportional-hazards analysis, adjusted for age, gender, and BMI, was performed to estimate the hazard-ratio of new cancer incidence.
Results: Among 5243 subjects with a median follow-up of 5.9 years, 265 were diagnosed with cancer. The most prevalent cancers were prostate (14.7%), hematological (12.8%), urothelial (9.4%), colorectal (9%), and breast (8.3%). In subjects who were diagnosed at age below 45 years (n=1533), a high AHI was significantly associated with cancer (HR 3.7, CI: 1.12–12.45, p=0.008).
Conclusion: Patients younger than 45 with severe OSA have a significantly higher all-type cancer incidence than the general population. These results should encourage clinicians to detect and diagnose young patients with suspected OSA and to recommend cancer screening methods in this high-risk population.
Support (If Any):

0624

VALIDATED MEASURES OF INSOMNIA, SLEEP RELATED FUNCTIONAL STATUS, SLEEPINESS, AND NASAL OBSTRUCTION IN A CPAP ALTERNATIVES CLINIC POPULATION

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Introduction: Obstructive sleep apnea (OSA) affects 9% to 38% of adults worldwide and contributes to significant cardiovascular, cerebrovascular, metabolic, and neurocognitive morbidity. While remarkably efficacious in the treatment of OSA, continuous positive airway pressure (CPAP) can be difficult to tolerate, with long-term adherence rates approaching 50%. CPAP alternatives clinics (CAC) specialize in the evaluation and treatment of CPAP intolerant patients; yet this population has not been studied in the literature. To better understand these patients, we sought to assess insomnia, sleep related functional status, sleepiness and nasal obstruction, utilizing data from validated instruments.
Methods: After approval from the Emory University Institutional Review Board, a retrospective chart review was performed from September 2015 to September 2016 of new patient visits at the Emory CAC. Patient demographics and responses were recorded from Insomnia Severity Index (ISI), Functional Outcomes of Sleep Questionnaire-10 (FOSQ-10), Epworth Sleepiness Scale (ESS), and Nasal Obstruction Symptom Evaluation (NOSE) scale questionnaires.
Results: A total of 172 patients (60.5% male, mean age 55.9 years) were included. The average ISI score was 16.0 (±6.42), with 59% demonstrating moderate (ISI 15–21) or severe clinical insomnia (ISI 22–28). The average FOSQ-10 score was 14.4 (±3.5). With the exception of activity level, all FOSQ-10 sub-scale averages were below 3.0, suggesting sleep-related functional impairment. The average ESS score was 10.1 (±6.11) with 56% of patients scoring in the normal range (ESS 0–10). Sixty-four percent of patients demonstrated at least moderate nasal obstruction (NOSE ≥30), with an average NOSE score of 43.0 (±26.9).
Conclusion: This is the first study to assess characteristics of a CAC population. These patients exhibit significant clinical insomnia, functional impairment, and nasal obstruction as demonstrated by their ISI, FOSQ-10, and NOSE scores, respectively. ESS scores however, indicated that the majority of patients lack excessive daytime sleepiness.
Support (If Any): None

0625

OSAS SCREENING TEST IN PERIODICAL MEDICAL EXAMINATION: A PRELIMINARY STUDY

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Introduction: Since January 2016, the Occupational Health Department of the European Space Agency (ESA) has screened staff members for obstructive sleep apnoea syndrome (OSAS) who had complaints during the medical examination. The complaints frequently included daytime fatigue, performance problems and snoring. In total, 46 patients were screened and 59% were positive. Participants of the screening are highly educated office workers.
Methods: The Berlin questionnaire was used during the periodical medical examination if OSAS was suspected. The Apnea Link® polysomnography test was used for the screening. For staff members with risk indicator › 5, referrals to a sleep specialist were done.
Results: 85% of male and 15 % of female were tested positive for the OSAS screening. They were referred to a sleep apnoea specialist. Out of the 27 patients with positive screening results, 33% followed the referral recommendation and made an appointment with the specialist. Out of the referred patients, 78 % were confirmed positive by the sleep specialist and were treated accordingly.
Conclusion: Awareness for the importance of sleep health should generally be implemented in occupational health programs. For patients exposed to a high-performance office environment, sleep has become an indicator for health on the clinical level. OSAS is often masked by other conditions such as depression, burnout and high blood pressure. Our results show that when these disorders are present, a sleep apnoea screening should be done. Finally, in some patients we observed reluctance to being treated. 67% of the participants who were screened positive for OSAS did not pursue the recommended specialist referral, and 22 % rejected the recommended use of a continuous positive airway pressure (CPAP) mask, which is necessary for treatment.
Support (If Any): None.

0626

A METHOD FOR IDENTIFICATION OF INSPIRATORY FLOW LIMITATION USING RESPIRATORY AIRFLOW

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Introduction: Inspiratory flow limitation (IFL) is a common component of sleep-disordered breathing, but current methods of identification require catheterization of the pharynx. The objective of this study was to develop and validate an accurate, non-invasive method of identifying IFL.
Methods: Participants with high upper airway resistance underwent a full-night polysomnogram wearing temporary dental trays connected to a remotely controlled mandibular positioner (MATRx). A pressure transducer connected to a saline-filled nasopharyngeal catheter measured supra-glottic pressure, and respiratory airflow was calculated from naris pressure. These two signals were processed by an auto-labeler (AL) which identified IFL breaths that served as a "gold standard". A neural network (NN) was trained on six patients using airflow as input and the gold standard as ideal output. The trained NN was then validated on three new patients using airflow as the sole input with no ideal output.
Results: In training, the AL identified 17652 breaths (61%) as IFL and 11220 (39%) as non-IFL; in validation, the AL identified 8123 breaths (59%) as IFL and 5650 (41%) as non-IFL. A 5-fold cross validation on the training data yielded an area under ROC curve of 0.86. The area under the ROC using the trained NN on all validation breaths was 0.89, and this increased to 0.90 when equivocal breaths, comprising 10% of the total, were excluded.
Conclusion: A non-invasive method of identifying IFL was developed by training a NN using a "gold standard" and respiratory airflow. When applied to a new population of patients, the trained NN, using airflow alone, showed reasonable accuracy in identifying IFL breaths. This was improved by excluding equivocal breaths, yielding an area under ROC curve of 0.90 on 90% of all breaths.
Support (If Any): The authors acknowledge Alberta Innovates - Technology Futures, NRC-IRAP, and Zephyr Sleep Technologies for supporting this research.

0627

ESTIMATION OF LOCALIZED IDEAL OXIMETRY SENSOR LAG VIA OXYGEN DESATURATION-DISORDERED BREATHING EVENT CROSS-CORRELATION

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Introduction: In previous work, we attempted to identify events using sensor data from full-night polysomnography studies using a global 20-second oximetry sensor lag across all studies. However, we observed that oxygen desaturation onset trailed the corresponding human expert-labeled events by varying amounts of time, even within the same study. In this work, we estimate the localized ideal oximetry (SpO_2) sensor lag using the cross-correlation between the labeled disordered breathing event and the observed desaturation.
Methods: We used a corpus of 15 human-expert scored full-night clinical polysomnography studies collected at Oregon Health & Science University's sleep lab. For each study, we first estimated the baseline SpO_2 by computing the 95th-percentile SpO_2 value across the entire night. Then, we calculated the SpO_2 desaturation from baseline by subtracting the baseline from the observed SpO_2. For each event label, we generated an aperiodic pulse wave yielding a 5-minute signal containing a single pulse at the center having a duration equal to that of the labeled event. We then performed cross-correlation between the corresponding SpO_2 desaturation signal and the generated pulse wave signal. We calculated the localized ideal oximetry sensor lag (τ) as the lag corresponding to the maximum correlation value for that event.
Results: We calculated the mean τ for each study and analyzed the τ-values for the entire corpus. We found τ ranging from 16.6 to 31.2 seconds ($\mu = 25.6$, $\sigma = 4.3$), supporting our hypothesis that τ varies considerably across studies.
Conclusion: We conclude that our cross-correlation-based method successfully estimates the localized lag τ not only across studies, but also within a single study. We expect our estimated τ to increase the accuracy of future machine learning efforts to automatically identify disordered breathing events by providing a more accurate SpO_2 disordered breathing event time alignment.
Support (If Any):

0628

ROUTINE UTILIZATION OF ESOPHAGEAL PRESSURE MONITORING (PES) CAN BE DONE RELIABLY WITH GOOD PATIENT ACCEPTANCE AND CAN ENHANCE THE QUALITY OF CARE FOR SLEEP CENTERS COMMITTED TO GAIN THE NECESSARY EXPERIENCE

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Introduction: In most sleep medicine textbooks, esophageal pressure (Pes) monitoring is considered the reference standard for monitoring respiratory effort in PSG testing. However, Pes monitoring is rarely implemented by sleep centers. Within the field, biases against the practicality of Pes monitoring and lack of motivation to acquire the necessary experience to utilize this measure result in avoidance of its implementation. Despite changes in the healthcare system toward home sleep apnea testing (HSAT), most sleep facilities have not enhanced the sophistication of in-lab measures to improve the sensitivity of testing for those patients in whom HSAT is not diagnostic. Since its inception in 2006, our program routinely has been performing Pes monitoring in appropriate cases. We provide data demonstrating high success rates of routine Pes monitoring.
Methods: We tracked consecutive PSGs ordered with Pes monitoring from 1/1/2015 through 12/13/2016. Pes failures were tabulated and categorically characterized as to the cause, including patient refusal, technical failure and patient discomfort.
Results: Pes monitoring was ordered on 1365 studies, of which 187 were not attempted because of patient refusal. Of the 1178 Pes studies attempted, 987 (83.8%) were performed successfully, while 191 (16.2%) were not successful due to patient discomfort or technical issues.
Conclusion: Our high success rate in performing Pes monitoring demonstrates that it can be incorporated into an in-lab sleep center. Our experience is in contrast with the biases within the field that Pes monitoring is not practical or cannot be achieved on a routine basis. The Pes is the best objective parameter to quantifiably measure respiratory effort. The clinical benefits for implementing Pes monitoring become obvious after reviewing multiple studies done in this format, allowing for more objective assessment in patients in whom the routine respiratory parameters provide obscure results that are not quantifiable and lead to inaccurate conclusions. Examples of how Pes monitoring distinguishes respiratory events in a superior fashion than flow limitation and other parameters will be presented.
Support (If Any): None

0629

PREOPERATIVE STOP-BANG SCORES AND THEIR ASSOCIATION WITH POSTOPERATIVE DELIRIUM AMONG THORACIC SURGERY PATIENTS

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Introduction: The presence of obstructive sleep apnea (OSA) is associated with significant perioperative morbidity and mortality, including a predisposition to develop delirium. Delirium in the postoperative period is associated with longer hospital stays, increased healthcare costs, long-term cognitive decline, and increased mortality. The STOP-BANG questionnaire is a validated tool which screens for OSA and a score of ≥ 3 is considered high-risk for OSA. This study tests the hypothesis that higher preoperative STOP-BANG scores are associated with an increased duration of postoperative delirium and longer hospital stays.

Methods: This observational cohort study included 128 thoracic surgery patients (n=80 esophagectomy; n=48 other thoracotomy). Each patient completed the STOP-BANG questionnaire preoperatively. Postoperative delirium was assessed using the Confusion Assessment Method for the ICU (CAM-ICU) scale. Richmond-Agitation-Sedation Scale (RASS) was used to assess level of sedation. Coma was defined as RASS scores of -4 or -5.

Results: Of the 128 patients, 97 (76%) had STOP-BANG scores ≥ 3. Patients in this high-risk group were more likely to be male (82.5%), older (mean 62.8 years), have a higher Charlson's comorbidity burden (mean 3.1), and had more esophagectomies (67%). No differences were observed in the incidence of delirium (26.8% vs 19.4%; p=0.481), delirium days (0.4 vs 0.2; p=0.297), ICU days (2.8 vs 2.2; p=0.072), or total hospital days (10.1 vs 8.4; p=0.019). After adjusting for age, gender, surgery type, comorbidities, and BMI, the high-risk group had a longer duration of acute brain dysfunction (coma/delirium) (1.4 days vs 0.9 days; p=0.04).

Conclusion: The results show that preoperative STOP-BANG scores ≥ 3 are associated with a significantly longer duration of post-operative coma/delirium in this unique patient population.

Support (If Any):

0630

DIET AS A RISK FACTOR IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is independently associated with cardiovascular disease and metabolic syndrome. Established risk factors for OSA include obesity, male gender, post-menopausal state, smoking and increased neck circumference. Studies using mouse models have suggested that high fats diets increase the severity of sleep apnea independent of BMI (body mass index). We hypothesized that dietary habits, especially increased fatty food intake, are independently associated with severity of OSA.

Methods: 104 patients, diagnosed with obstructive sleep apnea and presenting to the George Washington-Medical Faculty Associates Center for Sleep Disorders, completed a validated diet survey, Rapid Eating Assessment for Patients (REAP). Apnea-hypopnea index (AHI) was used as a measure of the severity of OSA. Subjects were divided using BMI in to obese (BMI ≥ 30 kg/m^2) and overweight (BMI > 25 but < 30 kg/m^2) categories. Regression analysis was performed to relate severity of OSA to gender, BMI, age, % energy from fat, and the individual dietary components of REAP.

Results: Subjects with a BMI <30 who consumed a diet high in fat (>35% of their total diet) had twice the severity of sleep apnea (AHI 18.2 ± 10.1 vs. 36.6 ± 27.5; p = 0.001). There was a statistically significant difference (p= 0.04) in OSA severity between subjects eating processed meats "often" [AHI 42.5 ± 30.7] versus those eating "rarely/never" [AHI 28.9 ± 22.7], even after adjusting for BMI. Conversely, eating greater than 2 servings of dairy per day conferred protection against sleep apnea [AHI 26.2 ± 15.6 vs. 39.7 ± 31; p = 0.04].

Conclusion: Dietary components may confer increased risk for worsening severity of OSA. Based on these findings, unhealthy dietary patterns warrant further study of their role in OSA associated cardiovascular diseases and metabolic syndrome development.

Support (If Any): None

0631

EFFECT OF DISEASE SEVERITY ON DETERMINING BODY POSITION DURING SLEEP IN PATIENTS WITH POSITIONAL OBSTRUCTIVE SLEEP APNEA

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Introduction: Positional obstructive sleep apnea (OSA) is reported to be quite prevalent, accounting for more than 25% of all patients with OSA. Prior research has suggested that positional OSA patients may actually demonstrate a learning effect to avoid sleeping on their back during the night. The aim of our study is to more closely evaluate this relationship between disease severity and avoidance of the supine position in those patients with positional OSA. We hypothesized that those patients with the most severe disease while supine would be those that tended to avoid this position during sleep.

Methods: We evaluated 38 patients (25 men, aged 49 ± 12 years, body mass index 31 ± 5 kg/ m2) diagnosed with positional OSA on a baseline polysomnogram study (overall apnea-hypopnea index [AHI] of 13 ± 5 events/hour, supine AHI 31 ± 19 events/hr, non-supine AHI 2 ± 1 events/hr) that was performed for suspected OSA.

Results: There was a significant correlation noted between the overall AHI during the night and the % total sleep time (TST) supine (R = 0.498, p = 0.002). However, there was a significant inverse correlation noted between the supine AHI and the % TST supine (R = -0.605, p = 0.0001). In addition, there was a significant correlation noted for supine AHI and the %TST spent non-supine (R = 0.605, p = 0.0001). The relationship between AHI and %TST supine was similar in male as compared to female patients (R = -0.665, p = 0.012, R = -0.662, p = 0.0002, respectively).

Conclusion: In patients with positional OSA, those with more severe disease spend the least amount of time in the supine position, suggesting there may be a learning effect. These finding appear to be similar in both male and female patients with positional OSA.

Support (If Any): None

0632

CENTRAL SLEEP APNEA IN PATIENTS ON BACLOFEN

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Introduction: Baclofen, a gamma-aminobutyric acid receptor B (GABA-B) agonist, is used to relieve muscle spasticity. Recent reports have indicated the possibility of increased rates of central sleep apnea (CSA) in patients on baclofen. We performed a systematic search of all patients who received baclofen and underwent polysomnogram (PSG) at a large specialty sleep center to identify the type and severity of sleep disordered breathing (SDB) and further delineate patient characteristics and treatment outcomes.
Methods: A retrospective chart review of patients ≥18 years who had a PSG diagnosis of SDB within 90 days of documented baclofen use (n=157) between 2001 and 2016 was performed. Subjects on concurrent opioid medication (n=141) and with incomplete data on baclofen and/or PSG (n=5) were excluded. Information on demographics, Epworth Sleepiness Scale (ESS) score, baclofen dose and route of administration at the time of PSG, other medications, PSG data, type of SDB, medical diagnoses, medications, final effective treatment modality for SDB and mortality was extracted.
Results: A total of 11 subjects on baclofen but not on opioids at the time of PSG confirming SDB were identified. Mean age was 53.9 years (SD=12.5), 54% were male and mean BMI was 28.8 kg/m^2 (SD=6.5). Mean ESS score was 10.2 (SD= 6.2). Baclofen was most commonly administered orally (n=8) with a mean maximum daily dose of 56.8 mg (SD=42.3). Mean AHI was 33.8/hour (SD=18.6) and mean CAI 17.9/hour (SD=19.6). All patients were diagnosed with CSA; 8 without Cheyne-Stokes breathing (CSB), 2 with CSB and one with Treatment-Emergent CSA. One subject each had a prior history of stroke and heart failure. Most (n=7) received baclofen for a medical condition that was not known to be predominantly associated with CSA. Adaptive servoventilation (ASV)(n=4) and bilevel positive airway pressure in the spontaneous-timed mode (BPAP-ST)(n=3) were the most common effective treatments. Five (45%) subjects had died at the time of analysis.
Conclusion: CSA is the predominant type of SDB in patients receiving baclofen. ASV and BPAP-ST were the most common effective treatment modalities. All-cause mortality was approximately 45% in subjects with baclofen use and CSA.

Support (If Any):

0633

BENEFITS OF OXYTOCIN IN OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is independently associated with cardiovascular disease. Autonomic dysfunction, particularly the withdrawal of parasympathetic activity, plays a major role in mediating the adverse cardiorespiratory events that occur with OSA. In an animal model of OSA, activation of oxytocin receptors has been shown to restore autonomic balance. We sought to test if nocturnal oxytocin administration could have beneficial effects in patients with OSA.
Methods: 8 patients, diagnosed with OSA by polyomnography (night 1) and presenting to the George Washington-Medical Faculty Associates Center for Sleep Disorders, underwent a repeat diagnostic polysomnogram (night 2) preceded by intranasal administration of 40 i.u. oxytocin. Paired t-test was used to compare changes in various sleep-related physiological and cardiovascular parameters between the two polysomnograms.
Results: Oxytocin significantly increased the total sleep time (from 414 ± 9 minutes to 459 ± 17 minutes, $p<0.05$), and increased the Post-Polysommogram Sleep Assessment (PPSA) score, an index of self-reported sleep satisfaction (from 17 ± 2 to 23 ± 3, $p< 0.05$). Where the Apnea-Hypopnea Index (AHI), was not significantly changed with oxytocin administration, when apnea and hypopnea events were compared independently, the frequency of hypopneas (12 ± 3 vs 9 ± 2 events/hour), but not apneas, were significantly ($p<.005$) decreased with oxytocin treatment. Both apneas and hypopneas were significantly shortened in duration with oxytocin treatment (apnea durations decreased from 29 ± 3 to 24 ± 2 seconds, $p<0.05$, hypopnea durations decreased from 34 ± 2 to 27 ± 2 seconds, $p<0.005$). Oxytocin treatment significantly decreased the percent of apnea and hypopnea events that were accompanied with an arousal (from 67 ± 2 % to 55 ± 6 %, $p<0.05$).
Conclusion: Oxytocin administration was noted to have beneficial effects in OSA patients. It has the potential of restoring cardiorespiratory homeostasis in OSA patients. Additional studies are needed to further understand the mechanisms by which oxytocin promotes these changes in respiratory function in patients with OSA.
Support (If Any): None

0634

THE EFFECT OF HEAD PITCH AND ROLL ROTATION INDEPENDENT OF TORSO POSITION ON THE AHI

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Introduction: Reduction in AHI severity by avoiding sleeping in the torso supine position has shown positive outcomes for those diagnosed with POSA. Limited observed data from recent sleep studies confirm that the occurrence of OSA is dependent on head position. Head position, independent of torso position, that might improve upper airway collapse has not been adequately studied. This preliminary study hypothesizes that the roll angle of the head independent of torso position alleviates the gravity induced "crush force" seeking to close the upper airway and also that the crush force is proportional to the Sine (θ) measured between the head and the horizontal.
Methods: Following signature of IRB approved consent forms, enrolled subjects are asked to undergo a standard polysomnography with an additional head angle sensor. Subjects are coached during the night, to fall asleep in desired head positions close to 90°, 30° or 150°, and 0° or 180°. Head angles are achieved with wedge pillows or verbal intercom requests to reposition the head. Scoring was completed utilizing AASM guidelines. Each sleep epoch of unique head angle is scored individually for AHI and oxygen desaturation.
Results: Two subjects have completed the clinical trial to date. Both subjects show a decrease in the scored AHI with head roll angles less than 20 degrees above the horizon. Additionally the SpO2 channel also

showed improvement. Both subjects have showed a higher AHI with the torso sensor in the left and right side positions. Phase One of this clinical trial will be enrolling up to 10 additional subjects.
Conclusion: Very preliminary data shows that head position, independent of torso position can decrease the AHI and improves oxygen desaturation. The proposed treatment device will be validated in phase II clinical trials.
Support (If Any):

0635
FEASIBILITY OF DRUG INDUCED SEDATION ENDOSCOPY IN THE BRONCHOSCOPY SUITE
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Introduction: Patients with obstructive sleep apnea (OSA) commonly experience difficulty tolerating positive airway pressure (PAP) therapy. Drug Induced Sedation Endoscopy (DISE) assesses airway characteristics while the patient is sedated and may help guide alternative interventions for OSA. Since DISE is performed in the operating room, its cost is high and its availability limited to the surgeon's busy schedule. Performing DISE in the bronchoscopy suite may reduce cost and improve access to care while maintaining a low risk for complications.
Methods: Following training by an ENT physician, a sleep boarded pulmonologist performed DISE in the bronchoscopy suite. Patients with OSA and difficulty tolerating PAP therapy were evaluated for alternative interventions via DISE. A propofol infusion was administered by an anesthesiologist trained on performing DISE and sedation level was tracked via Bispectral Index™ for a target level of 60–75. Videos of the DISE were recorded for multidisciplinary conference review with ENT and to track patient outcomes following interventions. Baseline polysomnography prior to DISE was reviewed to classify severity of OSA. Complication rates were tracked. Facility costs of DISE in the bronchoscopy suite were compared to those of the operating room.
Results: The sleep trained pulmonologist performed 21 DISE procedures in the bronchoscopy suite over a period of ten months. Review of polysomnography prior to DISE demonstrated an average AHI of 34.3+/-15.9 and an average SpO2 nadir 78 +/- 8.3%. No complications were observed during DISE. The facility fee for performing DISE procedures in the operating room was twice as much as the facility fee for performing DISE in the bronchoscopy suite while the operator charges were the same.
Conclusion: Based on these findings, performance of DISE in the bronchoscopy suite appears feasible, safe and cost effective. Its performance by the sleep trained pulmonologist may improve access to care and may help identify successful alternative treatments for patients with PAP intolerance. Further studies are needed to identify the training necessary for pulmonary based sleep specialists to become proficient in the procedure.
Support (If Any): None

0636
NON-SURGICAL, UPPER AIRWAY REMODELING FOR UARS
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Introduction: Upper airway resistance syndrome has become a prevalent form of sleep-disordered breathing. The causes for UARS include decreased pharyngeal muscle tone, and craniofacial deficiencies amongst others. Current methods used to manage UARS - include no standard medical treatment; continuous positive airway pressure (CPAP) therapy and/or mandibular advancement appliances have been used without any results.Therefore, this study is to test the hypothesis that a biomimetic oral appliance therapy (BOAT) can be used followed by a DNA appliance, with a forward facial head-gear mask.
Methods: This pilot study included two adults: 2 females, 29 years and 32 years, (mean age 31yrs.) diagnosed with UARS to mild OSA who were treated with FDA-cleared BOAT (MRNA appliance®) followed with a forward facial mask for osseous remodeling. Prior to treatment the craniofacial region was imaged using 3D cone-beam CT scans.After 9 to 15 months of treatment, the upper airway volume was reassessd with 3D cone-beam CT scans and upper airway analysis.
Results: For case 1, the upper airway volume (from the posterior nasal spine to the epiglottis) prior to treatment was 9.28cm 3 and increased to 16cm 3, representing a 29% increase in upper airway volume. For case 2, upper airway volume increased from 16.7cm 3 prior to treatment to 20.5cm 3 post-treatment, showing a 12.5% increase in upper airway volume. By subjective questionnaires of before and after, the patients have improved immensely.
Conclusion: This preliminary study indisputably suggests that increases in 3D airway may be associated with non-surgical upper airway remodeling for UARS in adults with craniofacial deficiencies.
Support (If Any): None

0637
NON-SURGICAL, UPPER AIRWAY REMODELING FOR SKELETAL CLASS III AND MALOCCLUSION WITH OSA
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Introduction: Obstructive Sleep Apnea (OSA) is the most common form of sleep-disordered breathing. The causes of OSA vary and include decreased pharyngeal muscle tone, craniofacial obesity, and craniofacial deficiencies amongst others. Current methods used to manage these characteristics include continuous positive airway pressure (CPAP) therapy and/or mandibular advancement appliances. However, both of these methods are life-long therapies.

The skeletal class III malocclusion OSA patients have under developed maxilla with posterior cross-bite due to childhood sleep breathing disorder.

This study tests the hypothesis that biomimetic oral appliance therapy (BOAT) can be used in combination with a forward facial mask.
Methods: This pilot study included two class III adults: 1 female (51 years) and 1 male (33 years) diagnosed with mild OSA and treated with FDA-cleared BOAT (MRNA appliance®) followed with a DNA with a forward facial mask for osseous remodeling. Prior to treatment the craniofacial region was imaged using 3D cone-beam CT scans. After 9 to 15 months of treatment, the apnea hypopnea index (AHI) of each subject was reassessed, without any appliance in the mouth during sleep, by means of a home sleep study (HST). Furthermore, the upper airway volume was reassessed with another 3D cone-beam CT scan and upper airway analysis.
Results: For case 1, the mean AHI decreased from 6 to 1hr -1. Simultaneously, the upper airway volume (from the posterior nasal spine to the epiglottis) prior to treatment was 31.9cm 3 and increased to 45.1cm 3, representing a 29% increase in upper airway volume. For

case 2, the AHI decreased from 5hr pre-treatment to 1hr post-treatment, while the upper airway volume increased from 15.9cm 3 prior to treatment to 25cm 3 post-treatment, showing a 36% increase in upper airway volume.
Conclusion: This preliminary study suggests that decreases in AHI may be associated with non-surgical upper airway remodeling for skeletal class III with OSA in adults with craniofacial deficiences.
Support (If Any): None

0638

FUNCTION AND WORK PRODUCTIVITY MEASURES IN A PHASE 3, RANDOMIZED, PLACEBO-CONTROLLED, DOUBLE-BLIND, MULTICENTER, 12-WEEK STUDY OF THE SAFETY AND EFFICACY OF JZP-110 FOR THE TREATMENT OF EXCESSIVE SLEEPINESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Excessive sleepiness in patients with obstructive sleep apnea (OSA) is associated with reductions in function and daily activities. JZP-110 is a selective dopamine norepinephrine reuptake inhibitor with wake-promoting effects. Effects of JZP-110 on function, work productivity, and activity impairment were evaluated in a phase 3 study in patients with OSA.
Methods: Eligibility criteria included: OSA diagnosis according to International Classification of Sleep Disorders-3 criteria; past or present use of a primary OSA therapy; Epworth Sleepiness Scale score ≥10; mean sleep latency <30 minutes on first 4 trials of a 5-trial, 40-minute Maintenance of Wakefulness Test; and usual nightly sleep time ≥6 hours. Patients were randomized (1:1:2:2:2) to JZP-110 37.5mg, 75mg, 150mg, or 300mg, or placebo for 12 weeks, stratified by adherent or non-adherent use of primary OSA therapy. The Functional Outcomes of Sleep questionnaire short version (FOSQ-10) evaluated functional status. Work productivity impairment among employed patients and overall activity impairment among all patients were assessed using the Work Productivity and Activity Impairment questionnaire for Specific Health Problems (WPAI:SHP); "OSA" was the specified health problem. Both measures were administered at baseline and weeks 1, 4, 8, and 12.
Results: By final enrollment, which occurred in September 2016, preliminary baseline data from 427 (of 476 randomized) patients revealed 62.1% male, 74.9% white, and the mean±standard deviation age was 54.2 ± 10.6 years. Clinical Global Impression of Severity ratings were 41.5%, 33.3%, and 12.2% in patients moderately, markedly, or severely ill, respectively (2.8% were most extremely ill). All patients have completed participation in the study and data are being analyzed.
Conclusion: Complete data on the effects of JZP-110 on the WPAI:SHP and FOSQ-10 functional measures and safety results will be reported at the time of presentation.
Support (If Any): Jazz Pharmaceuticals.

0639

SLEEPINESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA IS ASSOCIATED WITH UNHEALTHY DIET

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Introduction: Sleep restriction and Obstructive sleep apnea (OSA) are commonly associated with excessive daytime sleepiness (EDS). Sleep restriction is associated with alterations in appetite regulation, particularly with desire for high calorie foods. The Epworth Sleepiness Scale (ESS), a validated, self-administered, eight-item questionnaire is considered to be the best subjective tool for measuring EDS. The total ESS score can range between 0 and 24, with higher scores signifying more severe EDS. We hypothesized that patients with OSA, due to EDS, will have a higher intake of high calorie foods.
Methods: 104 patients, diagnosed with OSA and presenting to the GW-Center for Sleep Disorders, completed a validated diet survey, Rapid Eating Assessment for Patients (REAP). Apnea-hypopnea index (AHI) was used as a measure of the severity of OSA and ESS was used to measure subjective sleepiness. Statistical tests are based on the Spearman correlation between the ESS and the ordinal scales for the individual dietary components of REAP.
Results: ESS was significantly higher in subjects that: "often" ate greater than 8oz of meat a day vs. those eating "rarely" (10.4 ± 4.7 vs 7.8 ± 4.3; p = 0.023), "often" ate fried food vs. "rarely" (11.5 ± 4.3 vs 8.2 ± 4.4; p = 0.027), "often" ate snack foods vs "rarely" (10.5 ± 4.7 vs 7.6 ± 3.5; p = 0.012), "often" drank soda or other high calorie beverages vs. "rarely" (10.5 ± 5.1 vs 7.9 ± 4.2; p = 0.011). In addition, subjects "often" skipping breakfast had a higher ESS compared to those that skipped breakfast "rarely" (10.9 ± 4.3 vs 7.8 ± 4.2; p = 0.005)
Conclusion: EDS due to OSA is associated with increased intake of high calorie foods. Unhealthy diet can further contribute to the burden of cardiovascular diseases and metabolic syndrome present in patients with OSA.
Support (If Any): None

0640

FACTORS AFFECTING FATIGUE SEVERITY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Patients with obstructive sleep apnea (OSA) frequently complain of both fatigue and sleepiness. A limited number of studies have investigated the relationship between fatigue and sleepiness and OSA severity. This study evaluated the factors affecting fatigue severity in patients with OSA.
Methods: We investigated 633 OSA patients who were diagnosed by polysomnography. All patients completed sleep questionnaires

including self-reported sleep duration, the Fatigue Severity Scale (FSS), the Korean version of Epworth Sleepiness Scale (K-ESS), Insomnia Severity Index (ISI), Korean version of Pittsburg Sleep Quality Index (K-PSQI) and Beck Depression Inventory-2 (BDI-2).
Results: The subjects had a mean age of 48.7 ± 10.5 years and 72.5% (n = 459) were men. The subjects were distributed as follows: 160 with mild, 168 with moderate, and 305 with severe OSA. A multiple regression model found that age (ß = -0.146, p = 0.005), K-ESS (ß = 0.689, p < 0.001), 8 ≤ ISI score < 15 (ß = 3.801, p = 0.006), 15 ≤ ISI score (ß = 4.565, p = 0.009), and K-PSQI (ß = 0.684, p = 0.002) were predictors of a higher FSS score. BDI-2 (ß = 0.007, p = 0.918), AHI (ß = -0.006, p = 0.895), arousal index (ß = 0.034, p = 0.415), and nadir O_2 saturation (ß = -0.044, p = 0.655) were not associated with FSS score.
Conclusion: Our findings indicate that fatigue severity is more likely to be associated with younger age, severity of insomnia, K-ESS and K-PSQI and less likely to be directly related to OSA severity.
Support (If Any):

0641

A PHASE 3, RANDOMIZED, PLACEBO-CONTROLLED, DOUBLE-BLIND, 12-WEEK, MULTICENTER STUDY OF THE EFFICACY AND SAFETY OF JZP-110 FOR THE TREATMENT OF EXCESSIVE SLEEPINESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Patients with obstructive sleep apnea (OSA) may experience excessive sleepiness (ES), which can persist despite primary treatment. JZP-110, a selective dopamine norepinephrine reuptake inhibitor with wake-promoting effects, was evaluated in a phase 3 study for the treatment of ES in patients with OSA.
Methods: Adults with an OSA diagnosis according to International Classification of Sleep Disorders-3 criteria along with current or prior use of a primary OSA therapy had to meet the following inclusion criteria: Epworth Sleepiness Scale (ESS) score ≥10; mean sleep latency <30 minutes on the first 4 trials of a 5-trial, 40-minute Maintenance of Wakefulness Test (MWT); and usual nightly sleep time ≥6 hours. Patients were randomized (1:1:2:2:2) to JZP-110 37.5mg, 75mg, 150mg, or 300mg, or placebo for 12 weeks and were stratified by adherence or non-adherence with primary OSA therapy. Co-primary endpoints were change from baseline to week 12 in MWT mean sleep latency and ESS score. The Patient Global Impression of Change was a key secondary endpoint. Clinical Global Impression of Change (a secondary endpoint) and safety and tolerability, including adverse events, were collected.
Results: Enrollment was completed in September 2016. A total of 1030 patients were screened; preliminary demographics of 427 (of 476) patients randomized are 62.1% male, 74.9% white, age 54.2 ± 10.6 (mean±SD) years. At baseline, MWT sleep latency was 11.9 ± 7.1 minutes, ESS score was 15.2 ± 3.3, and Clinical Global Impression of Severity indicated 41.5%, 33.3%, and 15.0% of patients were moderately, markedly, or severely/extremely ill, respectively. Approximately 84% of patients completed the study. Efficacy and safety data results will be available and reported for the complete study population.
Conclusion: Baseline demographics and sleepiness of the OSA patients in this study appear to be representative of the target OSA population with moderate to severe levels of sleepiness and illness. Results of the efficacy and safety of JZP-110 for treatment of ES in OSA will be available in the first quarter of 2017.
Support (If Any): Jazz Pharmaceuticals.

0642

A PHASE 3, RANDOMIZED, PLACEBO-CONTROLLED, DOUBLE-BLIND, MULTICENTER, 12-WEEK STUDY OF THE SAFETY AND EFFICACY OF JZP-110 IN THE TREATMENT OF EXCESSIVE SLEEPINESS IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA: SF-36 AND EQ-5D-5L MEASURES

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Introduction: Excessive sleepiness (ES) is a frequent symptom of obstructive sleep apnea (OSA) and persists in some patients despite primary OSA therapy and can adversely impact health-related quality-of-life (HRQoL). JZP-110 is a selective dopamine norepinephrine reuptake inhibitor with wake-promoting effects. The efficacy and safety of JZP-110 for the treatment of ES in OSA were evaluated in a phase 3 study for patients with OSA. This also included measures of health-related quality-of-life (HRQoL) as pre-specified secondary endpoints.
Methods: Eligibility criteria in this study included: OSA diagnosis according to International Classification of Sleep Disorders-3 criteria; past or present use of a primary OSA therapy; Epworth Sleepiness Scale score ≥10; mean sleep latency <30 minutes on the first 4 trials of a 5-trial, 40-minute Maintenance of Wakefulness Test; and usual nightly sleep time ≥6 hours. Patients were randomized (1:1:2:2:2) to JZP-110 37.5mg, 75mg, 150mg, or 300mg, or placebo for 12 weeks, stratified by adherent or non-adherent use of a primary OSA therapy. HRQoL was assessed as changes from baseline to week 12 using the 36-Item Short Form Health Survey version 2 (SF-36v2) and the 5-dimension, 5-level EuroQoL questionnaire (EQ-5D-5L). Safety and tolerability were also evaluated.
Results: Complete enrollment of this trial occurred in September 2016. Preliminary data from 427 (of the 476 randomized) patients were 62.1% male, 74.9% white, and a mean±SD age of 54.2 ± 10.6 years. At baseline, the Clinical Global Impression of Severity showed that 41.5%, 33.3%, 12.2%, and 2.8% of patients were moderately, markedly, severely, and extremely ill, respectively. All patients have completed participation in the study and data are being analyzed; complete HRQoL and safety results will be available and reported.
Conclusion: Complete data on the effects of JZP-110 on the SF-36v2 and EQ-5D-5L HRQoL measures and safety information will be reported at the time of presentation.
Support (If Any): Jazz Pharmaceuticals

0643

EXCESSIVE DAYTIME SLEEPINESS AND VITAMIN D DEFICIENCY IN A COHORT OF PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Vitamin D deficiency has been recently associated with different sleep disorders, such as sleep apnea and restless leg syndrome (RLS). An increasing number of papers has been recently published concerning the contribution of D3 deficiency to OSA severity.
Methods: We enrolled all sleep apnea patients referred to our sleep center in the last year who accepted to test their vitamin D levels on blood. All patients were diagnosed for OSA according to the Apnea/hypopnea index (AHI>5) by ambulatory cardiorespiratory monitoring. We collected all anthropometric data, Epworth Sleepiness Scale (ESS) scores, comorbidities and eventual response to available therapy (NINV). Uni and multivariate analysis were performed.
Results: Eight-one patients (31 female and 50 male), mean age 59.7 y.o. (range 16–86), mean BMI 31.1 (range 19.1–50), mean AHI 31 (range 6–95) were enrolled. 31/81 patients reported EDS with mean ESS score of 12.78. Mean vitamin D values were 21.9 (n.v > 30). Patients with ESS≥10 had lower vitamin D values than patients without EDS ($p<0.1$). Regression analysis showed an inverse correlation between AHI and vitamin D values ($r=0.1$) and between ESS and vitamin D values ($r=0.06$).
Conclusion: In our sample, vitamin D values are strictly and inversely correlated with OSA severity and EDS.
Support (If Any): Nothing to declare

0644

A PHASE 3, PLACEBO-CONTROLLED, RANDOMIZED-WITHDRAWAL, DOUBLE-BLIND, 6-WEEK MULTICENTER STUDY OF THE SAFETY AND EFFICACY OF JZP-110 FOR THE TREATMENT OF EXCESSIVE SLEEPINESS IN PARTICIPANTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Patients with obstructive sleep apnea (OSA) may experience excessive sleepiness (ES) despite use of a primary OSA therapy. JZP-110 is a selective dopamine and norepinephrine reuptake inhibitor with wake-promoting effects. This phase 3 study assessed the safety and efficacy of JZP-110 for treatment of ES in adults with OSA.
Methods: Eligibility criteria for this study included a diagnosis of OSA per International Classification of Sleep Disorders-3 criteria; Epworth Sleepiness Scale (ESS) score ≥10; mean sleep latency <30 minutes on the first 4 trials of a 5-trial, 40-minute Maintenance of Wakefulness Test (MWT); and current/past use of a primary OSA therapy. Participants were initiated on once-daily 75-mg JZP-110 and titrated open-label to a maximum tolerated once-daily dose of 75mg, 150mg, or 300mg (weeks 1–2), which was continued for the subsequent 2 weeks. At week 4, participants who reported "much" or "very much" improvement on the Patient Global Impression of Change (PGI-C) scale and improvement on MWT and ESS were randomized 1:1 to placebo or the same dose of JZP-110 for 2 weeks. Co-primary endpoints were the change from week 4 to 6 in MWT mean sleep latency and ESS score; PGI-C was a key secondary endpoint. Safety and tolerability were also evaluated.
Results: Preliminary demographics for the 162 (of 176 enrolled) participants were 59.3% male, 78.4% white, and age 55.7 ± 10.7 years (mean±standard deviation). Baseline mean±standard deviation MWT and ESS scores were 12.2 ± 6.7 minutes and 15.5 ± 3.4, respectively; 126 of 176 participants met improvement criteria at week 4 and advanced to the randomized withdrawal period. Enrollment was completed by September 2016 and data are being analyzed.
Conclusion: Seventy-two percent of OSA participants in this study had numerical improvement (as measured by PGI-C, MWT, and ESS) after 4 weeks of open-label treatment with JZP-110.
Support (If Any): Jazz Pharmaceuticals

0645

A DOUBLE-BLIND, PLACEBO-CONTROLLED, RANDOMIZED-WITHDRAWAL, MULTICENTER STUDY ON THE EFFICACY AND SAFETY OF SODIUM OXYBATE IN PEDIATRIC SUBJECTS WITH NARCOLEPSY WITH CATAPLEXY

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Introduction: Narcolepsy is a life-long neurological disorder with disease-onset largely occurring during childhood/adolescence. Few treatments have been formally evaluated in pediatric populations. Sodium oxybate (Xyrem®) is approved in the United States (US) for the treatment of cataplexy and excessive daytime sleepiness in patients with narcolepsy. The FDA requested a study of sodium oxybate (SXB) in pediatric narcolepsy patients.
Methods: Children and adolescents (7–16 years) diagnosed with narcolepsy with cataplexy who were on SXB treatment or were SXB-naïve were eligible. SXB-naïve patients were titrated to a stable dose. After a stable dose period (SD), patients entered a two-week double-blind, placebo-controlled withdrawal period (DB) and were randomized 1:1 to receive either SXB (at stable dose) or placebo. Efficacy assessments compared measurements during or at the end of the DB period, relative to the SD period.
Results: The trial enrolled 106 patients; 63 were randomized. Among randomized patients, 41% were aged 7–11, 44% were female, and 38% were on SXB treatment at study entry. A pre-planned interim analysis of 35 patients showed that efficacy was achieved ($p<0.005$) on the primary endpoint (reduction in weekly cataplexy attacks). The double-blind randomized withdrawal period was therefore terminated early on the advice of the Data Safety Monitoring Board, and in agreement with the FDA. Preliminarily reported adverse events were similar to those seen in adults and in prior pediatric experiences. Results from the randomized cohort will be presented for primary endpoint, key secondary endpoints (Clinical Global Impression of Change (CGIc) for cataplexy severity and change in the Epworth Sleepiness Scale for Children and Adolescents (ESS [CHAD]) score), and safety findings during the DB period.
Conclusion: Preliminary results indicate that sodium oxybate is efficacious in reducing cataplexy in pediatric patients with narcolepsy. The safety profile appears similar to that previously observed in adult and pediatric populations.
Support (If Any): Jazz Pharmaceuticals.

0646

THE PREVALENCE OF HYPERSOMNOLENCE, ITS CORRELATES AND ASSOCIATED ROLE IMPAIRMENT IN THE NATIONAL COMORBIDITY SURVEY REPLICATION (NCS-R)

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Introduction: The prevalence of hypersomnolence in the U.S. and associated socio-demographic characteristics are not well studied. Its comorbidity with insomnia and relationship with psychiatric, alcohol and drug use disorders, use of prescription medications and impact on functional impairment is poorly delineated.
Methods: The National Comorbidity Survey Replication (NCS-R) is a nationally representative community household survey of individuals ≥18 years. As part of this survey, subjects (n=5,962) were queried about their sleep in the NCS-R Part II questionnaire. Socio-demographic characteristics and prescription medication use were assessed. Subjects were administered the WHO Composite International Diagnostic Interview (WHO-CIDI) to determine various DSM-IV diagnoses and the WHO Disability Assessment Schedule 2.0 (WHO-DAS II) to evaluate for functional impairment. The prevalence of 12-month hypersomnolence, defined per DSM-5 as a subjective sense of sleepiness during the daytime associated with lapses into sleep, not feeling rested despite getting adequate sleep, or having difficulty waking in the morning, was determined. Odds ratios were used to assess associations with various socio-demographic characteristics, insomnia, DSM-IV diagnoses, prescription medication use, alcohol and drug abuse/dependence as well as functional impairment.
Results: The prevalence of hypersomnolence in U.S. adults was 23.34% (SE=0.88). Tetrachoric correlations among constituent symptoms were high (0.56 to 0.97; all $p<0.05$). Among socio-demographic characteristics, being female (OR=1.41; CI:1.20–1.61), ≤45 years (OR=1.35; CI:1.10–1.66), having a low/low-average family income (OR=1.36; CI:1.13–1.65) and being unemployed (OR=1.38; CI:1.11–1.70) were associated with a higher risk of hypersomnolence. Insomnia (OR=5.65; CI:4.55–7.02), DSM-IV anxiety disorders (OR=2.78; CI:2.34–3.31), mood disorders (OR=2.72; CI:2.18–3.39), conduct and oppositional disorders (OR=2.11; CI:1.52–2.93), and substance use disorders (OR=1.56; CI:1.27–1.91) were significantly comorbid with hypersomnolence after accounting for socio-demographic characteristics and other DSM-IV diagnoses. Hypersomnolence was significantly associated with functional impairment (OR=2.01; CI:1.30–3.12). Among medication classes, antidepressants (OR=1.77; CI:1.43–2.19), benzodiazepines (OR=1.50; CI:1.15–1.95) and buspirone (OR=2.78; CI:1.46–5.27) were associated with increased rates of hypersomnolence.
Conclusion: Hypersomnolence is common in the general population, especially in younger, female, lower income and unemployed subgroups. Hypersomnolence is comorbid with multiple psychiatric and substance abuse disorders, particularly insomnia, anxiety and depression, as well as antidepressant and benzodiazepine use. Finally, hypersomnolence is associated with significant functional impairment.
Support (If Any): N/A.

0647

PREVALENCE, INCIDENCE AND CHRONICITY OF EXCESSIVE SLEEPINESS IN A LONGITUDINAL STUDY OF NARCOLEPTIC FAMILY MEMBERS

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Introduction: Previous studies have shown that the prevalence of narcolepsy is higher in familial members than in the general population. However it is difficult to identify family members at higher risk of evolution to narcolepsy. Through a longitudinal study of the family members we have investigated the factors most frequently involved in the evolution to narcolepsy.
Methods: We explore how excessive sleepiness predicts the occurrence of narcolepsy in comparison with other symptoms such as cataplexy, sleep paralysis and hypnagogic hallucinations in a cohort of 4,045 family members of 362 narcoleptic patients. Data were collected

using the Sleep-EVAL system. 3,313 family members were re-interviewed 5 years after the initial evaluation.
Results: Prevalence of excessive sleepiness was 34% among family members. At wave 2 there were 1.2% new narcolepsy cases, of which 62% occurred among first-degree relatives, 31% among second-degree relatives and 7% among third-degree family members. Incidence of excessive sleepiness among family members was 2 to 3 times higher than in the general population. Excessive sleepiness was chronic for 30% of family members, with the highest rate observed among third-degree relatives. At wave 2, 11.7% reported an increase in severity of excessive sleepiness.
Conclusion: Risks for narcolepsy and narcolepsy symptoms are high among narcoleptic family members. Excessive sleepiness is highly prevalent in these families, more often chronic and increasing in severity over time. Excessive sleepiness represents a strong predictor of occurrence of narcolepsy and as such deserves serious care and treatment.
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0648

NARCOLEPSY SPECTRUM DISORDER IN 378 PARENTS OF PATIENTS WITH TYPE 1 NARCOLEPSY-CATAPLEXY

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Introduction: To evaluate familial risk of narcolepsy in parents of children with Type 1 narcolepsy using objective sleep recording studies.
Methods: From a total of 5,462 patient visiting the Sleep Center of Peking University People's Hospital from 09/01/2012 to 12/03/2014, 496 narcolepsy cases were identified, including 307 children meeting inclusion criteria (<18 y, HLA-DQB1*0602 positive, typical cataplexy, or measured CSF Hcrt ≤ 110 pg/ml). One hundred and six families refused further evaluation or had parent(s) unavailable, leaving 201 families (66%) with at least one parent available. The resulting 378 parents underwent HLA typing, nocturnal polysomnography, multiple sleep latency tests(MSLT), interviews and questionnaire evaluation. CSF hypocretin-1 was tested in 4 subjects. Three subjects with a positive MSLT had a second MSLT for confirmation. ICSD3 criteria were used to diagnose Type 1 and Type 2 narcolepsy. Symptoms in parents with versus without DQB1*06:02 were also compared.
Results: We found 3 parents (0.7%) with narcolepsy- cataplexy (100% DQB1*06:02) and 9 with a positive MSLT but no cataplexy (78% DQB1*06:02). In the four parents tested for CSF hypocretin-1 level, one with and one without cataplexy had low CSF Hcrt (≤110) one without cataplexy had intermediary level(153 pg/ml), and normal in the last relative. Repeat PSG-MSLT was positive in 3 relatives retested. Analysis of individual patients suggests that between 3 (0.7%) and 6 (1.4%) of the 9 subjects with narcolepsy-cataplexy have hypocretin deficiency.
Conclusion: This study is the first to confirm the existence of a genuine narcolepsy/hypocretin deficiency spectrum using systematic MSLT testing, HLA typing and CSF hypocretin-1 measurements in a very large number of relatives of patients with Type 1 narcolepsy. These findings illustrate the urgent need to find biologically measurable immune markers for the disease autoimmune process, as this would greatly facilitate large population based studies and a better understanding of its spectrum.
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0649

STRUCTURAL BRAIN ABNORMALITIES IN IDIOPATHIC HYPERSOMNIA

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Introduction: Idiopathic hypersomnia (IH) is characterized by excessive daytime sleepiness but, in contrast with narcolepsy, does not involve cataplexy, rapid REM sleep onset (at the multiple sleep latency test, MSLT), or any consistent hypocretin-1 deficiency. The pathophysiological mechanisms of IH remain unclear, and no neuroimaging study has been conducted in IH. We hypothesize that IH is characterized by cortical alterations within networks involved in alertness.
Methods: We conducted magnetic resonance imaging (MRI) on a 3T scanner in 12 participants with IH (mean age 33, range 22–59 years, 6 males, 10 females) and 16 good sleepers (mean age 31, range 22–53 years, 3 males, 9 females). High-resolution T1-weighted anatomical images were used to perform voxel-based morphometry (VBM) to measure regional volume and cortical thickness analyses. Daytime mean sleep latency from MSLT and Epworth sleepiness score were collected to measure respectively objective and self-reported scores of daytime sleepiness. Student t-tests were used to compare groups, and regression analyses were conducted on sleepiness scores, controlling for total intracranial volume (only for VBM), age and sex (threshold T>2.5, equivalent to p<0.01).
Results: Participants with IH had thicker and larger cortical structures, mainly within the default-mode network, compared to good sleepers: the anterior cingulate cortex, precuneus extending to posterior cingulate cortex, lateral parietal cortex bilaterally, and right premotor cortex were larger in IH. These larger volumes and thickness in IH were correlated with increased levels of subjective daytime sleepiness.
Conclusion: The present results show that IH is associated with structural brain alterations, mainly located within the default-mode network and changing in proportion of clinical severity. Larger volume and thickness in these structures might reflect compensatory changes to chronic daytime sleepiness.
Support (If Any): Supported by the Sleep Research Society Foundation, the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), the Fonds de Recherche du Québec - Santé (FRQ-S), and the Canada Foundation for Innovation (CFI).

0650

INCIDENCE AND DURATION OF COMMON, EARLY-ONSET, TREATMENT-EMERGENT ADVERSE EVENTS OCCURRING DURING TWO RANDOMIZED, PLACEBO-CONTROLLED, PHASE 3 STUDIES OF SODIUM OXYBATE FOR THE TREATMENT OF EXCESSIVE SLEEPINESS IN PATIENTS WITH NARCOLEPSY

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Introduction: Sodium oxybate (SXB) is approved for treatment of excessive sleepiness and cataplexy in narcolepsy. This post hoc analysis evaluated timing and duration of common, early-onset, treatment-emergent adverse events (TEAEs) in two phase 3 studies of SXB in narcolepsy.
Methods: In SXB-15, patients (N=228) received daily placebo or SXB 4.5-, 6-, or 9-g dose (6- and 9-g doses titrated in 1.5-g increments). In SXB-22, patients (N=231) received daily SXB, placebo, modafinil (stable dose), or SXB+modafinil; SXB increased from 6-g (weeks 1–4) to 9-g dose (weeks 5–8). Most common TEAEs were defined as ≥5% patients and >placebo during week 1.
Results: In both studies, most common TEAEs during week 1 with SXB were dizziness, headache, and nausea. Incidence of new or changed-severity TEAEs in SXB-15 (median) was highest at week 1 (dizziness, 7.5% [n=14]; headache, 7.5% [n=14]; nausea, 5.9% [n=11]) and decreased over time (dizziness, 0%-3.8%; headache, 0.6%-4.3%; nausea 0%-3.8%). Median (min, max) durations of dizziness, headache, and nausea occurring any time with SXB were 9.0 (1.0, 69.0), 2.0 (1.0, 58.0), and 4.5 (1.0, 57.0) days, respectively. In SXB-22, the incidence of new or changed-severity TEAEs with SXB and SXB+modafinil (median) was highest at week 1 (dizziness 5.4% [n=6]; nausea, 7.1% [n=8]), was lower weeks 2–4 (dizziness 0.9%-2.7%; nausea, 0%-4.5%) increased at week 5 concurrent with a scheduled dosage increase (dizziness 6.3% [n=7]; nausea, 6.3% [n=7]), and decreased over time after week 5 (dizziness 0%-1.0%; nausea, 0%-1.8%). Median (min, max) durations of dizziness and nausea with SXB and SXB+modafinil were 17.5 (1.0, 53.0) and 3.0 (1.0, 60) days, respectively. These TEAE types caused discontinuations in 9 (4.8%) SXB-15 (5/nausea [2.7%], 4/dizziness [2.2%]) and 6 (5.4%) SXB-22 patients (2/nausea [1.8%], 4/dizziness [3.6%]).
Conclusion: In two randomized, controlled trials of SXB, most common TEAEs during week 1 were dizziness, headache, and nausea. These TEAEs were generally short in duration and diminished over time.
Support (If Any): Jazz Pharmaceuticals.

0651

ASSESSING THE BENEFITS OF SODIUM OXYBATE (SXB) ON FUNCTIONING, PRODUCTIVITY, AND HEALTH-RELATED QUALITY OF LIFE IN PEOPLE WITH NARCOLEPSY: FINDINGS FROM THE NEXUS NARCOLEPSY REGISTRY

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Introduction: Little is known about the impact of medications used to manage narcolepsy on HRQOL, sleep, and productivity in real-world settings.
Methods: The Nexus Narcolepsy Registry is an ongoing disease registry of patient-reported data from adults diagnosed with narcolepsy. Participants completed a questionnaire every six months that included Epworth Sleepiness Scale (ESS), Functional Outcomes of Sleep Questionnaire (FOSQ-10), 36-Item Health Survey (SF-36), a sleep quality rating (SQ), Work Productivity and Activity Impairment questionnaire (WPAI), and current medications used to manage narcolepsy. Participants were classified into treatment categories: No current treatment, modafinil or armodafinil (M/A), stimulant with or without M/A (M/A/Stim), antidepressant (AntiD), and M/A/Stim+AntiD. Each category was then stratified by sodium oxybate (SXB) treatment. Using data from the first two assessments (n=970), mean scores were calculated for each treatment group stratified by SXB, and adjusted for socio-demographics, time since narcolepsy diagnosis, lifetime history of cataplexy, and comorbidities.
Results: Within each treatment category, patients taking SXB (monotherapy or combination therapy) scored statistically significantly better compared with SXB nonusers for 9 of the 11 measures (ESS, FOSQ-10, SF-36-Vitality, presenteeism, overall work impairment, non-work activity impairment, and SQ, P<.0001; SF-36 physical and mental component summaries, P<.05). Rates of employment and absenteeism were not significantly different. Concomitant SXB was associated with significantly better ESS and SQ (P<.001), regardless of other narcolepsy treatment(s). Compared with no treatment, SXB monotherapy was associated with significantly better scores for 7 of the 11 measures (ESS, FOSQ-10, SF-36-Vitality, presenteeism, overall work impairment, non-work activity impairment and SQ; P<.05).
Conclusion: In patients with narcolepsy, SXB, as monotherapy or in combination with other medications, was associated with statistically significantly better HRQOL, SQ, and productivity outcomes compared with non-SXB treatment even after adjustment for other characteristics that may affect outcomes.
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0652

HEALTH-RELATED QUALITY OF LIFE IN NARCOLEPSY AND IDIOPATHIC HYPERSOMNIA

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Introduction: The reported lower health-related quality of life (HRQOL) in hypersomnia disorders using small clinical populations has made comparisons between disorders challenging. The aim of the current study was to compare HRQOL in adult patients with Narcolepsy Type 1 (NT1), Narcolepsy Type 2 (NT2), and Idiopathic Hypersomnia (IH) through an online survey.
Methods: Participants with NT1, NT2, and IH answered the Veterans RAND 36-Item Health Survey (VR-36) assessing eight HRQOL domains (PF, physical functioning; RP, role physical; RE, role emotional; BP, body pain; GH, general health; VT, vitality; MH, mental health; SF, social functioning) and two standardized composite scales (PCS, physical; MCS, mental). The VR-36 was part of an anonymous survey in 2015, the Boston University Narcolepsy and Idiopathic Hypersomnia Patient Perspectives Study (BUNIHPPS). Analysis of variance was performed to assess between-group differences, and when significant ($p < 0.05$), Tukey's post hoc tests were performed while adjusting for age, gender, body mass index, number of comorbidities, and hypersomnia medication use.
Results: 833 participants completed the survey (338 NT1, 210 NT2, and 285 IH). Participants were predominantly female (706 females, 126 males) and on average 40 years. Mean PCS and MCS scores for hypersomnia patients were one standard deviation below

the normative United States population mean scores. Adjusted mean scores indicated between-group differences (PCS: *F 7, 700* = 9.93, p < 0.0001; MCS: *F 7, 700* = 3.51, p = 0.0306). Adjusted mean PCS scores were significantly higher in NT2 compared to NT1/IH, whereas MCS scores were significantly higher for NT1 than NT2. IH scored significantly lower than one/both narcolepsy group(s) on PF, RP, GH, VT, and SF domains. NT2 scored significantly lower than NT1 on the MH domain.

Conclusion: Lower physical and mental composite scale scores among hypersomnia patients suggests poorer functioning and the need for improved management options, including behavioral interventions and/or a more collaborative clinical approach. In our sample, IH was more compromised than NT1/NT2 in general health, social functioning, vitality, and physical health domains (PF/RP). NT2 reported more compromised mental health functioning (MH/MCS) despite having better physical functioning compared to NT1.

Support (If Any): NA.

0653

WORSENING PSYCHOMOTOR VIGILANCE AFTER BRIEF NAPS IN HYPERSOMNOLENT PATIENTS: MSLT NAP CORRELATES

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Introduction: Physiologic sleep inertia is operationalized as cognitive impairments upon awakening. Markedly pronounced sleep inertia, or sleep drunkenness, is common in idiopathic hypersomnia and may exist on a continuum with physiologic sleep inertia or may represent a distinct entity. Previous work has demonstrated significant worsening of vigilance on Psychomotor Vigilance Task (PVT) lapses (reaction times >500ms) and reciprocal of reaction time (RRT) following brief naps among hypersomnolent patients, but the MSLT correlates of these changes in vigilance are unknown.

Methods: Patients undergoing PSG/MSLT (N=118; Age=37.38±14.39; 62.71% women), with diagnoses of Idiopathic hypersomnia (n=37), Obstructive Sleep Apnea (n=29), Narcolepsy Type 1 (n=8) and Type 2 (n=6), and subjective sleepiness with normal MSLT (n=30), were administered PVT before and after MSLT naps 2 and 4. PVT performance was analyzed with paired t-tests, mixed-effects, and general linear models.

Results: For nap 2, lapses and RRT demonstrated significant worsening post-nap relative to pre-nap, (10.31±18.56 [pre] vs 13.42±20.65 [post]; t= -2.98, p=0.0035 and 3.24±0.87[pre] vs 3.05±0.91[post]; t=5.06, p= <.0001), respectively. Similar results were seen for nap 4 for lapses (t=-3.35, p=0.0011) and RRT (t=3.24, p=0.0016). Sleep duration on nap 2 was significantly associated with increased lapses (B=.80, S.E.=0.22, p=0.001) and worsened RRT (B=.03, S.E.=0.01, p=0.001) post-nap, but not on nap 4. Sleep efficiency on nap 2 was significantly associated with increased lapses (B=-8.57, S.E.=3.96, p=0.032) and worsened RRT (B=.38, S.E.=.14, p=0.006), but not on nap 4. Nocturnal PSG variables (sleep time, sleep efficiency, %N3 sleep, %REM sleep) and PSG/MSLT-based diagnoses were unrelated to PVT change in performance.

Conclusion: Despite the generally short amount of accrued sleep time, psychomotor vigilance worsens immediately upon awakening from a morning MSLT nap in hypersomnolent patients, and this worsening is strongly related to amount of sleep obtained/sleep efficiency. This finding has implications for napping recommendations among those with excessive daytime sleepiness.

Support (If Any):

0654

PSG AND MSLT CHARACTERIZATION OF REM SLEEP WITHOUT ATONIA AND REM BEHAVIOR DISORDER AMONG PEDIATRIC PATIENTS WITH NARCOLEPSY

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Introduction: In this study, we aim to determine the prevalence of nocturnal RWA and RBD in a drug-naïve pediatric narcolepsy population and compare findings to pediatric patients with other central nervous system hypersomnias and controls. We additionally aim to determine the prevalence of RWA and RBD during daytime REM bouts captured during MSLT testing. Given that RSWA, RBD and cataplexy are thought to underlie dysfunction within REM on/off neurons, we hypothesize that RSWA and RBD will be found only during the daytime and nighttime REM periods among patients with narcolepsy type 1.

Methods: Based on sleep study results and clinical history, we grouped subjects as narcolepsy type 1 (N1, n=11), narcolepsy type 2 (N2, n=4), idiopathic hypersomnia (IH, n=5) and controls (C, n=11). Mean age of patients was 13 years and 49% were female. RSWA and RBD were scored based on American Academy of Sleep Medicine specifications. We calculated a RSWA index for each subject (number of REM epochs with RSWA/total REM epochs).

Results: On the PSG, we only detected RBD among N1 patients (2/11, 18%) but found no difference in the frequency of RSWA among groups (P=0.18). Notably, all N1 patients had RSWA and the RSWA index was 5.5x higher on their nocturnal PSGs compared to all other groups (P=0.002). On MSLT, 82% of N1 patients had RSWA and RSWA was not detected in any other groups. The two N1 patients with RBD during the PSG also had RBD on the MSLT.

Conclusion: RSWA is uniquely detected among N1 patients on the MSLT but not the PSG. However, the frequency of nocturnal RSWA is markedly higher in N1 pediatric patients compared to other groups, findings consistent with adult narcolepsy data. Our findings have practical implications about scoring pediatric MSLTs as epochs of REM may lack the classic atonia in N1. Furthermore, the frequent presence of RSWA across day and night REM periods and higher mean RSWA index in the N1 group suggest that greater hypocretin loss results in phenotypic changes in REM sleep in addition to dysregulated REM sleep bouts.

Support (If Any): None.

0655

PREVALENCE OF DROWSY DRIVING AND SELF-REPORTED AUTOMOBILE ACCIDENTS IN A PRIMARY CARE VETERAN POPULATION

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Introduction: Findings in published reports implicate drowsy driving in up to 25 % of automobile accidents (AA) in the United States. The 2011 Behavioral Risk Factor Surveillance System reported that Puerto Rico had the highest prevalence of drowsy driving of the sample. Sleep disorders are common in veterans and health disparities are significant in Hispanics. We studied the prevalence of drowsy driving (DD) and self-reported AA in a population of veterans at the VA Caribbean Healthcare System (VACHS) Primary Care Clinic.

Methods: Veterans at the VACHS Clinics were invited to participate prior to their evaluation with a Primary Care Physician. Subjects

21–89 years old with a valid driving license, who reported driving at least three hours per month, were included. One thousand three hundred and three veterans completed the Epworth Sleepiness Scale (ESS) and a self-administered questionnaire to explore drowsy driving and AA associated with drowsiness.
Results: The mean age was 62 (range 21–89) and 98.8% were male. Twenty four percent had an ESS ≥11, with a mean of 6.7 (0–24). Twenty four percent of the sample reported DD in the previous thirty days and 42% in the previous year. AA attributed to drowsiness where reported in 5.5% in the last 30 days and in 11.9% in the prior year. The average daily hours of sleep was: <6 in 37%, 6–7 in 37%, ≥8 in 26%. Thirty eight percent had a sleep disorder diagnosis and 30% was treated for a sleep disorder. Patients with a sleep disorder diagnosis had more AA (18.3% vs. 7.8%; p<0.001). Patients involved in AA reported higher ESS (mean 12.6 vs. 6.3; p<0.001).
Conclusion: Drowsy driving and AA associated with drowsiness are highly prevalent in this representative sample of Hispanic veterans. Addressing drowsy driving and sleep disorders may help to reduce automobile accidents.
Support (If Any):

0656
SYMPTOMATIC NARCOLEPSY AMONG INHERITED DISORDER,SUCH AS NIEMANN-PICK TYPE C
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Introduction: The symptoms of narcolepsy can occur during the course of other neurological conditions. Inherited disorders, tumors and demyelinating diseases were the three most frequent causes for symptomatic narcolepsy. Among inherited disorders, Niemann-Pick type C (NPC), Myotonic dystrophy type 1 and Prader-Willi syndrome were major three disorders. NPC is an autosomal recessive and congenital neurological disorder characterized by the accumulation of cholesterol and glycosphingolipids in the peripheral tissues and in the brain. NPC had no effective treatment before, but since 2012, we can use Miglustat in Japan. Miglustat inhibits glucosylceramide synthase, an essential enzyme for the synthesis of most glycosphingolipids. In this study, 5 out of 10 cases have been treated with Miglustat.
Methods: The 10 patients with NPC were included in the study. Patients or families were given informed consent for the lumbar puncture. We checked clinical symptoms, brain MRI, HLA and measured orexin levels. In this study, previous 5 cases were untreated by Miglustat, and recent 5 cases were treated by Miglustat.
Results: Six out of 10 cases had cataplexy. Four cases with normal orexin level (>200pg/ml) did not show cataplexy. The cases which orexin levels were low level (<110pg/ml) of intermediate levels (110-200pg/ml) exhibit cataplexy. In two cases with cataplexy, orexin levels at the onset were intermediate, and became lower in the later period. About recent one case, she had cataplexy with intermediate orexin level. Her cataplexy was reduced and orexin level was increased to normal level, and other symptom (dysphagia, and oculography) got better.
Conclusion: The NPC patients with cataplexy have low or intermediate orexin levels. In the cases without cataplexy, their orexin levels were normal. Cataplexy and orexin measurement make a chance to early diagnose and treatment for NPC.
Support (If Any): a

0657
THE CIRCADIAN VARIANT OF IDIOPATHIC HYPERSOMNIA
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Introduction: Idiopathic hypersomnia is a heterogeneous disorder, characterized by long sleep, excessive daytime sleepiness, absence of core narcolepsy features and normal orexin biology, and severe sleep inertia. Any contribution from circadian mechanisms is currently unknown.
Methods: Patients presenting to the Beth Israel Deaconess Medical Center sleep center with clinical features suggesting idiopathic hypersomnia seen by the author were evaluated with a clinical examination and history, sleep logs, actigraphy, 24-hour urine 6-sulfatoxy melatonin (every 3 hours, in darkness, at home), and unrestricted polysomnography to capture the entire duration of sleep.
Results: Fifty patients were evaluated in a 4 year period (2013–2016). Mean age was 36.6 ± 8.4 years, mean ESS 16 ± 3, 35 were female, and BMI 27.3 ± 3.2 Kg/M2. Seasonal effects on mood were present in 12 patients; none demonstrated full criteria for seasonal affective disorder. Depression (27), fibromyalgia (16), circadian phase delay (7), hypertension (12) and sleep apnea (22) were main associations. MRI was performed and normal in 14. The biological night mean was 16 ± 1.2 hours, 10 were normal (not more than 9 hours). Subjective unconstrained total sleep time capability was 16 ± 2.1 hours, but habitual week day and weekend sleep was 9 ± 0.9 and 14 ± 2.1 hours, respectively. Polysomnographic total sleep time was 722 ± 32.2 minutes. If MSLTs were performed as per usual criteria, 26/50 could have received a diagnosis of narcolepsy without cataplexy, based on testing occurring in the biological night. Treatment responses with bright light therapy timed to the edges of the melatonin onset and baseline return were noted in the majority (32) of those with a long biological night, but not in those with a normal melatonin profile, with 32/40 continuing use for over 6 months. Sodium oxybate markedly improved two patients with a normal biological night and has not been effective so far in one patient with a long biological night.
Conclusion: A subset of patients with idiopathic hypersomnia demonstrate a long biological night. 24-hour melatonin mapping can identify this phenotype, with implications for pathophysiology, diagnosis, and treatment of idiopathic hypersomnia.
Support (If Any): None.

0658
FREQUENCY AND PREDICTORS OF SYSTEMIC EXERTION INTOLERANCE DISEASE/CHRONIC FATIGUE SYNDROME AMONG SLEEP CENTER PATIENTS REFERRED FOR HYPERSOMNOLENCE EVALUATION
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Introduction: Symptoms of central disorders of hypersomnolence (CDH) extend beyond excessive daytime sleepiness (EDS) to include non-restorative sleep, fatigue and cognitive dysfunction. Thus, they share much in common with myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS), recently renamed systemic exertion intolerance disease (SEID), whose additional discriminating features include post-exertional malaise and orthostatic intolerance. Clarifying the distinction and overlap between these disorders will help guide patient management.
Methods: Patients evaluated for hypersomnolence completed a questionnaire battery about EDS and fatigue; questionnaires and clinical

records were used for SEID assessment. PSG/MSLT, CSF hypocretin, and cataplexy status were additionally used to assign ICSD-3 diagnoses of CDH or sleep apnea. Patients reporting problematic hypersomnolence but not meeting any ICSD-3 criteria (i.e., with MSL > 8 min) were labelled subjective EDS (sEDS).

Results: Final sample was 205 patients, with mean age 35.6 years (+/- 14.9; 63% women) and diagnoses of idiopathic hypersomnia (n=68), narcolepsy type 1 (n=6), narcolepsy type 2 (n=25), persistent sleepiness after OSA treatment (n=25), insufficient sleep (n=41), psychiatric hypersomnolence (n=7), and sEDS (n=33). Nineteen percent met SEID criteria, and frequency of SEID was not different across ICSD-3 diagnoses (p=0.33). MSLT mean sleep latency was not different between those with and without SEID (6.58 vs 6.63, p=0.95). Patients with SEID were more likely than those without to have failed standard hypersomnolence treatments (88.6% vs 67.8%, p=0.02), but had similar response rates to clarithromycin (37.5% vs 42.9%, p=0.59) and flumazenil (64.0% vs 59.2%, p=0.67). SEID patients were no different from those without SEID by gender, age, chronotype, sleep duration, Epworth, depressive symptoms, family history, or PSG/MSLT parameters.

Conclusion: Nearly one-in-five patients evaluated for hypersomnolence meet SEID criteria, but this diagnosis is independent of ICSD-3 diagnoses and PSG/MSLT findings. Patients with comorbid SEID may be more refractory to standard hypersomnolence treatments, but appear no less likely to benefit from GABA-A antagonists.

Support (If Any): K23 NS083748 (LMT), R01 NS089719 and the Mind Science Foundation (DBR), and UL1 TR000424.

0659

FREQUENT CRAVING FOR SWEETS AT WAKE UP IS ASSOCIATED WITH SUBJECTIVE NOCTURNAL AWAKENING AND SLEEP STAGE TRANSITION INDEX IN PATIENTS WITH NARCOLEPSY TYPE 1

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Introduction: Body mass index independent metabolic abnormalities are reportedly associated with narcolepsy. We found that abnormal fatty acid metabolism is involved in the pathophysiology of narcolepsy and other hypersomnia, and appeared to be associated with the symptom of frequent nocturnal awakenings. We hypothesized that craving for sweets at wake up, often observed in narcolepsy patients, reflected the dysfunction of energy metabolism, and studied the possible association of this symptom with subjective and objective nocturnal sleep instability.

Methods: Subjects were a series of consecutive patients who visited Seiwa hospital for unexplained excessive daytime sleepiness and underwent PSG-MSLT for diagnosis purpose from October 2014 to November 2016. All subjects gave written informed consent. Those comorbid with other sleep disorders and with severe first night effect on PSG were excluded. Finally data from 139 subjects (Narcolepsy type1 19, type2 28, idiopathic hypersomnia 65, non hypersomnia control 27) were used for analyses. Age(25.8 ± 8.8) and BMI(21.6 ± 2.7) did not differ among 4 groups. Demographic data and information related to sleep habits, including frequency of craving for sweets at wake up and frequency and duration of subjective nocturnal awakening were obtained by questionnaire. Nocturnal sleep instability was also evaluated objectively by calculating sleep stage transition index in addition to conventional sleep variables.

Results: Frequency of craving for sweets at wake up tended to be high in narcolepsy group but the disese specificity did not reach statistical significance. This symptom was associated with the number of nocturnal awakenings and total duration of nocturnal awakenings. It is also associated with sleep transition index such that sleep transition index is higher among those with frequent sweets craving group, especially in narcolepsy type1.

Conclusion: Association of the frequency of craving for sweets and subjective/objective sleep instability suggests that this symptom could reflect the dysfunction in energy metabolism and contribute to the sleep instability. Further studies with larger sample size and with objective evaluation of energy status is required and ongoing.

Support (If Any): None.

0660

SUBGROUP OF NARCOLEPSY TYPE 2: CHARACTERISTICS OF SLEEP VARIABLES IN HYPERSOMNIA PATIENTS WITH ATTENTION-DEFICIT HYPERACTIVITY DISORDER (ADHD)

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Introduction: Patients with attention-deficit hyperactivity disorder (ADHD) have been reported to suffer from subjective and objective sleepiness, and sleepiness is suggested to have pathophysiological relevance to ADHD. Narcolepsy type 2 is reported to be heterogeneous, therefore, we examined the influence of ADHD pathophysiology in narcolepsy type 2. The aim of the present study was to (1) examine sleep variables in hypersomnia patients with ADHD and without ADHD, (2) characterize the narcolepsy type 2 associated with ADHD and (3) explore the correlation of ADHD symptoms with objective and subjective sleepiness.

Methods: Subjects were 156 consecutive outpatients with hypersomnia diagnosed by standard polysomnography (PSG) and the multiple sleep latency test (MSLT). Patients with narcolepsy type 1, sleep related breathing disorder, or periodic leg movements disorder were excluded. We subdivided hypersomnia patients (narcolepsy type 2; n = 28, idiopathic hypersomnia; n = 41) into patients with ADHD (n = 22) based on DSM-5 and patients without ADHD (non-ADHD) (n = 47) and compared sleep variables on PSG and MSLT. Correlation between the Adult ADHD Self-Report Scale (ASRS), Japanese Epworth Sleepiness Scale (J-ESS) and mean sleep latency on MSLT were examined.

Results: Hypersomnia patients with ADHD showed higher percentage of having multiple SOREMPs on MSLT ($p < 0.05$). In narcolepsy type 2 patients, there was no difference in the percentage of having SOREMP on PSG between patients with ADHD and non-ADHD. The percentages of having REM related symptoms and having HLA positivity were not different between the two groups. There was a correlation between ASRS and J-ESS scores ($r = 0.431$, $p < 0.01$) in non-ADHD patients, but not in ADHD patients.

Conclusion: Hypersomnia patients with ADHD showed frequent REM transitions only in daytime. This frequent REM transitions may be a characteristic marker of ADHD and this may form one subgroup of narcolepsy type 2. ADHD symptoms may be the consequence of sleepiness in non-ADHD patients, whereas ADHD symptoms (inattention) in ADHD patients might be intrinsic rather than secondary symptoms.

Support (If Any):

0661

EXCESSIVE DAYTIME SLEEPINESS IN ADULTS WITH POSSIBLE ATTENTION DEFICIT/HPERACTIVITY DISORDER (ADHD): A WEB-BASED CROSS-SECTIONAL STUDY

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Introduction: Arousal dysregulation has been speculated to be involved in the pathological mechanism of attention deficit/hyperactivity disorder (ADHD). However, there has been no epidemiological study assessing the real condition of excessive daytime sleepiness (EDS) in adults with ADHD. This study investigated the prevalence of EDS and the relationship between sleepiness and ADHD symptoms in adults with possible ADHD.
Methods: The study protocol was approved by the Ethics Committee of the Institute of Neuropsychiatry, Tokyo, Japan. An observational, cross-sectional, web-based study was performed. Participants were 9,822 Japanese adults ages 20–69 who completed an Internet-based questionnaire that assessed ADHD symptoms, autistic traits, depressive symptoms, chronotype, sleepiness, and sleep disturbances.
Results: Participants with possible ADHD were more likely than non-ADHD participants to have an evening chronotype and experience depressive symptoms, sleepiness, and sleep disturbances. The rates of having moderate and severe sleepiness in the possible ADHD group were higher than those in the non-ADHD group. Hierarchical logistic regression analyses revealed that the presence of ADHD symptoms was independently associated with EDS even after adjusting for factors related to the presence of sleepiness. When examining inattention and hyperactivity scores among participants with possible ADHD, the inattention score was significantly higher in the severe EDS group compared with the moderate and non-EDS groups.
Conclusion: EDS was relatively common in adults with possible ADHD. ADHD symptoms, especially inattentiveness, were associated with the formation of EDS in this population.
Support (If Any): This work was supported by a Grant from Japan Foundation for Neuroscience and Mental Health.

0662

ASSOCIATION BETWEEN SLEEP TENDENCY AND ABILITY TO MAINTAIN WAKEFULNESS: DIFFERENCE AMONG NARCOLEPSY, IDIOPATHIC HYPERSOMNIA AND INSUFFICIENT SLEEP SYNDROME

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Introduction: Both multiple sleep latency test (MSLT) and maintenance of wakefulness test (MWT) are used to measure objective daytime sleepiness. Although MSLT has an optimal cut-off value of mean sleep latency (MSL-MSLT) to diagnose central hypersomnia (< 8 min), MWT (MSL-MWT) does not. Furthermore, no study investigated association between MSL-MSLT and MSL-MWT in each subcategory of central hypersomnia. This study aimed to clarify a cut-off value of MSL-MWT corresponding to the value of MSL-MSLT and to compare association between the two measurements in narcolepsy (NA), idiopathic hypersomnia (IHS) and insufficient sleep syndrome (ISS).
Methods: A total of 110 patients complaining excessive daytime sleepiness underwent both nocturnal polysomnography followed by MSLT and MWT within two weeks before starting medical treatment. After excluding patients who did not meet inclusion criteria, 77 patients were finally analyzed (NA type 1 [N=12], NA type 2 [N=13], IHS [N=10], ISS [N=7] and others [N=34]). A cut-off value of MSL-MWT corresponding to MSL-MSLT< 8 min was explored by receiver operating characteristic curve. Variability of MSL-MSLT and MSL-MWT was evaluated by coefficient of variation (CV). Association between MSL-MSLT and MSL-MWT was evaluated as standard deviation of the residuals on regression line between the two values (SD-regression of MSLT/MWT).
Results: A cut-off value of MSL-MWT corresponding to MSL-MSLT<8 min was 7.4 min (AUC=0.592, sensitivity 61.3%, specificity 71.4%). CV of MSL-MSLT was lower in NA type 1, NA type 2 and IHS than in ISS and others; however, CV of MSL-MWT was lower only in NA type 1. SD-regression of MSLT/MWT showed the following order: NA type1 < NA type 2 < IHS < ISS < others.
Conclusion: MSL-MWT showed smaller variability and stronger linear association with MSL-MSLT especially in NA type 1. Variation of MSL-MWT and its association with MSL-MSLT can be useful to characterize typical disease type of central hypersomnia.
Support (If Any): not available.

0663

COMPARISON OF INTERNATIONAL CLASSIFICATION OF SLEEP DISORDERS (ICSD)-3 AND DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS (DSM)-5 GUIDELINES FOR DIAGNOSING NARCOLEPSY

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Introduction: Narcolepsy is a chronic disorder of sleep and wakefulness characterized by excessive daytime sleepiness, disrupted nocturnal sleep, hypnagogic or hypnopompic hallucinations, sleep paralysis, and cataplexy. Diagnosis of narcolepsy is made with nocturnal polysomnography (PSG) followed by Multiple Sleep Latency Test (MSLT). Both ICSD-3 and DSM-5 employ MSLT as a tool for diagnosis based on the principles of decreased mean sleep latency (MSL), rapid eye movement (REM) sleep latency ≤15 minutes, and ≥2 sleep-onset REM periods (SOREMPs). We compared the diagnostic criteria laid down by ICSD-3 and DSM-5.
Methods: We performed a retrospective analysis of 220 subjects who underwent MSLT from 2010 to 2015. Patients with positive MSLT for narcolepsy were identified. The demographics, clinical features, and nocturnal PSG and MSLT results were examined. These patients were categorized using ICSD3 and DSM5 guidelines, for diagnosis of narcolepsy.
Results: A total of 24 patients (10.9%) met the DSM-5 criteria for narcolepsy. 4 were males and 20 females. Mean age was 32.04 (+/- 15.91) years. The same 24 patients fit the ICSD-3 criteria for narcolepsy. 5 patients had the diagnosis of narcolepsy type 1, and 19 patients had narcolepsy type 2. Mean sleep latency was 2.93 (+/- 1.86) minutes and mean number of SOREMPs were 2.79 (+/- 0.98) in narcoleptics. Only 1 patient had short REM sleep latency of 14.5 minutes during baseline PSG, along with MSL of 1.7 minutes and 3 SOREMPs during MSLT.
Conclusion: Nocturnal PSG followed by MSLT diagnoses narcolepsy equally in accordance with DSM-5 and ICSD-3 criteria. Short REM sleep latency ≤15 minutes on PSG along with clinical presentation can be adequate for diagnosis of narcolepsy by DSM-5 criteria but not with ICSD-3 criteria, which requires MSL of ≤ 8 minutes + ≥ 2 SOREMPs. Our analysis showed that this difference in criteria had no bearing on the diagnosis of narcolepsy, as long as the MSLT is abnormal. Isolated

SOREMP during nocturnal PSG may not be sufficient to constitute a diagnosis of narcolepsy.
Support (If Any):

0664

VIDEO MONITORING DURING MAINTENANCE OF WAKEFULNESS TEST: MAY THE BEHAVIOURAL ANALYSIS BE AN ADDITIONAL TOOL FOR RESULTS INTERPRETATION?

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Introduction: The Maintenance of Wakefulness Test (MWT) is an objective test measuring sleepiness as impairment of the ability to stay awake. We routinely perform MWT with simultaneous face-trunk video monitoring and we aimed to determine whether the analysis of videotaped intra-test patient behaviours represents a useful tool for a more accurate identification of different degrees of sleepiness.
Methods: We selected 60 patients according to MWT results (mean SL): 20 non-sleepy (≥30'), 20 borderline (8'-30') and 20 sleepy (≤8'). The video monitoring was visually analysed for identification of sleepiness-fighting behaviours (SFB=yawns, facial expressions, body movements, scratching, face touching) and sleepy-behaviours (SB=blink, eyelid closure). To compare tests with different sleep latency we calculate the percentage trial index for SFB (number of epoch with behaviour/total number of epochs*100) and the percentage epoch index for SB (mean behaviour occurrence for epoch/total number of epochs*100). Then, we performed a MANOVA to compare the frequency of each behaviour among the three groups.
Results: SFB were significantly more frequent in non-sleepy than in sleepy patients (yawns, facial expressions, body movements, scratching, face touching mean difference 3.81,p=0.03; 8.37,p=001; 13.03,p=0.05; 3.63,p<0.01; 8.8,p<0.001). Conversely eyelid closures were significantly more frequent in sleepy subjects (-278.95,p=0.01). Borderline subjects did not significantly differ from sleepy patients for any behaviour, except for eyelid closures that were more frequent in the latter (-269.08,p=0.02).
Conclusion: The frequency of the intra-test patient behaviours during MWT resulted to be significantly different in different degrees of sleepiness. Particularly, SFB resulted more frequent in subjects with normal SL on MWT suggesting that active behavioural measures to fight sleepiness can mask an underlining clinical problem. In this group of subjects the video monitoring during MWT can be considered an informative additional tool, especially when the test is used to evaluate the ability to stay awake in critical working mission.
Support (If Any): None.

0665

FACTOR STRUCTURE OF THE EPWORTH SLEEPINESS SCALE (ESS) IN A LARGE CLINICAL SAMPLE

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Introduction: Prior studies have proposed 1-, 2- and 3- factor solutions for the ESS, but no studies have been conducted in a very large clinical sample.
Methods: A cross-sectional sample of all independent patients' first visit completions (from 1/8/2008 to 9/28/2012) of the Cleveland Clinic Sleep Disorders Center's electronically-archived ESS responses were obtained. The Kaiser-Meyer-Olkin (KMO) test for sampling adequacy and Bartlett's test of sphericity were performed. When 2 or more factors were considered, oblique (oblimin) rotation was considered first, and if correlation between factors fell below 0.30, an orthogonal rotation was used instead. Principal axis factor analysis, based upon polychoric correlations, was conducted on responses having all ESS items completed.
Results: Of 12,108 subjects, 10,832(5315 Males, 5517 Females; Age 49.7 +/- 15.1 years, Range 5–90 years; 8243 Caucasians, 1763 African Americans, 2103 Other) completed all ESS items. The KMO statistic was 0.91, and the Bartlett's was significant p<0.001. Scree plot inspection supported one-dimensionality. All items had 1-factor loadings between 0.67 and 0.86, altogether comprising 63% of the variance. The 2-factor orthogonal solution yielded plausible factors, but increased the coverage only to 68% of the variance. The 3-factor principal axis solution did not converge, but when the residual extraction method solution was used, it only comprised 75% of the variance.
Conclusion: Most criteria indicated that the 1-factor solution was sufficient. One-dimensionality of the ESS supports using Item Response Theory Analysis on the ESS items.
Support (If Any): Knowledge Project Program, Neurological Institute, Cleveland Clinic Foundation.

0666

ABILITY OF THE JAWBONE UP3 TO QUANTIFY SLEEP IN PATIENTS WITH HYPERSOMNOLENCE: A COMPARISON AGAINST POLYSOMNOGRAPHY

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Introduction: Commercially available fitness activity trackers are emerging as an alternative, cost-effective measure of sleep. Unlike other such devices, the Jawbone UP3 (JB3) purports the ability to quantify light, deep, and rapid eye movement (REM) sleep. REM sleep detection is a particularly important component in the assessment of patients with suspected central disorders of hypersomnolence. Thus, this investigation evaluated the abilities of the JB3 to quantify sleep relative to polysomnography (PSG) in clinical patients with reported hypersomnolence.
Methods: Seventeen patients undergoing ad libitum in-laboratory overnight PSG as part of a PSG and multiple sleep latency test (MSLT) protocol wore the JB3 on their non-dominant wrist during overnight evaluation. Bland-Altman analysis was utilized to compare total sleep time (TST), sleep efficiency (SE), sleep onset latency (SOL), wake after sleep onset (WASO), REM latency (REML), and total REM sleep time (TRT). Additionally, JB3 light sleep (LS) and deep sleep (DS) were compared to PSG N1 plus N2 and N3 sleep, respectively.
Results: Compared to PSG, the JB3 significantly overestimated TST (mean difference = 20.5 minutes; p-value = .03) and SE (mean difference = 3.7%; p-value = .01). Although no other comparison reached statistical significance (p <0.05), the JB3 overestimated REML (mean difference = 10.7 minutes), TRT (mean difference = 2.5 minutes), LS (mean difference = 2.4 minutes), and DS (mean difference = 15 minutes), while underestimating SOL (mean difference = -4.6 minutes) and WASO (mean difference = -44.5 minutes) relative to PSG.
Conclusion: The JB3 inaccurately estimated sleep duration and efficiency relative to PSG. Further investigation to determine JB3 specificity, sensitivity, and accuracy for sleep staging, as well as the evaluation of the JB3 to measure sleep during naps, is warranted.

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0667

WRIST ACTIGRAPHY IN THE ASSESSMENT OF HYPERSOMNIA

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Introduction: Hypersomnia is a common presenting symptom among patients in sleep disorders centers. The most commonly used clinical tools to assess hypersomnia are patient-completed questionnaires and laboratory multiple-sleep latency tests (MSLT). This study assessed the construct validity of wrist actigraphy for the quantification of hypersomnia severity. We hypothesized that actigraphically assessed daytime sleep parameters (i.e., total daytime minutes and % time asleep) would predict mean sleep onset latency (SOL) on the MSLT.
Methods: 17 adult patients referred to the UCLA sleep disorder center who required an overnight sleep study were enrolled. Those with significant neurologic or psychiatric disorders, suspicion of parasomnias or taking sedatives or stimulants were excluded. Subjects completed the Epworth Sleepiness Scale (ESS) and Pittsburgh Sleep Quality Index (PSQI) and wore an actigraph and completed a sleep diary for one week prior to the MSLT. Correlation coefficients relating actigraphically-derived (daytime and nighttime minutes and % time asleep) to mean sleep onset latency on the MSLT were computed.
Results: Mean age 44±19 years, 59% male, mean ESS 11.5±5.7, mean MSLT SOL 10.1±4.7 minutes. Wrist actigraphy showed total night time sleep 440±63 minutes, diary night time sleep was 437±81 minutes and PSQI night time sleep was 451±124 minutes. Both actigraphically and diary measured night time sleep were significantly correlated with MSLT SOL (p's <.0.03, r's >0.53) but PSQI night sleep was not (r=0.26, p=.31). Actigraphy daytime sleep was 154±113 minutes; and diary reported day time sleep was 30±31 minutes. Neither of these were correlated with mean MSLT-SOL (p's≥.27, r's ≤ .28).
Conclusion: Actigraphy total sleep time may be useful in describing insufficient sleep prior to MSLT; however, actigraphy assessed daytime sleep may not be a substitute for MSLT in patients presenting to sleep disorders clinics. Additional work is needed to determine the utility of wrist actigraphy in the assessment of hypersomnia and whether it is an optimal way to capture habitual sleep prior to an MSLT.
Support (If Any): American Sleep Medicine Foundation Strategic Research Award 107-SR-13.

0668

EVALUATION OF COMMERCIAL RIA AND ELISA FOR MEASURING CSF OREXIN-A (HYPOCRETIN-1)

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Introduction: RIA is currently the standard technique for quantifying CSF orexin-A (hypocretin-1), a biomarker used to diagnose narcolepsy type 1. However, orexin-A RIA kit (Phoenix Pharmaceuticals) requires special radioactivity precautions. The new Elisa kit (Wako Pure Chemical Industries) is now under development. In our current study, to directly compare these two assays, we analyzed the orexin-A concentration measurement results obtained from each assay.
Methods: Using pre-established method validation acceptance criteria, we determined and evaluated the detection limit, sensitivity, precision, linearity, and recovery of the two commercially available assays described above (ELISA and RIA). After validation requirements were met, we performed a method comparison by determining orexin-A concentration in 40 CSF samples collected from 16 narcolepsy type 1 patients (8 cases: <40pg/ml, 8 cases: 40-110pg/ml), 8 symptomatic hypersomnia patients (110-200pg/ml) and 16 idiopathic and other hypersomnia patients (>200pg/ml). All analyses were performed according to manufacturer instructions. To compare the assays, we used Person's and Spearman correlation analysis. This CSF measurement study was approved by Akita University ethics committee.
Results: Both assays met acceptance criteria. The RIA had a sensitivity of 40 pg/ml; it was linear to 400 pg/ml. The ELISA had a detection limit of 6 pg/ml; it was linear to 60 pg/ml. Recovery ranged from 89 to 110% with both assays. The coefficient of variability was 12% in inter- assay comparisons. Person's and Spearman correlation analysis directly comparing both assays revealed significant correlation between them (Person's correlation: r2=0.571, Spearman correlation: r=0.836, p<0.01).
Conclusion: orexin-A concentration can be reliably measured in CSF samples with either assay (RIA or ELISA). However, the orexin-A results generated by these two assays are not equivalent. Therefore, assay bias must be considered before directly comparing pre-clinical studies which used either of these assays.
Support (If Any):

0669

ADVANCED SIGNAL PROCESSING OF NOCTURNAL POLYSOMNOGRAM IN PATIENTS WITH NARCOLEPSY AND IDIOPATHIC HYPERSOMNIA COMPARED TO CONTROLS AND CASES WITH A NOCTURNAL SOREMP

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Introduction: Narcolepsy with cataplexy (N-C) is characterized by destabilized sleep/wake and REM, but less is known about sleep structure in narcolepsy without cataplexy (NwC) and other hypersomnias. The goal of this study was to evaluate the microarchitecture of the NPSG in N-C and NwC cases compared to age/sex matched hypersomnia, SOREMP, and control cases.
Methods: Fifty cases from each diagnostic group were sequestered from SleepMed's deidentified data repository (N=250). Patients on CNS medications were excluded. Controls were clinical cases with "normal" PSGs and low sleepiness (ESS<10). SOREMP cases were those with a PSG REM latency <15 min with otherwise normal PSGs and no indication of behavioral sleep or circadian abnormalities. Age and sex were similar for groups (Age=35+/-15 yr; 54% female, respectively), but race varied (% African American; narcolepsy=36%, hypersomnia=10%, SOREMP=53%, controls=26%; p<.01). Sleep stage and EEG frequency segment transition rate (per hour) were analyzed using Morpheus, an automated processing software which decomposes EEG using adaptive segmentation with fuzzy clustering and feature extraction into a 4-frequency state model (high frequency [HF], low-frequency [LF], and mixed frequency with low or high energy [MF1 & MF2, respectively]).
Results: N-C/NwC were collapsed into one group ("narcolepsy") as no differences were observed between groups for transition rate. Narcoleptics had a higher transition rate of REM-Wake compared to controls (3.8 vs. 2.5/hr; p=.04) and were more likely to transition between LF-HF (3.5 vs. 0.9/hr; p<.01), MF1-HF (187.8 vs. 163.2/hr; p=.03), and MF2-HF segments (223.6 vs. 191.2/hr; p=.04) compared to controls, holding constant age, RDI, and PSG TST. SOREMP and

hypersomnia patients were noted to have high variance in transitions, with group means often numerically similar to narcoleptics or "in between" narcoleptics and controls but with high standard deviations.
Conclusion: Narcolepsy with and without cataplexy cases appear to have sleep/wake and REM/NREM state stability. High variance in transitions for SOREMP and hypersomnia indicates a spectrum phenotype, some patients with "more" or "less" narcolepsy-like features. These data represent aggregate nightly data, current epoch-by-epoch analyses are ongoing.
Support (If Any): Jazz pharmaceuticals.

0670

REDUCED CENTROPARIETAL SLOW WAVE ACTIVITY DURING NON-RAPID EYE MOVEMENT SLEEP IN HYPERSOMNOLENCE DISORDER: A TRANSDIAGNOSTIC HIGH-DENSITY EEG STUDY

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Introduction: Hypersomnolence disorder is characterized by excessive daytime sleepiness and sleep duration of idiopathic origin. Major depressive disorder (MDD) is frequently associated with hypersomnolence, but it is unclear whether hypersomnolence disorder and hypersomnolence associated with mood disorders are distinct entities, or if they share a common neurobiology. Thus, this study utilized ad libitum high-density (hd) EEG polysomnographic recordings to examine differences in sleep duration and continuity, as well as topographic alterations in SWA, which has been associated with the restorative aspects of sleep, in patients with and without hypersomnolence disorder, as well as with and without MDD, to clarify whether hypersomnolence is associated with transdiagnostic alterations in neurophysiological function.
Methods: Eighty-three persons underwent 256-channel hdEEG polysomnography without prescribed wake time. Patients with MDD with (HYP+/MDD+) and without (HYP-/MDD+) comorbid hypersomnolence (n=22 each group), and age- and sex-matched healthy controls (HC; n=22) were recruited from a prospective study of hypersomnolence in mood disorders. Seventeen patients with hypersomnolence disorder without MDD (HYP+/MDD-) were drawn from a clinical sample. Clinical and sleep architecture variables were compared between groups. Topographic patterns of SWA relative to controls were also compared among disordered groups, and correlations between regional alterations in SWA and measures of sleepiness assessed.
Results: HYP+/MDD+ and HYP+/MDD- groups had similar sleep efficiency, stage distribution, and subjective sleepiness, and demonstrated similarly increased total sleep time relative to both HC and HYP-/MDD+ groups. HYP+/MDD+ and HYP+/MDD- also demonstrated reduced bilateral centroparietal SWA relative to HC, which was not observed for HYP-/MDD+ relative to HC. Slow wave activity in these regions also significantly negatively correlated with subjective measures of hypersomnolence.
Conclusion: Reduced bilateral centroparietal SWA may be a transdiagnostic neurophysiologic finding in patients with unexplained hypersomnolence. Further research is warranted to elucidate the mechanisms through which these cortical changes are related to clinical complaints of daytime sleepiness.
Support (If Any): This research was supported by grants from the American Sleep Medicine Foundation, the Brain and Behavior Research Foundation, and NIMH (K23MH099234).

0671

LISTENING TO THE PATIENT VOICE IN NARCOLEPSY: DIAGNOSTIC DELAY, DISEASE BURDEN AND TREATMENT EFFICACY

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Introduction: Though diagnostic delay in narcolepsy is well-reported, it is unclear what patient factors contribute to this clinical problem. Furthermore, health care providers and researchers tend to focus on assessments of core narcolepsy symptoms to determine treatment efficacy but it is not clear if these are the symptoms of most importance to patients for daily functioning. In this study, patients with narcolepsy completed a survey and report their most concerning symptoms, co-morbidities, functional limitations and treatment responsiveness to medications. We aimed to determine the impact of pediatric onset of narcolepsy symptoms on time to diagnosis of narcolepsy and presence of co-morbid depression.
Methods: Cross-sectional survey of 1699 people in the United States with self-reported diagnosis of narcolepsy. We utilized mixed methods data analyses to report study findings.
Results: Most participants reported receiving a diagnosis of narcolepsy more than 1 year after symptom onset. We found that the strongest predictor of this delayed diagnosis was pediatric onset of symptoms (OR=2.4, P<0.0005). Depression was the most common co-morbidity but we detected no association with pediatric onset of narcolepsy symptoms. Overall, participants reported that fatigue and cognitive difficulties were their most burdensome symptoms in addition to sleepiness and cataplexy. The majority of participants reported residual daytime fatigue and/or sleepiness despite treatment. Most participants reported they could not perform at work or school as well as they would like because of narcolepsy symptoms.
Conclusion: This study provides unique insight into the narcolepsy disease experience. The study quantifies the problem of diagnostic delay for narcolepsy patients in the United States and highlights that symptoms are more likely to be missed if they develop before 18 years of age. These results suggest that narcolepsy awareness efforts should be aimed at parents, pediatric health care providers, school professionals and children/adolescents themselves. Disease burden is high due to problems with fatigue, cognition and persistence of residual symptoms despite treatment.
Support (If Any): Wake Up Narcolepsy, Inc.

0672

IMPROVEMENT IN KNOWLEDGE OF DIAGNOSTIC CRITERIA OF NARCOLEPSY AMONG NEUROLOGISTS FOLLOWING PARTICIPATION IN AN ONLINE MEDICAL EDUCATION ACTIVITY

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Introduction: Narcolepsy remains underrecognized and underdiagnosed despite affecting approximately 1 in every 3000 Americans. A study was undertaken to evaluate the effectiveness of an online educational intervention with the goal of improving neurologists' knowledge of diagnostic criteria for narcolepsy issued by the American

Psychiatric Association (DSM 5) and American Academy of Sleep Medicine (ICSD 3).

Methods: The online continuing medical education (CME) activity consisted of a 30-minute video discussion between two faculty on how to diagnose narcolepsy. Educational effect was assessed by comparing a matched sample of neurologists' responses to 4 identical questions presented before and directly after exposure to the intervention. A chi-square test was used to identify significant differences between pre- and post-assessment responses. P values <0.05 were considered statistically significant. Cramer's V was used to calculate the effect size of the online education. Data was collected between January 26, 2016, and March 22, 2016.

Results: Participation in the CME intervention improved knowledge of neurologists as indicated by the medium educational effect size (n = 123; V=0.184; P <0.05). As a result of their participation in this educational intervention, significant overall improvements (P<0.05) were observed pre- vs post-participation in several specific areas, including knowledge of ICSD 3 criteria to diagnose type 1 narcolepsy (220% relative improvement), differentiation between the DSM 5 and ICSD 3 regarding the diagnostic criteria for narcolepsy (23% relative improvement), and knowledge of the clinical utility of the Swiss Narcolepsy Scale (118% relative improvement). No significant improvement was found regarding the identification of core symptoms of narcolepsy that typically accompany excessive daytime sleepiness.

Conclusion: The results indicated that the CME-certified 30-minute video discussion between two narcolepsy experts was effective at improving learner knowledge regarding guideline-based diagnostic criteria for narcolpesy. A significant improvement in knowledge was also demonstrated regarding the differences between the DSM 5 and ICSD 3 diagnostic criteria. Future education should continue to address the spectrum of symptoms indicative of narcolepsy.

Support (If Any): An unrestricted educational grant from Jazz Pharmaceuticals.

0673

ONLINE EDUCATION IMPROVES SPECIALISTS' KNOWLEDGE OF INITIATING PHARMACOTHERAPY FOR NARCOLEPSY

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Introduction: Narcolepsy is a chronic neurologic disorder that involves poor control of sleep-wake cycles. Treatment of patients with narcolepsy is suboptimal, due both to a lack of education and outdated management guidelines. An online educational intervention was developed with the goal of improving neurologists' knowledge of pharmacologic management strategies for narcolepsy.

Methods: An online educational intervention for neurologists was developed in the form of a 30-minute video lecture with slides overlaid using green screen technology. Educational effect was assessed by comparing individual participant's responses to 4 questions presented both before and directly after exposure to the intervention. A chi-square test was used to identify significant differences between pre- and post-assessment responses of the learners. P values were calculated and those <.05 were considered statistically significant. Cramer's V was used to calculate the effect size of online education. Data from the assessment were collected between February 26, 2016, and March 29, 2016.

Results: For neurologists who participated in the online activity and answered all assessment questions during the study period, comparison of responses to pre- and post-assessment questions demonstrated statistically significant improvements (n = 220; P <.05) and a medium effect size (V = 0.125). As a result of participating in this educational program, significant improvements were observed in several specific areas (P<.05): knowledge of the mechanism of action of d-amphetamine (20% pre vs post relative improvement); awareness that sodium oxybate improves cataplexy and excessive daytime sleepiness in narcolepsy (42% pre vs post relative improvement); and the appropriate approach to napping as a means of reducing excessive daytime sleepiness in narcolepsy (20% pre vs post relative improvement). No significant improvement was found regarding the selection of an initial treatment for sleep paralysis.

Conclusion: This study demonstrated the success of a targeted online, video lecture on improving the knowledge of neurologists regarding initial pharmacotherapy for the treatment of narcolepsy. Additional education should address treatment options for the management of sleep paralysis.

Support (If Any): An unrestricted educational grant from Jazz Pharmaceuticals.

0674

EFFICACY OF SODIUM OXYBATE FOR TREATMENT OF EXCESSIVE DAYTIME SLEEPINESS IN NARCOLEPSY: META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

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Introduction: Randomized controlled trials (RCTs) have demonstrated the efficacy and safety of sodium oxybate (SXB) for treatment of excessive daytime sleepiness (EDS) in narcolepsy. A meta-analysis was conducted to assess the efficacy of SXB for EDS in narcolepsy based on all available RCTs.

Methods: A systematic literature search for RCTs was undertaken using the databases PubMed, Embase, PSYCHInfo, OVID, and Google Scholar (1966-August 2016). For any data gaps, such as mean difference scores or standard deviations, we also searched clinical study reports and regulatory agency documents. A random effects meta-analysis was conducted for Epworth Sleepiness Scale (ESS), Maintenance of Wakefulness Test (MWT), and Clinical Global Impression of Change (CGI-C) scale using Cochrane's RevMan 5.3. For ESS and MWT the combined effect size was obtained using the inverse variance method. For CGI-C the odds ratio was estimated using the Mantel-Haenszel test.

Results: We identified 3 RCTs of SXB involving 634 patients. Pooled data from all studies showed significantly improved ESS scores in the SXB 9-g group (-4.12 [95% confidence interval {CI}, -4.98 to -3.27], P<0.00001) and the SXB 6-g group (-1.97 [95% CI, -2.91 to -1.02], P<0.0001) compared with those in the placebo group. MWT, as measured by sleep latency, was significantly improved in the SXB 9-g group (6.99 minutes [95% CI, 1.42 to 12.57], P=0.01) compared with placebo. The odds ratio for responder rate as measured by CGI-C scores of much or very much improved was 4.96 (95% CI, 2.83 to 8.69; P<0.00001) for 9-g SXB and 3.08 (95% CI, 1.65 to 5.78; P=0.0004) for 6-g SXB versus placebo. Overall, SXB demonstrated clinically and statistically significant improvement in symptoms of EDS as measured using ESS, MWT, and CGI-C (all P<0.05).

Conclusion: These findings suggest that SXB significantly reduced subjective and objective EDS in patients with narcolepsy.

Support (If Any): Jazz Pharmaceuticals.

0675

A RANDOMIZED, PLACEBO-CONTROLLED, PHASE 3 STUDY OF THE SAFETY AND EFFICACY OF JZP-110 FOR THE TREATMENT OF EXCESSIVE SLEEPINESS IN PATIENTS WITH NARCOLEPSY

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Introduction: JZP-110 is a selective dopamine and norepinephrine reuptake inhibitor with wake-promoting effects. In two phase 2 clinical studies in patients with narcolepsy type 1 and 2 (NT1/2), JZP-110 significantly improved wakefulness and reduced excessive sleepiness (ES). This phase 3 study is designed to further understand the safety and efficacy of JZP-110 in NT1/2.
Methods: Key eligibility criteria included: diagnosis of NT1/2 according to International Classification of Sleep Disorders-3 criteria; mean sleep latency ≤25 minutes on first 4 trials of a 5-trial, 40-minute Maintenance of Wakefulness Test (MWT); Epworth Sleepiness Scale (ESS) score ≥10; usual nightly sleep time ≥6 hours. Key exclusion criteria were: use of medications that could affect ES or cataplexy; night-time or variable shift work; conditions other than narcolepsy that cause ES. Patients were randomized (1:1:1:1) to receive JZP-110 75mg, 150mg, or 300mg, or placebo for 12 weeks and were stratified by NT1/2 phenotype. Co-primary endpoints were change from baseline to week 12 in MWT mean sleep latency and ESS score. The percentage of patients reporting improvement on the Patient Global Impression of Change (PGI-C) was the key secondary endpoint; cataplexy was an exploratory endpoint. Safety evaluation included adverse events, laboratory tests, and vital signs.
Results: Complete enrollment occurred in November 2016. Preliminary demographics from 175 of the 240 randomized patients show the population was 66.9% female, 78.3% white, with mean±-standard deviation age 37.1±13.7 years. Baseline ESS score and MWT were 17.2±3.3 and 6.2±4.8 minutes, respectively, and 96.0% of patients were ≥moderately ill on Clinical Global Impression of Severity. All patients have completed participation in the study; full efficacy and safety results will be reported.
Conclusion: This large randomized, placebo-controlled phase 3 study provides pivotal data on efficacy and safety of JZP-110 for treatment of ES with narcolepsy.
Support (If Any): Jazz Pharmaceuticals.

0676

FACTORS ASSOCIATED WITH USE OF DIFFERENT NARCOLEPSY MEDICATIONS AND MEDICATION DISCONTINUATION RATES: FINDINGS FROM THE NEXUS NARCOLEPSY REGISTRY

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Introduction: No published studies identify factors associated with use of different medications for the management of narcolepsy or report discontinuation rates.
Methods: Analyses were conducted using data from the Nexus Narcolepsy Registry, an ongoing study of adults diagnosed with narcolepsy. Using the first two biannual assessments (with participants contributing 1–2 assessments each), we ran four logistic regression models to identify variables statistically significantly (P<0.05) associated with use of current medications (modafinil or armodafinil [M/A], sodium oxybate [SXB], stimulants, or antidepressants). Covariates in all models were current use of the other medications, socio-demographic characteristics, time since diagnosis, lifetime history of cataplexy, and comorbidities. Medication discontinuation rates were estimated for the prior 6 months.
Results: Of the 970 assessments analyzed, 91.7% reported currently taking ≥1 narcolepsy medication. The majority (57.9%) of assessments reported use of stimulants, 45.5% antidepressants, 39.8% M/A, and 30.3% SXB. Stimulant use was associated with: M/A nonuse (P<0.001), anti-depressant use (P<0.001), not having higher education (P=0.001), and currently working for pay (P=0.021). Antidepressant use was associated with: M/A use (P<0.001), anxiety/depression diagnosis (P<0.001), stimulant use (P=<0.001), cataplexy history (P=0.006), higher education (P=0.015), and residing in Southern or Midwestern US (vs. Western US, P≤0.036). Covariates significantly associated with SXB treatment were living in any US region (vs. ex-US, P=0.001 or less), higher education (P=0.008), and male gender (P=0.047). M/A treatment was associated with stimulant nonuse (P<0.001), anti-depressant use (P=0.008), and current employment (P=0.004). There were statistically significant differences in discontinuation rates (P<0.001) across groups during the previous 6-months, from 25% for M/A to 9% for SXB.
Conclusion: Most participants took ≥1 narcolepsy medications. Factors associated with medication use were other concomitant medications, gender, region, and work status. SXB was associated with the lowest discontinuation rate in the previous 6-month period.
Support (If Any): This research was funded by Jazz Pharmaceuticals.

0677

THE EFFECTIVENESS OF MODAFINIL FOR THE TREATMENT OF IDIOPATHIC HYPERSOMNIA

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Introduction: Although modafinil has been widely accepted as a treatment candidate for idiopathic hypersomnia (IHS), the effectiveness of this drug on the disorder has not been proven especially in Asian patients. This study was set out to investigate the effectiveness

and safety of modafinil in Japanese patients with IHS using maintenance of wakefulness test (MWT) as primary outcome measure and Epworth Sleepiness Score (ESS) as well as weekly nap frequencies reported by patients themselves as secondary measures.

Methods: Seventy-one patients diagnosed as IHS without long sleep time (n= 69) or IHS with long sleep time (n=2) based on the criteria on the International Classification of Sleep Disorders 2nd edition (ICSD 2nd) were enrolled in this study. All the subject patients (most of them were drug-naïve) were asked to take 200mg of modafinil (n=34) or placebo (n= 37) in the morning for consecutive three weeks, and the outcome measures were evaluated both at the baseline and the end of the treatment period.

Results: The decrease in mean sleep latency of MWT at the end of treatment period was significantly larger in the modafinil group compared with the placebo group ($p<0.01$, ANCOVA). The reduction in the ESS score and the reported weekly nap frequency at the end of the treatment were also larger in the modafinil group than those in the placebo group ($p<0.01$, respectively). There was no difference in polysomnographic measures at the end of the treatment between the two treatment groups. The rate of the patients who had episodes with suspicion of side effect symptoms (headache, nausea or dry mouth) was higher in the modafinil group than in the control group ($p=0.003$, Fisher's exact test), but all the symptoms remained mild.

Conclusion: Modafinil was thought to be both subjectively and objectively effective and well-tolerated for the treatment of IHS.

Support (If Any): This study was supported by Alfresa Pharma Corporation, Japan (Study CN-801-0306).

0678

COMPARISON OF HEALTH RELATED QUALITY OF LIFE BETWEEN TYPE I AND TYPE II NARCOLEPSY PATIENTS

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Introduction: Narcolepsy with cataplexy is a rare chronic sleep disorder characterized by excessive daytime sleepiness, cataplexy, sleep paralysis, and hypnagogic/hypnopompic hallucinations. The aims of the present study were compare the quality of life (QOL) of patients with type I and type II narcolepy patients, and to determine the factors that influence the QOL in narcolepsy patients.

Methods: We evaluated QOL of 18 type I narcolepsy patients and 21 type II patients. All patients performed night polysomnography and multiple sleep latency test. QOL and the severity of subjective symptoms were evaluated using various questionnaires, including the Korean versions of the Medical Outcome Study Short Form-36 (SF-36), the Pittsburg Sleep Quality Index (PSQI-K), the Epworth Sleepiness Scale (KESS), and the Beck Depression Inventory (KBDI)-2.

Results: Type I patients had short REM latency on night polysomnography and more sleep onset REM periods on multiple sleep latency test. The total score of HR-QOL was worse in patients with type I narcolepsy than in the type II narcolepsy patients. There was association between the severities of excessive daytime sleepiness, depression, and the degree of worsening of QOL. CSF hypocretin level had no correlation with the scores of HR-QOL.

Conclusion: These findings demonstrate that narcolepsy patients represents a considerable burden on the QOL, and suggest that the impairment in QOL of patients with narcolepsy is related to the degree of excessive daytime sleepiness and depression that they suffer.

Support (If Any):

0679

ENDOGENOUS CIRCADIAN RHYTHM IN A MARKER OF MYOCARDIAL OXYGEN CONSUMPTION

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Introduction: Double product (DP), the product of heart rate and systolic pressure, is a non-invasive index of myocardial oxygen consumption commonly used for cardiovascular (CV) risk stratification. In the general population, DP peaks in the afternoon, but whether the endogenous circadian system contributes to the day/night pattern is unknown. We tested whether there exists an endogenous circadian rhythm in DP in healthy individuals, and whether this rhythm is different between non-obese and obese healthy individuals who may be considered to have greater cardiovascular vulnerability.

Methods: 15 healthy participants were studied (aged 41–63 years; 4 obese (BMI>30 kg/m^2); 9 women, 1 with mild hypertension). Following 1–3 weeks of regular sleep/wake schedules at home, participants underwent a 5 day in-lab forced desynchrony protocol (achieved by scheduling 10 identical, recurrent 5 h 20 min 'days' in dim light, thereby desynchronizing the circadian and behavioral cycles). Heart rate and blood pressure were measured while at rest at the beginning of each wake period, and DP was calculated. Circadian phase at each measurement was determined relative to the dim light melatonin onset, defined by salivary melatonin >3pg/mL. Cosinor analyses were performed on DP and the interaction between BMI and circadian phase was tested.

Results: Across all subjects DP at rest exhibited a significant endogenous circadian rhythm in our sample ($p<0.05$) with a trough at ~4AM and peak at ~7PM. Resting DP was greater in obese individuals and there was a significant BMI by phase interaction ($p=0.04$) such that the obese group had a peak ~4 hours later than the non-obese group.

Conclusion: DP at rest has a strong endogenous circadian rhythm in healthy individuals with differences between non-obese and obese participants. These differences may partly explain the increased cardiovascular risk that accompanies obesity. Our results also suggest that the administration of medications to lower DP might need to be timed, and titrated differently in non-obese versus obese individuals.

Support (If Any): R01 HL125893 (to SAS) and UL1TR000128 (to OHSU Oregon Clinical & Translational Research Institute), National Space Biomedical Research Institute through NCC 9–58 and F32HL131308 (to SST).

0680

ADULTS WITH DELAYED SLEEP-WAKE PHASE DISORDER HAVE MORE SLEEP AND CIRCADIAN VARIABILITY THAN HEALTHY CONTROLS

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Introduction: Delayed sleep-wake phase disorder (DSWPD) is characterized by sleep times that occur later than desired socially acceptable times. Assessment of the dim light melatonin onset (DLMO) in DSWPD is encouraged to improve diagnostic accuracy, and to optimize timing of light and/or melatonin treatment. However, the DLMO is often implicitly assumed to be stable in DSWPD. Here we compared sleep and circadian variability in DSWPDs versus healthy controls under the same conditions.

Methods: Twenty-two DSWPDs and 18 controls (21–52 years) completed a 10-day protocol consisting of two DLMO assessments, a 5-day study break, and then two more DLMO assessments. All participants were instructed to sleep within 1 hour of their self-reported average sleep schedule during the study break. Sleep onset, wake time, sleep efficiency (after sleep onset), and total sleep time were extracted from wrist actigraphy recordings.

Results: There were no group differences in sex, age, race, or employment status between the DSWPDs and controls. As expected, the DSWPDs had significantly later sleep onsets, later wake times, and later DLMOs than controls (all $p<0.001$). Root mean squared successive difference calculations revealed that the DSWPDs had significantly more night-to-night variability in their wake time and total sleep time than controls ($p\leq0.015$), but similar night-to-night variability in sleep onset time and sleep efficiency ($p\geq0.30$). DSWPDs had more drift in their DLMOs from before to after study break than controls ($p=0.05$).

Conclusion: Under the same conditions, we found increased sleep and circadian variability in DSWPDs versus controls. The increased sleep variability in DSWPD could be clinically significant, as sleep variability is associated with worse health outcomes, including depression, insomnia, obesity and insulin resistance. Furthermore, DSWPD patients with higher sleep variability are more likely to have a shifting, rather than stable DLMO, which should be taken into consideration when timing light and/or melatonin treatment.

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0681

AWAKE WITH THE ENEMY - VACCINATION RESPONSE IS REDUCED BY NOCTURNAL SHIFT WORK

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Introduction: Sleep regulates immune functions. We investigated whether nocturnal shiftwork can influence the immune response upon vaccination.

Methods: Thirty four healthy workers (23 females), nocturnal and diurnal shifts (17 day workers), were vaccinated against Meningococcal C (MenC) meningitis. Sleep was recorded polysomnographically and the compliance with the work schedule was evaluated with actigraphy. Humoral, cellular immune response and hormonal levels were assessed on baseline, 28 and 56 days after vaccination.

Results: Compared with day workers, the night workers showed increased inflammatory mediators (TNF-α and IL-6 levels) and a reduced specific humoral response to vaccination, N3 and REM sleep duration. The reduction of CD4 T lymphocytes, plasmacytoid dendritic cells (pDCs) and prolactin levels, and, on the other hand, increased T_{Reg} and IL-10 levels in night workers corroborate a possible weaker humoral response nocturnal shift work-dependent. In addition, both sleep and circadian rhythm alterations were associated with the reduced humoral response of night workers: a decrease in the total sleep time

(also revealed as a significant predictor) and an increase in the phase delay related to the nocturnal shift were associated with the reduction in the number of specific antibodies response.
Conclusion: Our findings provide novel evidence about negative consequences of shift work on workers' health based on real life circumstances. In association with circadian components, the total sleep time was essential for the Ag-specific immune response development, suggesting that the response to vaccination may be impaired in individuals with chronic sleep restriction and circadian misalignment.
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0682

COMPARING SLEEP, BURNOUT, AND QUALITY OF LIFE IN AIRLINE GROUND CREW SHIFT WORKERS MOVING FROM 8- TO 12-HOUR ROTATING SHIFTSCHEDULES: A PILOT FIELD STUDY

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Introduction: The effects of shift length on sleep quality, health, and performance of shift workers has been investigated yet few have followed workers prospectively in the field, before and after a change in shift length from 8- to 12-hour shifts. As part of an initiative of the Israel national airline to change the work schedule of the ground crew, we aimed to compare subjective and objective sleep measures, burnout, and quality of life (QOL) during 8- and 12-hour shift schedules in a repeated-measures design.
Methods: Thirty nine airline ground crew shift workers (mean age 38.9 ± 8.2 years; mean seniority 13.9 ± 7.1 years, 19 male) were invited to volunteer in a pilot study aimed at comparing workers' functioning in schedules of 8- vs. 12-hour rotating shifts. Sleep was measured by actigraphy and by the Pittsburgh Sleep Quality Index (PSQI) self-report. Participants also completed the Shirom-Melamed Burnout Measure (SMBM) and the Medical Outcome Survey Short Form (MOS-SF12) at two time points: during an 8-hour shift schedule, and 3 months after transferring to a 12-hour schedule.
Results: During the 12-hour shift schedule, according to the actigraph recoding, subjects had significantly higher sleep efficiency (79.8 ± 9.5%, 72.6 ± 7.4%), longer sleep time (2.1 ± 0.7, 1.6 ± 0.5), and longer sleep duration (2.6 ± 0.7, 2.1 ± 0.7) during naps; mean PSQI scores indicated shorter sleep latency (0.9 ± 1.0, 1.3 ± 1.1), better daytime functioning (0.6 ± 0.8, 1.1 ± 0.9), fewer sleep disturbances (1.0 ± 0.7, 1.2 ± 0.5), higher perceived sleep quality (0.7 ± 0.9, 1.2 ± 0.9), and a lower total score (4.6 ± 4.1, 6.5 ± 3.9) than during the 8-hour shift schedule ($p \leq 0.05$). Lower burnout indices were found for 12- than for 8-hour shift schedules for physical fatigue (2.9 ± 1.2, 3.9 ± 1.4), cognitive weariness (2.1 ± 1.0, 2.6 ± 1.1), and emotional exhaustion (1.8 ± 0.9, 2.4 ± 1.1) ($p \leq 0.05$). Mental QOL was also higher during the 12- than the 8-hour shift schedules (44.9 ± 8.0, 39.9 ± 8.8, $p=0.004$).
Conclusion: Consistent with the literature, findings demonstrate that shift workers' objective and self-reported measures of functioning, including sleep quality, burnout, and QOL, favor 12-hour shifts over 8-hour schedules.
Support (If Any): Support: We thank the El-Al management and ground crew workers for their participation, and the Israel Ministry of Economy and Industry for the funding.

0683

ASSOCIATION BETWEEN, BIMODALITY INDEX, PER3 GENOTYPES, AGING AND SLEEPINESS IN A POPULATION BASED COHORT IN BRAZIL

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Introduction: The circadian system coordinates internal events in a daily schedule to make sure that the body systems are synchronized to environmental time and internal cues. One important behavioral aspect of the circadian system is the chronotype. It is usually assessed through subjective questionnaires, being the Horne-Ostberg Morningness-Eveningness Questionnaire (MEQ) one of the most used. It classifies individuals into three major categories: morning, evening and intermediate types. Recently, it has been hypothesized the existence of a fourth chronotype, the bimodal type, through an algorithm derived from the MEQ responses. Bimodals answer as morning-types in some questions, and as evening-types in others, resulting in an intermediate total score. To better characterize this phenotype, the present study aimed to detect and characterize the frequency of the bimodal chronotype in the EPISONO, a large population-based cohort, as well as to verify the association between bimodality and sleep parameters and genetic variation in the PER3 gene.
Methods: A total of 1,042 participants completed a set of detailed sleep related questionnaires and underwent a polysomnography (PSG). An algorithm was used to classify bimodal individuals according to the number of morning-type/evening-type answers. Finally, genotyping of the variable number of tandem repeats (VNTR) polymorphism of the PER3 gene was performed by conventional polymerase chain reaction.
Results: Of the 1,042 individuals who participated of the EPISONO, 857 had MEQ filled correctly. We found that 16% of our sample were bimodal types. We observed that bimodal individuals were significantly younger and had lower body mass index. The association between PER3 VNTR genotype or gender with bimodal chronotype were not significant. However, we found an association between bimodality and Epworth Sleepiness Scale (EES) and apnea-hypopnea index (AHI). Lastly, it was observed that the most significant predictors for bimodal chronotype were male gender, AHI and EES.
Conclusion: In conclusion, the present work provides more evidence that the bimodal type might have to be considered when classifying chronotype and its association with young age and sleepiness may be due to the influence of social and environmental factors.
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0684

REDUCED LIGHT EXPOSURE NEGATIVELY IMPACTS SLEEP QUALITY AND ALERTNESS IN UNDERGROUND-OPERATING SUBWAY WORKERS

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Introduction: Apart of being a survival warranty, sleep is absolutely relevant for many functions of which depends attention, adequate behaviour and alertness. Two main oscilatory components (homeostatic and circadian) regulate human sleep-wake cycle. Circadian influence on the maintenance of a synchronised sleep-wake cycle with the 24h night and day rythm primarly depends on time and intensity of

light exposure. Furthermore, light exposure can affect wakefulness and sleepiness. This study aimed to compare underground-operating workers (UOW) with surface workers (SW) of the Lisbon subway company regarding sleep quality and sleepiness and look for the impact of light exposure on sleep and alertness.
Methods: Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS) were used to assess sleep quality and sleepiness, respectively. Iluminance was assessed by Minolta T10 -iluminance meter. For statistics it was applied the Statistical Software Package for the Social Sciences (SPSS, version 22.0). Qui-square independece test was used to test association of categorical variables. Statistical meaning was assumed for p<0,05.
Results: 399 otherwise healthy workers were included (262 males): 57,1% working in underground and 42,9% working on the surface. 56,6% of the UOW compared to 43,9% of the SW complained of disturbed sleep. Sleep quality was affected (PSQI>5) in 79,8% of UOW versus 65,1% of SW and significant sleep disturbance (PSQI>10) in 32,6% of UOW versus 13,3% of SW. Sleepiness (ESS>10) was assumed in 41,2% of UOW versus in 28,7% of SW. Iluminance was significantly lower for UOW (5 to 40 Lux) compared to SW (334 to 781 Lux).
Conclusion: Underground operating workers are more prone to complain about sleep and to have a lower sleep quality and higher levels of sleepiness compared with surface workers of the same subway company. Reduced light exposure appear to be the main factor explaining this differences.
Support (If Any): Any.

0685
FIXED VS. AD LIB TIME IN BED IMPACTS SLEEP DURATION FOLLOWING SIMULATED NIGHT SHIFTS IN OLDER ADULTS

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Introduction: Night work is associated with shorter sleep, increased injury and accident risk, and greater chronic disease risk compared with day work. Older shiftworkers report greater difficulty sleeping when working nights compared with younger workers. Here, we explored whether the timing of sleep or the duration of time-in-bed could improve sleep duration when working nights.
Methods: 26 healthy adults (57.6±3.90y; mean±SD) who were not shiftworkers participated. Four laboratory simulated day shifts were followed by four night shifts. Participants slept at home and maintained 8 h sleep schedules for one week before study and while on day shifts. After the first night shift, participants were randomized into one of four groups with different sleep instructions: A-ad lib sleep (control group; n=9); B-Fixed 8h evening sleep (n=9) with a light intervention; C-Fixed 8h evening sleep (n=5); D-ad lib evening sleep (n=3). Groups B and C were instructed to get into bed between 1-2pm and remain in bed attempting to sleep for 8h; group D was instructed to not initiate sleep until at least 1pm. Sleep was monitored by actigraphy, sleep diary and call-in data.
Results: Compared to the control group, both groups with fixed 8h evening sleep had significantly longer time-in-bed and total sleep time, and greater mean sleep efficiency following night shifts (p<0.01). The fixed 8h evening sleep groups showed similar sleep durations following night and day shifts, while the control group showed shorter sleep (p<0.001). The ad lib evening sleep group was not significantly different from the control group.
Conclusion: Our preliminary data indicate that older adults can comply with an 8h scheduled evening sleep episode after night shifts, and in doing so are able to obtain more sleep. While this remains to be tested in actual night workers, this strategy may improve the sleep, safety, and health of older shiftworkers.
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0686
OPTIMIZATION OF LIGHT INTERVENTION TO TREAT CIRCADIAN MISALIGNMENT

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Introduction: Circadian misalignment, as observed during jetlag and shiftwork, leads to increased fatigue, risk of accidents and disease. A number of studies demonstrated that re-entrainment can be accelerated by bright light intervention, applied according to the phase-response curve. However, no standardized guidelines regarding the duration, intensity or timing of light exposure to optimize re-entrainment have been established. Mathematical models have been used before to investigate optimal light exposure and facilitate adaptation. However, they predicted one optimal lighting solution for each phase difference, which makes them difficult to apply in practice due to differences in individuals' social and physiological constraints.
Methods: We use arousal dynamics model comprising the neurobiological, sleep-wake switch model of Phillips and Robinson and the dynamic circadian oscillator model by Kronauer et al. to investigate optimal light schedules for adaptation to circadian misalignment.
Results: Using the model we build a 3-dimensional phase-response surface, which allows us to determine optimal light schedules and can be verified experimentally. The model predicts multiple light exposure solutions leading to an optimized duration of adaptation. The solutions for the same phase shift are diverse, ranging from short bright light exposure of 2–3 hours per day to prolonged exposure of more than 10 hours per day.
Conclusion: Our study thus allows customization of light exposure schedules to treat circadian misalignment depending on individual social and physiological constraints without increasing adaptation times.
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0687
WITHDRAWN

0688
IMPACT OF CIRCADIAN MISALIGNMENT AND BMI ON GLUCOSE DYSREGULATION IN NIGHT-SHIFT WORKERS

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Introduction: Epidemiological studies suggests that night shift workers are at increased risk for obesity and diabetes, and simulated shift work studies in day workers have implicated circadian misalignment

as a culprit for reduced glucose tolerance. However, this has not been tested in actual night shift workers. To better understand the role of circadian misalignment on glucose dysregulation, we examined glucose tolerance in a sample of fixed night shift workers.

Methods: Thirty fixed night shift workers participated in this study. All subjects were given an eight-hour opportunity to sleep upon arrival at the lab, and remained under dim-light conditions for 24 hours. An oral glucose tolerance test was administered two hours after awakening. The change in glucose from fasting to one hour after glucose intake, and from fasting to two hours after glucose intake were measured. Melatonin was also assayed via hourly salivary samples, and circadian phase was indexed using the dim light melatonin onset (DLMO). Analyses included years of night shift work as a covariate.

Results: Partial correlations controlling for years of shift work indicated that DLMO was not significantly associated with change in glucose tolerance at one-hour, r(27) = .07, p>.05, or at two-hour, r(27) = -.24, p>.05. However, DLMO was significantly associated with glucose tolerance when accounting for weight. Specifically, overweight shift workers (BMI ≥ 26) with earlier DLMOs showed lower glucose tolerance at the two-hour time point, r (15) = -.46, p<.05, compared to subjects with healthy weight, r (9) = .06, p>.05.

Conclusion: Results suggest that circadian misalignment alone may not be a significant predictor for glucose dysregulation, but instead may interact with other risk factors for diabetes, such as weight. Thus, increased risk for diabetes in night shift workers should not be generalized, but rather considered only when circadian disturbance is paired with pre-existing risk factors.

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0689

DISCREPANCIES IN WEEKDAY-WEEKEND SLEEP-WAKE PATTERNS AND SELF-REGULATION

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Introduction: Poor self-regulation is commonly seen in mood disorders (e.g., anxiety) and behavioral problems (e.g., substance use). Current study aims to investigate the association of weekday-weekend discrepancies in sleep-wake pattern with self-regulation abilities.

Methods: A total of 1,043 subjects participated in an online survey (256 males, age = 13 - 65 y). Weekday-weekend discrepancies in sleep-wake pattern were measured by the Sleep Timing Questionnaire (STQ), from which the differences over weekday nights and weekend nights in bedtime, wake up time, mid-point of sleep (also known as "social jetlag") and time-in-bed were calculated. The self-regulation abilities were assessed by the Emotion Regulation Questionnaire (ERQ) and the Behavioural Inhibition System and Behavioural Approach System (BIS/BAS) Scales. Linear regression analyses were applied to examine the relationships between self-regulation abilities and the degree of weekday-weekend sleep discrepancies, in which age, gender, mental health, chronotype and sleep duration during weekday nights were controlled.

Results: Participants with more delayed weekend wake up time (ß = -0.10, p = 0.010), more sleep compensation during weekend (ß = -0.09, p = 0.021), or greater social jetlag (ß = -0.08, p = 0.030) were more likely to show lower cognitive reappraisal, i.e. less adaptive emotion regulatory strategy. The behavioral activation systems, especially the fun-seeking and reward responsiveness domains, were associated with more delayed bedtime (BAS-F: ß = 0.10, p = 0.003; BAS-R: ß = 0.08, p = 0.016), and less weekend sleep compensation (BAS-F: ß = -0.10, p = 0.018; BAS-R: ß = -0.08, p = 0.040), suggesting a decreased sensitivity towards rewards and more reward/fun seeking behaviors. Meanwhile, the behavioral inhibition system (BIS) was related with more delayed wake up time (ß = 0.09, p = 0.023) and more social jetlag (ß = 0.09, p = 0.011), suggesting an increased sensitivity towards threating cues and tendency towards withdrawal behaviors.

Conclusion: Irregular sleep-wake pattern might be a risk factor for impaired self-regulations, which are often implicated in psychopathology. Moreover, shifts in sleep timing, wake up timing and changes in sleep duration may have differential effects on motivation drives.

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0690

SYMPTOMS CONSISTENT WITH SHIFT WORK DISORDER ARE COMMON ACROSS GROUPS OF FIRST RESPONDERS

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Introduction: Shift work is common in first responders, ensuring that services are provided 24-hours a day. Shift work disorder (SWD) is characterized by excessive sleepiness and/or insomnia associated with shift-schedules, however these symptoms are common to many sleep disorders. The aim of this study was to examine more closely the incidence of symptoms consistent with SWD derived from a validated scale across two groups of first responders; police and firefighters.

Methods: We previously evaluated SWD in groups of first responders (police and firefighters) using a modified Epworth Sleepiness Scale, and two iterations of a modified Athens Insomnia Scale: one based on night-shift work and one based on a recent vacation. Subsequently, in a separate sample, we identified and then cross validated self-reported symptoms of SWD that were most strongly associated with a clinical diagnosis. In this study, we retrospectively evaluated the incidence of these self-reported symptoms (i.e., waking too early, impaired sense of wellbeing, dozing at work, and likelihood of dozing while driving after at least two days off) in the original groups of first responders (n= 5833 firefighters, n= 2304 police).

Results: Approximately 80% of police and 70% of firefighters reported problems with waking up too early, 70% of police and 50% of firefighters reported a diminished sense of wellbeing during wake periods, 60% of police and 40% of firefighters reported dozing at work, and 8% of police and 10% of firefighters reported dozing while driving after at least two days off.

Conclusion: Self-reported symptoms associated with SWD are highly prevalent across populations of first responders. Future research should evaluate whether these symptoms are associated with adverse health and safety outcomes including performance and sleepiness at work, and propensity to doze while driving after shift work.

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0691

A FIELD STUDY OF MARINE PILOTS' PERFORMANCE, FATIGUE, AND SLEEPINESS LEVELS

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Introduction: Working on atypical schedules leads to sleep-wake disturbances and increased fatigue. This study aims to quantify how time-of-day, work duration, and time awake interact to affect ship pilots' performance and sleepiness.

Methods: A total of 17 male St-Lawrence River ship pilots (46.0±7.2 years; ±SD) participated to a 16–21 day field study comprised of a succession of work and rest days. The sleep-wake cycle was documented by wrist-worn actigraphy and sleep-wake log. Performance was assessed by a 5-min psychomotor vigilance task (PVT) at the start and end of each work and rest day. Sleepiness and fatigue were assessed 5x/day by the Karolinska sleepiness scale (KSS) and the Samn Perelli Fatigue scale, respectively. Probability of presenting increased sleepiness and fatigue as well as reduced performance was modelled using repeated measure logistic regressions. Specifically, the probability of exceeding 1 SD from each individual's mean was modelled.

Results: Ship transits occurred throughout the 24-hour day and lasted in average (±SEM) 5:56±0:22h. The probability of reduced reaction speed, elevated fatigue, and sleepiness levels significantly varied as a function of time-of-day ($p \leq 0.002$) and increased with work duration ($p \leq 0.029$). These factors interacted such that the effect of work duration on all dependent variables was more prononced when the transit ended at the end of the night. The effect of time-of-day was less and more pronounced with shorter and longer transit durations, respectively. A similar interaction was observed for the duration of waking ($p > 0.001$) and time-of-day ($p \leq 0.029$) on probability of elevated fatigue and sleepiness.

Conclusion: Ship pilots' performance, fatigue, and sleepiness levels are sensitive to work duration, time awake, and time-of-day. In this group, the worst scores occurred when longer transits ended at the end of the night.

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0692

AGE AND GENDER DIFFERENCES AND CORRELATES OF MORNING-EVENINGNESS AMONG ADOLESCENTS IN PAKISTAN

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Introduction: Delayed sleep phase syndrome (DSPS) is an abnormal delay of major sleep period in relationship to the desired clock time often thought to originate in adolescence. A delay of sleep has been reported for teenagers in many countries across several continents, but inconsistent results are reported regarding gender differences in sleep pattern timing. We investigated the morningness/eveningness preferences of adolescents in Pakistan and its consequences on mood and functioning level.

Methods: One thousand Pakistani adolescent students from private schools (Age range: 8–20; mean age: 14.9 years, SD: 1.49; 497 girls) participated in the study. They completed Children's Morningness-Eveningness Preferences (CMEP) scale,(Carskadon 1993) and Short Mood and Feeling Questionnaire (SMFQ) (Angold and Costello 1987). Information about demographics, sleep habits, bedtime routine, and absences from school in the last month were obtained. We also collected information about presence or absence of cell phones, video games and television use in bedrooms.

Results: Mean CMEP scores were 29.78 (5.53) with 17.2% of the sample falling in the evening category, 39.8% in the morning category and 43% in neither category. Analysis of variance was used to compare grouping variables on CMEP scores. Males had significantly higher scores (greater morningness) than females (31.4 (5.2) vs 28.1 (5.4), [$F(1,966=97.78)$, $p < .001$]. Examining CMEP categories, we found 65.1% of those in the Evening category were females whereas 67.3% of those in the Morning category were males ($\chi 2=78.3$, $p<.001$). Greater proportion of those in the evening category had cell phones (87%) compared to neither (79.3%) and morning (77.1%). Video games presence in the bedroom ($F(1,970)=16.14$, $p=.017$) and habitual snoring was associated with eveningness. There were more school absences (last month) in the evening category (2.25) vs (1.31) in the morning or neither category,$F(2,970)=6.32$, $p=.002$.

Conclusion: One difference between our data and most samples from North America and Europe is that the tendency for eveningness was greater in girls than boys. In addition, the association of eveningness with cell phone and video game availability was notable. Eveningness was also coupled to more school absences reported in the last month.

Support (If Any): N/A.

0693

VARIATION IN ACTIGRAPHY-ESTIMATED REST-ACTIVITY PATTERNS BY DEMOGRAPHIC FACTORS

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Introduction: Rest-activity patterns provide an indication of circadian rhythmicity in the free-living setting. We aimed to describe the distributions of rest-activity patterns in a convenience sample of adults and children across demographic variables using parametric and non-parametric analytical methods.

Methods: A sample of adults (N=590) and children (N=58) wore an actigraph on their non-dominant wrist for 7 days and nights. Cosinor regression methods were applied to the accelerometer count data to

calculate MESOR, acrophase and amplitude. Non-parametric methods were used to calculate the intra-daily stability, inter-daily variability, most active 10 hour period, least active 5 hour period, and relative amplitude. Demographic variables examined included age, sex, race, education, marital status, and household income. Linear mixed effects models were used to test for demographic differences in rest-activity patterns.

Results: Adolescents, compared to younger children, had later timing of peak activity (β=1.1 hours [95%CI: 0.4, 1.2] and peak inactivity (β=1.6 hours [95%CI: 0.9, 2.3]), lower activity levels during their least and most active periods (β=0.4 ln counts [95%CI: 0.1, 0.6] and β=-709 counts [95%CI: -1003, -416]), and less regular rest-activity patterns. Adults (i.e. ages 40 to 49 years), compared to younger adults (ages 18 to 29 years), had earlier timings of peak activity and peak inactivity (β=-1.0 hours [95%CI: -1.6, -0.4] and β=-0.7 hours [95%CI: -1.2, -0.2]), and their rest-activity patterns were more regular. Adult females and whites had more stable rest-activity patterns compared to African Americans and adult males. Higher educated adults had a later timing of their peak activities (β= 0.8 hours [95%CI: 0.4, 1.2]) and also showed less stable rest-activity patterns.

Conclusion: Rest-activity patterns vary across the lifespan, and differ by race, sex and education. Understanding population variation in these patterns provides a foundation for further elucidating the health implications of rest-activity patterns across the lifespan.

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BEDTIME VARIABILITY AND ALTERED EFFORT DISCOUNTING AMONG COLLEGE STUDENTS

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Introduction: Sleep variability (intra-individual variability in bedtime and sleep duration) is prevalent among college students. The current study aims to investigate the associations between sleep variability and decision making behaviors.

Methods: Sixty-six college students (16 males, age = 17–23 y) participated in the present study, which included the actigraphic sleep assessment (Actiwatch Pro, Philips Respironics, Inc.) for eight consecutive days, followed by the completion of computerized tasks in the laboratory. Sleep parameters derived from the actigraphy included the means and standard deviations (SD) of sleep onset time, sleep offset time, nocturnal sleep duration and wake-after sleep-onset. Sleep variability was represented by SD. Impulsive decision-making behaviors were measured by the Balloon Analogue Risk Task (BART) and the reward discounting task. Temporal discount (i.e., preference to smaller immediate rewards over larger delayed rewards) and effort discount (i.e., preference to typing less letters for smaller rewards over typing more letters for larger rewards) were reflected by the area under the curve (AUC), in which smaller AUCs suggesting more impatient choice pattern. Linear regression analyses were applied to examine the relationships between decision-making (dependent variables) and sleep variability (independent variables), in which gender, mental health, average sleep onset time and nocturnal sleep duration were included as covariates.

Results: The average sleep onset time was 01:13 ± 1:17am, and the SD of sleep onset time was 1.17 ± 0.65 h. The average night sleep duration was 6.87 ± 0.95 h, and the SD of night sleep duration was 1.56 ± 0.66 h. Higher degree of variability in sleep onset time (as reflected by larger SD) was related with lower AUC in the effort discounting task, indicating a higher discount rate (ß = - 0.52, $p < 0.001$). However, no significant association was found between the performance in BART or temporal discounting of monetary rewards, and the variability in sleep parameters.

Conclusion: Bedtime variability showed differential associations with discounting behaviors, which were similarly observed in individuals with sleep deprivation. In addition to sleep duration, the regularity of sleep-wake schedule may interfere with individual's decision making especially when efforts are required.

Support (If Any): HKU seed fund to Dr. Li, S.

0695

EXPLORE INFLUENCING FACTORS OF SLEEP DISTURBANCES AMONG NURSES IN CHINA BY USING BACK-PROPAGATION NEURAL NETWORK MODEL

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Introduction: Sleep disturbances and fatigue are prevalent among shift work nurses. Sleep problems could be resulted from physic-psychological and environmental factors, and has negative effects on health. To date, research in shift work nurses' sleep are rare in China, which could be due to few people attentive the potential negative health impacts resulted from shift work and nurses are required to work rotating day/night shift within one week. This study aimed to describe sleep quality and further to explore factors related to sleep quality among the registered nurses (RNs) in Beijing, China.

Methods: A total of 672 shift work RNs from one teaching hospital at Beijing participated in this study. A battery of questionnaires and physiological data (blood pressure, body mass index, blood sugar, ECG etc.) were collected to assess sleep quality, fatigue severity, and physical health. Back-Propagation (BP) neural network was used to allowing for nonlinear self-tuning adaptive control; further, to identify influencing factors for poor sleep. The demographics and physiological data were used as the input neurons (independent variables), fatigue severity as the covariate, and sleep quality as the output neuron (dependent variable) to simulate the analog BP neural network model, and identify the sensitivity of the factors accounted for poor sleep quality as index by the General Sleep Disturbance Scale.

Results: Majority of the RNs reported clinically significant poor sleep (69.6%) and fatigue (75.3%). A total of 11 independent variables were entered the model; BMI (mean=21.97, SD=3.21; sensitivity=29.3%), total sleep hours in past week (mean=6.6, SD=1.5; sensitivity=26.4%), systolic pressure (mean=111.3, SD=12.7; sensitivity=22.8%), age (mean=31.8, SD= 6.8; sensitivity=21.9%), and total years working in the unit (mean=10.5, SD=7.5; sensitivity=21.8%) are the top five predictors for poor sleep quality.

Conclusion: Most of RNs in this study experienced sleeping disturbances and severe fatigue, which could negatively impact to work safety and their own health, and call for further study in shift work coping. Objective sleep measurements are required to identify circadian rhythms issues. Tailored interventions are needed to help nurses to improve their sleep through sleep hygiene practice and maintain ideal BMI.
Support (If Any): Chinese National Natural Science Foundation [71603279].

0696

EFFECTS OF MORNING BRIGHT LIGHT THERAPY ON CIRCADIAN ACTIVITY RHYTHMS IN LUNG CANCER SURVIVORS

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Introduction: Robustness and stability in circadian rhythms indicate well-entrained circadian function. Cancer patients and survivors often experience dampened circadian activity rhythms (CAR) that are associated with, insomnia, fatigue and poor quality of life. Lung cancer survivors (LCS) have the worse patterns for CAR among cancer survivorship. Chronobiological interventions such as bright light therapy (BLT) have been implemented to re-entrain circadian rhythms, and prevent the worsening of fatigue in breast and gynecological cancer patients. However, this intervention is yet to be tested in LCS.
Methods: A randomized controlled trial to explored the effects of morning BLT on CAR in LCS. Fourteen non-small cell lung cancer survivors (NSCLC), stage I-III were randomly assigned into experimental (green-blue) and attention control (red-yellow) light intervention groups. Individuals with macular degeneration, glaucoma, bipolar disease, seizure disorder or other psychiatric conditions were excluded. Demographic information and chronotype (Morningness and Eveningness Questionnaire) were assessed at pre-test. Pre and posttest comparison on visual acuity (Snellen visual acuity chart), fatigue (Brief Fatigue Inventory), and insomnia (Insomnia Severity Index) were performed along with a five-week assessment of CAR with wrist actigraphy (2-week pre-test, 1-week of intervention, and 2-week posttest). Data were analyzed using a t-test, ANCOVA, and non-parametric analysis as appropriate.
Results: Preliminary data on four participants shows predominance of female 83.3% (n=3), older age 66.03.5 (SD 7.8, range=53–82), Caucasian-non-Hispanic 100% (n=4) with evening chronotype (100%, n=4), moderate to severe fatigue 66.7% (n=3) and clinically significant insomnia 66.7% (n=3). Participants had CAR patterns similar to free-running rhythms at pre-test but exhibited entrainment when exposure to morning green-blue light. No changes in visual acuity and no side effects were reported.
Conclusion: This study in ongoing. Disrupted patterns of CAR may be associated with decreased light exposure. Morning BLT may be effective to re-entrain and strengthen circadian rhythms leading to better quality better sleep quality and overall quality of life.
Support (If Any): Supported by Oncology Nursing Society Foundation Research Grant.

0697

IRREGULAR SLEEP SCHEDULE ASSOCIATES WITH DISTURBANCES OF MOOD AND MULTISCALE BEHAVIORAL REGULATION IN COLLEGE STUDENTS

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Introduction: One of the major concerns regarding the lifestyle of college students is irregular sleep-wake cycles that may have adverse health consequences. The goal of this study was to test whether irregular sleep-wake schedules in college students associate with mood decline and perturbed motor activity regulation at multiple time scales.
Methods: Forty-four healthy college students (18–30 years old) were studied for 3 weeks during their normal daily routines. Sleep-wake regularity (SWR) was determined based on daily sleep-wake diaries, and depression symptoms were assessed weekly based on the Beck Depression Index (BDI) questionnaire. Motor activity was continuously monitored using a wristband (Actiwatch or LKK ECG-Activity Monitor) throughout the 3 weeks, and data were stored over 1-min bins. To assess motor activity regulation, we calculated inter-daily stability (IS) of daily activity rhythms and examined temporal correlations in activity fluctuations during wakefulness at multiple time scales from ~0.1–8 hours. Additionally, mean physical activity levels were assessed weekly based on International Physical Activity Questionnaires.
Results: College students with lower SWR had lower IS ($p=0.0001$) and higher BDI scores ($p=0.0003$). These associations were independent of physical activity levels. Additionally, for those students with physical activity levels <3345 METs (median of weekly values of all students), lower SWR was associated with more random activity patterns during wakefulness at time scales <1.5h (i.e., reduced temporal correlations, $p=0.0077$). No associations were observed for activity correlations at larger time scales. There was not enough power to determine the association between SWR and activity correlations in students with high physical activity levels because all these subjects had relatively higher SWR.
Conclusion: Irregular sleep-wake schedules are associated with increased depression symptoms, less stable daily rhythms, and more random activity patterns during wakefulness in college students.
Support (If Any): NIH grants R00HL102241, R01AG048108, and P01AG00975; the International Postdoctoral Exchanging Fellowship 20150042 from China Postdoctoral Council.

0698

PER3 POLYMORPHISM PREDICTS DIFFERENTIAL COGNITIVE IMPACTS OF CIRCADIAN MISALIGNMENT IN SHIFT WORKERS

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Introduction: Some night-shift workers are more impacted by circadian misalignment than others, resulting in differential impairments to cognitive performance. One explanation may be a polymorphism in the period 3 gene, as 4- and 5-repeat alleles have been shown to predict differences in cognitive performance and alertness after sleep loss. However, the role of Per3 polymorphism in shift workers has not been examined, and may have implications

for circadian interventions. This study examined if Per3 genotypes differed in the cognitive consequences of circadian misalignment in night-shift workers.
Methods: Thirty fixed night-shift workers (22 female) were enrolled in a large observational study examining the health and performance consequences of circadian misalignment. Participants were genotyped as having the 5-repeat allele ($Per3^{5/-}$; n=20) or not ($Per3^{4/4}$; n=10). Circadian phase was assessed hourly via salivary melatonin for 24 hours (dim light melatonin onset). Nocturnal sleepiness was assessed using Multiple Sleep Latency Tests (every two hours from 11pm to 5am). Cognitive flexibility was measured using a computerized task-switching paradigm (tested at 5:30am), which indexed switch-cost (efficiency in switching to a new task) and set-inhibition (efficiency in suppressing previous task rules).
Results: As expected, individuals with a delayed circadian phase exhibited less sleepiness ($r = -.50$, $p < .01$), though this relationship did not differ by Per3 genotypes. Individuals with delayed circadian phase also showed greater cognitive flexibility ($r = .40$, $p < .05$). However, this relationship differed by Per3 genotypes ($\beta = .72$, $p = .05$); delayed circadian phase was associated with greater cognitive flexibility in $Per3^{4/4}$ individuals ($\beta = .86$, $p < .01$) but not in $Per3^{5/-}$ individuals ($\beta = .14$, $p > .05$).
Conclusion: Results suggest that $Per3^{5/-}$ shift workers may experience cognitive deficits resulting from factors beyond circadian misalignment. As prior studies have demonstrated increased susceptibility to sleep disruption in $Per3^{5/-}$ individuals, future studies may explore the role of variable sleep timing in cognitive performance, particularly because night shift workers commonly switch to nighttime sleep on nights-off.
Support (If Any): The work was supported by Teva Pharmaceuticals.

0699

CIRCADIAN ACTIVITY RHYTHMS AND SLEEP AMONG CHINESE COLLEGE STUDENTS

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Introduction: Sleep problems are prevalent for young adults. For college students, sleep disturbances could be associated with their stress derived from school works or daily life. Circadian activity rhythms (CAR) have been found to be altered among dementia, cancer patients, and distressed postpartum women. To date, studies exploring CAR in healthy adults are rare. The study aimed to: 1) describe the characteristics of CAR, and 2) explore the associations between CAR and stress and stress-related symptoms in college students.
Methods: Impaired Sleep Model was used to guide for this descriptive correlational study. A total of 26 (12 males, 14 females) college students completed this study. A battery of questionnaires was used during the week after midterm examination to assess stress and stress-related symptoms (sleep disturbances, fatigue, physical symptoms). One-week consecutive wrist actigraphy data, including total sleep time (TST) and wake after sleep onset (WASO) were collected. Cosinor analysis was used for computing the CAR, including mesor, acrophase (time of the peak of the fitted activity curve), and amplitude.
Results: The mean age for the students was 21.04 (SD= .92) and in average they need about 8 hours of sleep to feel refreshed; however, the actual nocturnal TST (M= 396.7 minutes, SEM= 12.57) was significantly less then what they needed (paired t[25]= -3.7, p= .001). They perceived moderate stress, reported a clinically significant fatigue severity, and half of them experienced at least two physical symptoms. The CAR was desynchronized (M= .63, SEM= .03) and WASO was 7.2% (SEM=.7). The average peak activity level was at 17:18 indicates delayed sleep phase syndrome. A trend was seen between poor CAR and poor daytime functioning and more physical symptoms. After control for gender, CAR along with perceived stress explained 64% of variance in nocturnal total sleep time.
Conclusion: Results showed that college student's sleep and CAR were disturbed, and they also experienced distress and fatigue. It appears that CAR plays a role in stress-related symptoms. Educational materials in the areas of sleep hygiene and mind-body exercise to regulate CAR should be mandatorily included in the college education.
Support (If Any):

0700

DIFFERENTIAL EFFECTS OF CIRCADIAN TYPOLOGY ON SLEEP, FATIGUE, MOOD, AND QUALITY OF LIFE

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Introduction: Effects of circadian typology (CT) on various psychological and physiological conditions have been controversial. We aimed to investigate the association between CT and sleep, mood, and quality of life (QOL) after controlling for possible confounding factors, and to assess how the effect of CT differs depending on the variables in employees of a university hospital.
Methods: The present study included a total of 1807 participants, who consisted of nurses, technicians, other paramedics, and office workers. The response rate was 80.2%. Data on demographic variables, lifestyle, engaging shift work, sleep quality, sleepiness, fatigue, mood, quality of life, morningness-eveningness and resilience were obtained and compared according to the circadian typology. Stepwise regression analyses were performed to assess the role of contributing variables including morningness-eveningness on sleep quality, sleepiness, fatigue, mood and QOL.
Results: The mean age of the participants was 29.8 years, 86.3% of them were female and 53.0% were shift workers. With respect to CT, 7.6% the participants reported themselves as morning-types, 61.1% reported themselves as neither-types, and 31.3% replied that they were evening-types. Subjects with evening-type showed greater disturbances in sleep quality, sleepiness, fatigue, mood, and QOL than neither-types and morning-types. In the regression analysis, CT explained a much less portion of the total variance for fatigue, depression, and QOL than resilience did. Resilience was found to be a powerful predictor of all the variables measured.
Conclusion: We found a differential effect of CT on sleep quality, daytime sleepiness, fatigue, mood, and QOL. Sleep directly reflects an individual's intrinsic circadian rhythm, but other physical and psychological functions interact with CT in a more complex way. Given the robust association of resilience with fatigue, mood, and QOL, resilience-promoting programs can be considered helpful in overcoming the undesirable effect of CT.
Support (If Any): None.

0701

CIRCADIAN TAU DIFFERENCES IN BIOLOGICAL, BEHAVIOURAL AND SLEEPINESS RHYTHMS IN DELAYED SLEEP-WAKE PHASE DISORDER AND NON-24-HOUR SLEEP-WAKE RHYTHM DISORDER PATIENTS

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Introduction: In this study we investigated biological, sleepiness and behavioural rhythm period lengths (i.e., *taus*) of Delayed

Sleep-Wake Phase Disorder (DSWPD), Non-24-Hour Sleep-Wake Rhythm Disorder (N24SWD) patients and healthy control sleepers. We also ran cross-correlation analyses between different rhythm variables to examine phase angle of entrainment. The aim was to explore if behavioural rhythms, in addition to the biological circadian rhythms contribute to misalignments of sleep timing symptomatic of DSWPD and N24SWD.

Methods: Twenty-six DSWPD participants who met diagnostic criteria (17m, 9f, age: 21.85±4.97 years) and 18 controls (10m, 8f, age: 23.72±5.10 years) participated in an 80-hour modified constant routine. Additionally, 4 full-sighted patients (3m, 1f, age: 25.75±4.99 years) were diagnosed with N24SWD and included as a discrete study group. A forced-desynchrony ultradian protocol of 1-hour 'days' in dim light, controlled conditions alternated 20-minute sleep opportunities with 40-minute enforced wakefulness. Subjective sleepiness ratings were recorded prior to every sleep opportunity and median reaction time (vigilance) was measured hourly. Amount of sleep obtained (sleep propensity) was derived from 20-minute sleep opportunities to quantify hourly objective sleepiness. Hourly core body temperature was recorded and salivary melatonin assayed to measure endogenous circadian rhythms. Rhythm data were curved using the 2-component cosine model.

Results: DSWPD and N24SWD patients had significantly longer melatonin and temperature *taus* compared to controls. There were no significant *tau* differences between groups as measured by subjective sleepiness, sleep propensity and vigilance rhythms. However, DSWPD patients showed a greater interval between maximum sleep propensity and minimum core body temperature. Their sleep propensity rhythms lagged core temperature rhythms by an hour more compared to controls' sleep propensity and core temperature rhythms.

Conclusion: The findings provide further evidence that delayed circadian rhythms in DSWPD may result from larger phase angles between core body temperature and sleep propensity. This interval may result in later sleep timing in DSWPD patients relative to their circadian timing thus masking their light exposure during a time that is critical to phase-advancing the circadian system.

Support (If Any): This project was funded by the Australian Research Council.

0702

FUNCTIONAL NEUROIMAGING INSIGHTS INTO THE EFFECT OF SHIFT WORK ON SLEEP, EMOTION AND ATTENTION

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Introduction: Shift work is known to disrupt workers' normal circadian rhythms and social life, and to be associated with increased health problems. In contrast to the considerable literature regarding attention in shift work, evidence for the impact of shift work on brain functional imaging is limited. The aim of this study was to compare sleep quality and quantity, which was measured by actigraphy, between shift workers (SW) and day workers (SW). Secondly, we performed comparisons of perfusion brain MRI between two groups.

Methods: Ten DW and 10 SW (all female nurses, mean age 35.1 y) were enrolled. Measures of habitual sleep were obtained from two weeks of wrist actigraphy for determination of total sleep time (TST), sleep latency (SL), sleep efficiency (SE), minutes of wakefulness after sleep onset (WASO), and sleep fragmentation. We compared demographics, emotional states (mood and anxiety), insomnia severity, daytime sleepiness and automated battery of psychometric measures between two groups. The perfusional differences of regional brain were measured in the morning in after finishing night shifts in SW and in the afternoon in DW.

Results: SW was associated with higher anxiety (HADS-A score 8.0±3.3 vs. 4.7±2.6, p=0.024) and depressive mood (HADS-D score 9.5±3.2 vs. 5.6±4.5, p=0.039) and reported more severe insomnia (ISI score 13.9±4.7 vs. 4.7±3.5, p<0.001) than day worker. Shift workers' actigraphy showed that total sleep time was different depending on their work schedule, less sleep time during night shift(287.1±148.7 vs. 400.9±105.6, 365.6±100.1,382.0±96.8, p<0.001; day shift, evening shift and DW respectively).There was no significant difference when it comes to SE, SL and WASO between SW and DW. SW showed increased mean transit time at right inferior frontal gyrus, left cerebellum, left parahippocampal gyrus, right insula and left superior occipital gyrus compared to SW. neurocognitive performance showed no significant difference between two groups

Conclusion: The findings may reflect the disruption of the SW's sleep-wake cycles resulting in anxiety and depressive mood. Perfusion MRI finding suggests the early functional changes in the brains of SW.

Support (If Any):

0703

LOW DOSE OF ARIPIPRAZOLE REDUCED NOCTURNAL SLEEP TIME IN THE PATIENTS WITH DELAYED SLEEP PHASE DISORDER AND DEPRESSIVE SYMPTOMS.

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Introduction: Delayed sleep phase disorder (DSPD) typically begins in the second decade of life or earlier. DSPD comprises a persistent or recurrent pattern of sleep disturbances, sleep disruption that leads to insomnia and/or excessive daytime sleepiness, and impaired functioning in social, occupational, or other spheres. Three techniques are typically used to treat DSPD: chronotherapy, phototherapy, and exogenous melatonin administration.Although, antipsychotics have not been reported in the treatment of DSPD, such as, aripiprazole (APZ), a partial agonist of D2 receptors. Depression is reported to be the most common psychopathology associated with DSPS, and APZ is reported to be effective in major depressive disorder as adjunctive therapy. Therefore, we have speculated that APZ was effective to treat DSPD.

Methods: 17 subjects (included 6 women) who are 14-48-year-old (the average is 33 +/- 10) were included. As comorbidity, they have depression (n=5), dysthymia (n=2), schizophrenia (n=2), hypersomnolence disorders (n=4) and others (n=2). Majority of subject had depressive symptoms were treated by antidepressants sometimes with ramelteon and/or VB12. These patients were prescribed 0.75–4.5 mg of APZ at evening. The protocol of this study was approved by Akita university ethics committee.

Results: Before APZ treatment started, previous medications didn't show enough effects for depressive symptoms, and all subjects showed DSPD symptom. Since we prescribed 1.5 - 3.0 mg/day of APZ, almost all subject reduced total sleep time (11◇7 h, p=0.00108), many cases got

up earlier (9◇6 h, p=0.000677) in the next morning and advanced their sleep phase within one week. The sleep onset also got earlier (24.5◇23 h, p=0.0425). Thereafter, their depressive moods were also improved.
Conclusion: Low dose of APZ would reduce nocturnal sleep time in the subjects who has prolonged sleep time and DSPD symptoms. The mechanism of action would be dopaminergic up regulation due to presynaptic dopamine auto receptor agonistic activity. Since it is difficult for physicians to treat prolonged sleep time and DSPD symptoms, this medication would become a new therapeutic tool for these patients.
Support (If Any): a.

0704

THE CIRCADIAN QUOTIENT OBTAINED FROM WRIST ACTIGRAPHY EXPLAINS SLEEP QUALITY PARAMETERS AMONG PATIENTS WITH STABLE HEART FAILURE

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Introduction: Validated metrics are needed to efficiently evaluate 24 hour activity patterns with wrist actigraphy. We compared the extent to which the circadian quotient and the ratio between daytime and night time activity level were associated with polysomnographic sleep quality parameters in patients with stable heart failure (HF)
Methods: The sample included 132 HF patients [66.7% male, age=60.6(16.3)]. We collected 24 hour activity with wrist actigraphy (Respironics Minimitter Actiwatch 64) over 2–3 days and unattended nocturnal polysomnography in patients' homes for one night. We computed the mesor, amplitude, and acrophase and the circadian quotient (ratio of amplitude to mesor) with cosinor analysis and the ratio of daytime to nighttime activity (activity ratio). Partial correlations with the sleep quality variables were calculated while adjusting for age. The general linear model (GLM) was used to test the effect of circadian quotient on the REM sleep after controlling for the activity ratio, sleep efficiency, age, and comorbidity.
Results: Patients older than 60 years of age (n=69) had significantly lower mesors (p=.01), earlier acrophases (p=.02), and less daytime activity (p<.01) than younger patients (n=63). The circadian quotient had a stronger correlation with the activity ratio in older patients (r=0.76) than younger patients (r=0.43). The circadian quotient and activity ratio had a similar correlation with total sleep time (r=0.32) but the activity ratio had a greater correlation with sleep efficiency (r=0.41) than the circadian quotient (r=0.21). In the GLM, controlling for the covariates, the circadian quotient was positively associated with the percentage of sleep time in REM sleep (beta=7.81±3.40, p=.02), but the activity ratio was not significantly related (beta=-1.78±1.12, p=.13). In patients older than 60 years of age, greater REM percentage was more closely associated with greater circadian quotient (beta=12.24±4.58, p<.01) but not associated with the activity ratio (beta=-2.56±1.56, p=.10).
Conclusion: While the activity ratio is associated with sleep efficiency, the circadian quotient is more closely associated with REM sleep, with stronger associations in older patients. The age related difference may be associated with biological differences in circadian or lower levels of daytime activity among older adults.
Support (If Any): NA.

0705

SLEEP PATTERNS AND CHRONOTYPES IN WOMEN NEWLY DIAGNOSED WITH BREAST CANCER

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Introduction: Sleep disturbance is a common symptom associated with breast cancer treatment. Difficulties in falling asleep and frequent nighttime awakenings are pervasive among patients undergoing chemotherapy. However, data on baseline sleep before cancer treatment begins are sparse; and data regarding circadian rhythms are even less. The chronotype of patients with cancer is largely unknown despite the linkage between circadian aberrations and cancer progression. This study was conceived to begin to address this knowledge gap by describing sleep quality and chronotype in women newly diagnosed with breast cancer who have not started chemotherapy.
Methods: This secondary data analysis included 20 women newly diagnosed with stage I-III breast cancer scheduled to receive chemotherapy (mean age= 53.4±13.8 years, 70% White, 75% stage II). Global sleep quality and chronotype were self-reported using the Pittsburgh Sleep Quality Index (PSQI) and the Horne-Ostberg Morningness-Eveningness Questionnaire (MEQ), respectively. Data were analyzed using descriptive and nonparametric statistics.
Results: A large proportion (71%) of the participants had difficulty sleeping (global PSQI scores >5); more than half (56%) had sleep efficiencies <85% (*M*=80%, *SD*= 17%). Nearly two thirds (60%) of the women slept 7 or less hours at night. Although problems with sleep onset latency (*M*= 18.5, *SD*= 12.1 minutes) were not prominent, frequent nighttime or early morning awakenings (≥3 per week) were reported by 35% of the women. According to the Horne and Ostberg classification, 50% of the women were intermediates (neither morning or evening type), 45% were morning types (MEQ ≥ 59), and 5% were evening types (MEQ ≤ 41). Those who were classified as morning or evening types reported significantly more sleep disturbances than those who were classified as intermediates (p<0.05).
Conclusion: Women with breast cancer appear to have some degree of sleep disturbance prior to chemotherapy. In this study, the majority of patients were intermediates which is somewhat inconsistent with the findings from existing population-based studies showing that the majority of the adult population is morning type. Future studies need to investigate the association between sleep and circadian rhythms in individuals with cancer considering the influence of factors that may affect circadian preference.
Support (If Any):

0706

CONTRIBUTIONS OF INSOMNIA SYMPTOM AND CIRCADIAN RHYTHM OF ACTIVITY PATTERN ON DAYTIME SYMPTOMS AND FUNCTIONAL PERFORMANCE IN STABLE HEART FAILURE PATIENTS

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Introduction: Daytime symptoms and decrements in functional performance have been explained by insomnia symptoms in stable heart failure (HF) patients and some associations were weaker among older adults. The purpose of this study was to examine associations between insomnia symptoms, daytime symptoms, and functional performance and circadian rhythms of activity-rest patterns among patients with stable HF.
Methods: The sample included 132 stable HF patients [66.7% male (*M* (SD) age = 60.6±16.3 years)]. We collected 24 hour activity with wrist actigraphy (ACT) (Respironics Minimitter Actiwatch 64) over 2–3 days. Difficulty initiating and maintaining sleep (DIMS), multi-dimensional assessment of fatigue scale (MAF), depression (CES-D), Epworth sleepiness scale (ESS), six-minute walk (6MW), and physical function (PF, SF-36) were collected in a cross-sectional study. Generalized linear model (GLM) was performed to test the effect of insomnia symptoms and the circadian quotient on daytime symptoms

and functional performance with covariates including age, gender, race, left ventricular ejection faction, NYHA classification, body mass index, respiratory disturbance index, % time at oxygen saturation less than 90%, and comorbidity. The GLMs were repeated in the patients older than 60.

Results: Insomnia symptoms are significantly associated with greater fatigue (p=.02) and depression (p<.01), but not significantly associated with sleepiness and functional performance after controlling for the circadian quotient. In addition to insomnia symptoms, greater circadian quotient is associated with lower fatigue (beta=-2.43 ± 0.99, p=.02), less sleepiness (beta=-4.03 ± 1.76, p=.02), and greater 6MW (beta=445 ± 169, p=.01). In patients older than 60 years of age (N=69), the effect sizes of the circadian quotient were stronger on fatigue (beta=-4.06 ± 1.43, p<.01), sleepiness (beta=-4.58 ± 2.51, p=.07), 6MW (beta=456 ± 244, p=.07), and physical function (beta=2.78 ± 1.06, p=.01) but the statistical significance was overall lower than in the total group due to reduced sample size.

Conclusion: In addition to insomnia symptoms, circadian rhythms of activity-rest contribute to daytime symptoms and functional performance among patients with stable HF. These associations are especially pronounced among older adults.

Support (If Any): NA.

0707

THE EFFECT OF MORNINGNESS EVENINGNESS TYPE OF SHIFT WORKING NURSES ON SLEEP QUALITY, DEPRESSIVE SYMPTOM, AND OCCUPATIONAL STRESS

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Introduction: The purpose of this study is to evaluate the effect of morningness-eveningness type of shift working nurses on the sleep parameters, depressive symptoms and occupational stress.

Methods: Data were collected by self-administrating questionnaires by 257 shift working nurses who work at one university hospital. The questionnaires were composed of baseline demographic data, Korean version of Morningness-Eveningness quesstionnaire, Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale, Beck Depression Inventory and Korean Occupational Stress Scale.

Results: There were significant differences in Subjective Sleep Quality score between eveningness, intermediate, and morningness group. Morningness group showed tendency to have better sleep parameters such as sleep efficiency, PSQI Total score, and daytime sleepiness, but they were not statistically significant. There were no significant differences in Total sleep time, Depressive symptoms, Occupational stress including 8 sub categories between groups.

Conclusion: Eveingness type shift working nurses showed lower Subjective Sleep Quality and tendency to have poor sleep efficiency, higher PSQI Total score, more severe daytime sleepiness than other types. However Morningness-Eveningness did not seem to be a decisive factor for total sleep time, depressive symptoms, and occupational stress of shift working nurses. Short-term medication, workers' chronotypes consideration, nap before night shift work might be helpful to improve mental health and quality of life for shift working nurses, especially Evening type.

Support (If Any): none.

0708

PREDICTORS OF PERCEIVED FATIGUE: A SURVEY OF 1,566 COMMERCIAL AIRLINE PILOTS

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Introduction: Fatigue is a matter of serious concern in airline operations, with long, irregular, and night shifts, time zone crossings, disruption of circadian cycles, and concomitant sleep deprivation as potential contributing factors. Of the few fatigue surveys that have been performed among commercial airline pilots, none has investigated, to our knowledge, the correlates and predictors of perceived fatigue. The present study aimed to identify factors associated with fatigue in commercial airline pilots.

Methods: A total of 1,566 pilots from a commercial airline company filled out a survey including questions on pilots and aircraft characteristics, commuting mode, sleep quality (Pittsburgh Sleep Quality Index, PSQI), fatigue management strategies, and flight duty periods. Pilots also completed the Fatigue Severity Scale (FSS). A multiple linear regression was performed to identify factors associated with increased fatigue levels.

Results: The $R^2_{adjusted}$ for the regression model explains 44% of the variance in fatigue levels ($R^2_{adjusted}$ = 0.44;p<.001). The 7 factors associated with higher fatigue levels were: 1) higher daytime dysfunction (β=.42;p<.001); 2) poorer subjective sleep quality (β=.19;p<.001); 3) greater sleep disturbances (β=.12;p<.001); 4) greater sleep needs (β=.09;p<.001), and; 5) use of sleep medication (β=.05;p<.01) on the PSQI, as well as; 6) less frequent naps the day before a night flight while away from home (β=.07;p<.001) and; 7) sleep having occurred on the flight deck during the last pairing (β=.07;p<.001). Rank, number of hours of duty, number of duty periods, and number of days being on duty between 02:00 and 05:00 home base time were forced in the regression model to control for work conditions but did not significantly contribute to the model.

Conclusion: The relationship between higher fatigue levels and sleep disturbances indicates that interventions targeting sleep improvement could be beneficial for pilots. Future studies should specify how fatigue levels vary with fatigue management strategies, both during layover and on the flight deck.

Support (If Any): This study was supported by a NSERC grant (CUI2I 430856-12) awarded to L.L. and D.B.B.

0709

TASIMELTEON TREATMENT ACHIEVED CLINICALLY IMPORTANT DIFFERENCE IN SLEEP QUALITY IN BLIND INDIVIDUALS WITH NON-24-HOUR SLEEP-WAKE DISORDER

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Introduction: The SET and RESET studies demonstrated the effectiveness of tasimelteon in treating Non-24-Hour Sleep-Wake Disorder (Non-24) by entraining the master body clock, and improving sleep-wake measures and global functioning.

Methods: Patients in the SET and RESET studies completed a daily Post Sleep Questionnaire (PSQ) via an Interactive Voice Response System (IVRS). Sleep quality was rated on a 4-point scale (1: Excellent

to 4: Poor) by asking "how would you describe the overall quality of your sleep last night?" A distributional method was used to estimate the Minimal Clinically Important Difference (MCID).
Results: Sleep quality was statistically significantly better in the tasimelteon treated group as compared to placebo ($p<0.01$). The placebo values do not change from baseline and all the difference is carried by improvements in the tasimelteon arm. When analyzing sleep quality within the worst 25% of nights as determined by total sleep time, the improvement of the tasimelteon treated group is even more statistically significant versus placebo ($p<0.0005$). The results also demonstrate that tasimelteon exceeds the MCID while the placebo group does not.
Conclusion: HETLIOZ® (tasimelteon) addresses both the underlying mechanism of the disease (entrainment) as well as the clinical expression of the disorder. In the SET study, Tasimelteon treated patients experienced clinically meaningful improvements in sleep quality, and a statistically significant improvement compared to the placebo treated group. Moreover, patients withdrawn from tasimelteon treatment in the RESET study experienced statistically significant worsening of their sleep quality than the patients continuing on tasimelteon treatment. The magnitude of the benefit observed in the tasimelteon treated group is clinically meaningful and self-evident to these patients.
Support (If Any): Vanda Pharmaceuticals, Inc.

0710

REPRODUCIBILITY OF CIRCADIAN VARIABLES (MEQ, MSF, DLMO, PHASE ANGLE, AND CIRCADIAN PERIOD) OVER MONTHS

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Introduction: We conducted two studies that were similar for the first 10 days (nature.com/articles/srep08381, nature.com/articles/srep36716), and determined each subject's morningness-eveningness score (MEQ), Mid-sleep on Free Days (MSF) from the MCTQ, baseline dim light melatonin onset (DLMO), phase angle of entrainment, and free-running circadian period. Ten African-Americans (6 women, 4 men) and 8 European-Americans (2 women, 6 men) participated in both studies separated by 9 to 33 months (mean ± SD = 16 ± 7). They were 32.2 ± 6.7 years old at the first study. The purpose of this report is to examine the reproducibility of these circadian variables.
Methods: Subjects slept in the lab on a fixed 8-h sleep schedule similar to their usual sleep schedule for 4 days, followed by a circadian phase assessment with 30 min saliva samples to calculate baseline DLMO. Phase angle was the interval from DLMO to bedtime. There were also 3 days of ultradian LD cycles producing forced desynchrony. Circadian period was determined from phase assessments before and after the days of ultradian LD cycles. For each circadian variable, we made scatter plots with identical x and y axes. Lines of unity showed when the variable was exactly the same in both studies. Lines parallel to and on each side of the line of unit showed how much the variable differed between the studies. We also calculated Pearson correlations for each variable.
Results: The MEQ score differed by less than 10 points between the two studies; MSF by 1 h or less, except for 2 subjects, baseline DLMO by 1 h or less except for 3 subjects, phase angle by 2 h or less, and circadian period by 0.3 h or less except for 2 subjects. All correlations were significant ($p\leq.0001$), MEQ r=.85, MSF r=.78, baseline DLMO r=.81, phase angle r=.80, circadian period r=.78. A longer time between the two studies did not make the variables more different. In this small sample, there were no differences between men and women or between European and African-Americans in the stability of these variables.
Conclusion: Circadian parameters were relatively stable over months.
Support (If Any): NIHR01NR007677.

0711

TASIMELTEON ENTRAINS THE CIRCADIAN CLOCK IN TOTALLY BLIND INDIVIDUALS WITH NON-24 HOUR SLEEP-WAKE DISORDER (NON-24) IMPROVING SLEEP-WAKE MEASURES

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Introduction: HETLIOZ® (tasimelteon) is a dual melatonin receptor agonist exhibiting a unique pharmacodynamic profile with a greater affinity for MT2, believed to regulate circadian oscillation. Two randomized, double-masked, multicenter, phase III trials, SET and RESET, demonstrated tasimelteon's efficacy in treating Non-24 by entraining the previously non-entrained rhythm of the circadian clock and improving sleep-wake measures and global functioning. As entrainment is necessary for improving both sleep and wake, here we present the overall entrainment rates on tasimelteon from both SET and RESET trials, and improvements in sleep-wake measures.
Methods: SET and RESET trials were conducted in blind individuals with sleep-wake complaints and a Non-24 diagnosis. Patients received 20 mg tasimelteon or placebo at a fixed bedtime. Entrainment (l of < 24.1 with a 95% confidence interval including 24.0) was measured during month one of SET and after one month in RESET. Sleep-wake measurements included Nighttime sleep on worst nights (LQ-nTST), Daytime Sleep on worst days of sleep (UQ-dTSD), Nighttime Total Sleep Time (nTST), Daytime total Sleep Duration (dTSD), Sleep Quality (SQ), Number of Daytime Naps (DN), Latency (L), and Wake After Sleep Onset (WASO).
Results: Entrainment rates increased with increasing length of treatment with tasimelteon: 20% (8/40) after one month and 59% (10/17) after seven months. Fourteen patients entrained in the SET tasimelteon treatment arm (8 entrained at Month 1; 6 entrained at Month 7) were compared with 26 non-entrained patients in the SET tasimelteon treatment arm. All sleep-wake parameters amongst patients who entrained improved significantly compared to those who did not entrain.
Conclusion: Robust changes in sleep-wake measurements are observed in entrained patients treated with tasimelteon. Benefit from daily tasimelteon use, may take several weeks or months because of individual differences in circadian rhythms.
Support (If Any): Vanda Pharmaceuticals, Inc.

0712

SUBJECTIVE SLEEPINESS IN SHIFT WORK DISORDER

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Introduction: Excessive sleepiness is a main symptom of shift work disorder (SWD). However, shift worker's perception and clinical evaluation sometimes offer different views of excessive sleepiness. Time course of sleepiness over a 24-hour period according to different work schedules remains understudied. The present study aims at identifying sleepiness specific to shift workers with SWD working under two different work schedules.
Methods: 80 night-shift workers of whom 43 met SWD criteria were recruited. They worked 6 to 10 nights out of 14. Night shifts were

either consecutive (CNS) or fragmented (FNS), for which nights were intervened with free days. Participants without SWD and satisfied with sleep were identified as good sleepers (GS). Four groups were created: CNS-SWD; CNS-GS; FNS-SWD; and FNS-GS. Sleepiness was assessed with three methods: 1) during a clinical interview with a dichotomous question (yes/no); 2) Stanford sleepiness scale (SSS) on 7 points in time (Pre and post day sleep and night sleep as well as before, during, and after night work); 3) Epworth sleepiness scale.

Results: SWD sufferers presented a significant higher total score on the SSS than GS (p= .01). Point-in-time on the SSS revealed specificity for each work schedule: CNS-SWD reported significantly greater sleepiness when they woke up after day sleep (p = .03) while FNS-SWD, compared to FNS-GS, did so during night work (p = .03). There was no significant difference between workers with SWD and GS on the Epworth or the proportion of "yes".

Conclusion: Excessive sleepiness is higher for shift workers with SWD. However, the moment sleepiness is excessive varies according to the work schedule. Indeed, high sleepiness after day sleep appears specific to CNS-SWD. When the work schedule is fragmented, the sleepiness seems more problematic during night work. Results highlight that neither a dichotomous question nor scores on the Epworth sleepiness scale allow the proper identification of excessive sleepiness for shift workers. A thorough evaluation of sleepiness in shift workers is warranted while paying attention to work schedule and the presence or not of SWD.

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0713

SEX AND THE FORBIDDEN ZONE

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Introduction: We examined the forbidden zone for sleep (wake maintenance zone) when subjects were put on a polyphasic sleep schedule, and determined whether there were sex or ancestry/race differences.

Methods: We combined the data from two studies (nature.com/articles/srep08381, nature.com/articles /srep36716) in which subjects lived on a 5-h ultradian light-dark cycle; 2-h nap opportunities alternated with 3-h wake episodes for 3 days. We had actigraphy data during 15 naps for 23 African-Americans (11 women, 12 men) and 26 European-Americans (13 women, 13 men) 29.4 ± 6.8 years (mean ± SD). Subjects lived in a time-free environment, and were not told the duration of their nap or wake episodes. Circadian phase, marked by the dim light melatonin onset (DLMO), was determined before and after the 3 days of napping. Total sleep time in each nap was analyzed according to when it started relative to each individual's average DLMO.

Results: Subjects slept the least when the naps started in the 6-h interval before the usual time for nocturnal sleep, 4 h before until 2 h after the DLMO, and the most when naps started in the 8-h interval corresponding to the usual sleep time, 2 to 10 h after the DLMO (1.4 ± 0.3 vs 1.7 ± 0.2 h/nap, t-test, $p<0.0001$). There was no difference between men and women or between African-Americans and European-Americans in the 6-hour forbidden zone. Women slept more than men during naps that started in the 8-hour interval corresponding to habitual sleep time (1.8 ± 0.1 vs 1.6 ± 0.2 h/nap, t-test, $p <0.05$).

Conclusion: There was a 6-h forbidden zone (when it was more difficult to sleep) right before typical bedtime, despite the fact that subjects had no knowledge of time and had nothing to do while lying in bed during the 2-h dark episodes. This shows that it is difficult to go to sleep earlier than usual, and helps explain why some people, especially night owls and adolescents, have difficulty falling asleep as early as demanded by our early-bird dominated society.

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0714

DELAYED-PHASE, SLEEP INSTABILITY, SLEEP CONCORDANCE AND AWAKENINGS: PRELIMINARY ASSOCIATIONS WITH SOCIAL AND NEUROCOGNITIVE DIFFICULTIES AND PARENTING RISK

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Introduction: Social and neurocognitive problems (unrealistic expectations and hostile biases toward children, cognitive inflexibility, slow processing, and poor problem solving/planning) have been linked to parenting risk including risk for child maltreatment. In laboratory studies examining individuals, sleep problems have been linked to similar cognitive difficulties (e.g., cognitive inflexibility, slow processing). Less work has been conducted in real-world settings or relational contexts. This study examined associations between sleep, cognition and parenting within disadvantaged mothers.

Methods: Participants: 22 low-income mothers of 3–5 year olds.

Sleep Measures: Phase (actigraphy), Chronotype (self-report on the Munich), Bedtime/sleep-onset instability (average night-to-night variability in mother bedtime/sleep-onset), WASO and number of awakenings (7 days), Positive sleep mismatch (% of 15-second epochs where mother awake and child asleep/resting), Negative sleep mismatch (% of 15 second epochs where mother asleep/resting and child awake)

Cognitive Measures: Parent Opinion Questionnaire (rigid/unrealistic expectations of children), Child Vignettes (attributions for aversive child behavior), Wisconsin Card Sort/Alternate Uses Test (cognitive flexibility), Tower of London (planning/problem-solving), Trailmaking Test (EF/planning/processing speed), WAIS-IV Coding/WAIS-III Symbol Search (processing speed)

Parenting Measures Observations of maternal behavioral warmth/flexibility; dyadic synchrony, Child Vignettes (punishment ratings for aversive child behavior)

Results: Delayed-phase was significantly associated with greater hostile attributions, cognitive inflexibility, and slow processing (r's range from .418-.527). Self-reported chronotype mirrored these findings with significant associations with greater hostile attributions and slower processing. Bedtime and sleep-onset instability were significantly associated with unrealistic expectations. Mothers' WASO and awakenings were significantly linked to slower processing. Negative sleep mismatch was significantly associated with poorer planning/problem-solving.Mothers' delayed phase, later chronotype and bedtime instability showed significant associations with less maternal flexibility and lower dyadic synchrony (r's range from .452-.469). Positive sleep mismatch was associated with greater maternal behavioral warmth and flexibility. Mothers' delayed phase, delayed chronotype, WASO, and awakenings were associated with greater punishment ratings.

Conclusion: Findings indicate that maternal sleep is associated with decrements in cognition and parenting. Positive and negative sleep mismatch showed differential associations with maternal cognition and parenting risk. Findings suggest sleep interventions may have utility for reducing parenting risk.

Support (If Any): Penn State CYFC, National Institute of Health and Human Development.

0715

SELECTING FUNCTIONAL DATA ANALYSIS SUMMARY MEASURES OF SLEEP ACTIGRAPHY DATA TO REFLECT CLINICAL MORNINGNESS/EVENINGNESS

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Introduction: Statistical approaches to continuous actigraphic data for periods of 24-hours or more include cosinor analysis (fitting rest-activity data to a cosine curve), and functional data analysis (FDA). We herein contrast the properties of the FDA summary measure reflecting the lowest point of activity (the bathyphase) versus the summary measure reflecting the highest point of activity (the acrophase).
Methods: Actigraphy data were collected on 47 patients, each with 3 to 12 24-hour periods of data. The reduced Morningness-Eveningness Questionnaire (rMEQ) measured whether each patient considered themselves a morning versus an evening person. Actigraphy data were analyzed using FDA to create smoothed 24-h curves of activity. The clock time and activity value of the bathyphase and acrophase were calculated for each patient. Correlation analysis was used to determine whether the bathyphase versus acrophase was a stronger correlate of the rMEQ.
Results: Median bathyphase time was 3:40 AM (SD=3hrs 9 min) while the mean bathyphase activity value was 1.74 (SD=3.16). Median acrophase time was 12:21 AM (SD=7hrs 37 min) with a mean acrophase activity value of 388.8 (SD=211.09). rMEQ score was significantly correlated with age (r= 0.35, p=0.016) and median bathyphase time (r= -0.37, p=0.009). Number of nights of data collection was significantly correlated with the coefficient of variation of the bathyphase activity value (r= 0.44, p=0.002).
Conclusion: Our findings suggest that FDA bathyphase and acrophase do not have a 12 hour periodicity, implying that FDA may produce different results than cosinor analysis. rMEQ score was significantly correlated with the median bathyphase time but did not have significant correlations with the acrophase time. This suggests that the bathyphase calculated from FDA may be a stronger correlate of morningness/eveningness than the FDA acrophase. Future analyses comparing cosinor and FDA indices would be helpful in understanding the strongest correlates of self-reported chronotype.
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0716

OPTIMIZING ULTRADIAN FORCED DESYNCHRONY PROTOCOLS TO ASSESS INTRINSIC CIRCADIAN PERIOD

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Introduction: Previous theoretical work has been used to optimize the extended day forced desynchrony (FD) protocol for reliable estimation of intrinsic circadian period in humans. Recently investigators have introduced ultradian FD protocols that require less time in the lab and are cost effective compared to longer FD protocols. However, a standard ultradian protocol has not yet emerged, and the effects of protocol design on estimated intrinsic periods have not been formally quantified.
Methods: To address this gap, we applied a mathematical model of the human circadian pacemaker to investigate the parameters of the ultradian protocols and their effect on estimated intrinsic period. We simulated ultradian FD protocols with varying periods, light levels, and study lengths. Since the intrinsic period of the model pacemaker was known, deviations between observed and actual periods under different protocol conditions could be quantified precisely.
Results: We found that estimates of intrinsic period under ultradian FD protocols depended on the light level during wake episodes, the scheduled period, and the length of the study. Higher light levels corresponded to larger deviations between observed and actual periods. The rate of convergence of the observed period to the intrinsic period varied for different protocols, suggesting that the optimal study length depended on the scheduled period of the protocol.
Conclusion: Using a mathematical model of the human circadian pacemaker, we quantified the dependence of observed circadian period on different features of ultradian FD protocols. This analysis establishes a theoretical framework that may be used to optimize the design of ultradian FD protocols to address specific research questions requiring accurate assessment of intrinsic circadian periods.
Support (If Any): NSF DMS 1412571 (CDB).

0717

THE ROLE OF LIGHT AND PHASE OF ENTRAINMENT IN SEASONAL AFFECTIVE DISORDER

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Introduction: The phase shift hypothesis suggests that seasonal affective disorder (SAD) is caused by a circadian phase delay in winter. As light is the most robust entrainment cue, light exposure is proposed to be involved in SAD etiology. Blue light may be of particular interest as it is most effective for circadian photoreception. The timing of light exposure is also important for entrainment, as morning light leads to a phase advance, and evening light to a phase delay. Therefore, we hypothesized that evening circadian phase in winter will mediate the relationship between morning and/or evening light exposure and depression symptomatology.
Methods: Individuals (*n*=28; 75% female; aged 18–65) with varying degrees of seasonality were recruited in Pittsburgh during the winter. Participants wore an actigraphy watch with a photodiode for one week. Light was analyzed for blue wavelength ranges (400-500nm; photons/cm^2/sec) across a minimum of four days. Total daily light exposure was averaged across each day. The Composite Scale of Morningness was used as a proxy for circadian phase. The Structured Clinical Interview Guide for the Depression Rating Scale, SAD Version (SIGH-SAD) was used to measure depression symptomatology. Age and gender will be used as covariates.
Results: Circadian preference was significantly associated with higher SIGH-SAD scores (R^2=0.176, β= -0.40, p=0.04), while controlling for age and gender. There was no significant association between light exposure and circadian phase (R^2=0.020, β=0.05, p=0.20), or light exposure and SIGH-SAD scores (R^2=0.059, β=0.23, p=0.32), thus precluding mediation.
Conclusion: The current study replicated previous findings that a delayed circadian phase is associated with greater depressive symptomatology. However, there is currently no evidence to suggest the role of total daily blue light exposure on depressive symptomatology or circadian phase, as estimated by circadian timing preference.
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0718

7 TESLA IMAGING OF MICROSTRUCTURAL BRAINSTEM CHANGES IN REM SLEEP BEHAVIOR DISORDER

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Introduction: REM-sleep-behavior-disorder (RBD) is characterized by the absence of muscle-atonia during REM-sleep, and represents a prodromal clinical manifestation of evolving Parkinsons's disease (PD) and other synucleinopathies. Interestingly, RBD is hypothesized to be related to a dysfunction of brainstem-nuclei (Bn) of the arousal/motor networks based on: (i) lesion/connectivity studies in animals, and a few human studies *in-vivo*; (ii) *ex-vivo* human staging models of PD progression. Yet, a precise identification of the Bn involved in living humans is still missing, thus limiting our understanding of idiopatic-RBD/prodromal PD. We investigated the presence of microstructural brainstem changes in idiopatic-RBD in humans by high-resolution multi-contrast 7 Tesla MRI and our recently developed stereotaxic probabilistic structural atlas of 11 Bn of the arousal/motor networks, which included two subregions of the substantia nigra (SN) and three raphe nuclei.
Methods: At 7 Tesla, on 6 patients with idiopathic-RBD (5m/1f, age 70 ± 1) under IRB-approval, we aquired .75mm-isotropic M2PRAGE and multi-echo GRE images. We computed a T_1-map from the MP2RAGE. Multi-echo GRE images were coregistered to the T_1-map. Regions of interest (ROI) displaying T_1 hyperintensity (T_1>2500ms) within a brainstem mask were automatically detected. To determine the location of these ROIs with respect to the 11 Bn, we precisely coregistered T_1-maps to the Bn atlas space.
Results: In 5 out of 6 RBD patients we detected ROIs with T_1 hyperintensity (i.e. microstructural changes) in the ventro-caudal part of the right SN-subregion 1 (compatible with SN pars-reticulata) and in a paranigral region (rostro-medial to the caudal part of SN-subregion1). These ROIs colocalized to T_2*-weighted hyperintensity and had a volume of .4-1.2mm^3. The other 10 Bn displayed normal appearing gray matter.
Conclusion: These results provide compelling empirical evidence for the hypothesized role of specific Bn nuclei in the pathogenesis of RBD. Interestingly, the observed contrast (hyperintensities in T_1 and T_2*-weighted MRI) in the detected ROIs is compatible with the presence of small lacunar infarcts (i.e. parenchymal spaces filled with CSF/interstitial-fluid) in the nigral and peri-nigral region of RBD patients. This original result differs from recent findings of iron accumulation in the SN pars-compacta of idiopatic-RBD patients.
Support (If Any): NIH-NIBIB: K01-EB019474, P41-RR014075.

0719

TRAUMA ASSOCIATED SLEEP DISORDER: A CASE SERIES OF 21 PATIENTS

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Introduction: Sleep disturbances following traumatic experiences are frequently reported. Trauma associated sleep disorder (TSD) is a proposed parasomnia that develops after an inciting traumatic event with clinical features of trauma related nightmares (TRN) and disruptive nocturnal behaviors (DNB). The purpose of this study is to characterize TSD in a cohort of active duty service members to provide a better understanding of this novel parasomnia.
Methods: A case series of patients evaluated in our sleep center from December 2015 through November 2016 who met criteria for TSD were included in the study. The diagnosis was rendered if the patient developed the following after combat or other traumatic experience: altered dream mentation related to the traumatic event, DNB with symptoms of hyperarousal, and REM sleep without atonia on polysomnography (PSG). Clinical and video PSG data were reviewed for each patient.
Results: The cohort consisted of 16 males and 5 females with ages ranging from 24–49 (mean 37.1). All patients reported TRN and dream enactment behaviors within the last month with 76% having symptoms at least weekly. The inciting traumatic experience for the majority, 81%, was a combat deployment. Typical dream content ranged from escaping rocket attacks to observing burning bodies. Self-reported DNB included vocalizations, symptoms of autonomic hyperarousal, violent limb movements, and running or jumping out of bed. Insomnia and OSA were frequent comorbid sleep diagnoses, rendered in 86% and 52% of TSD patients, respectively. On PSG, 66% of patients had movements in REM sleep ranging from non-purposeful limb movements and facial grimacing to thrashing and protective posturing. Prazosin therapy was initiated in 10 patients, with 4 having significant clinical improvement.
Conclusion: Traumatic experiences incite a variety of sleep disturbances including a novel parasomnia, TSD. The majority of patients in this cohort had movements in REM sleep, a finding not previously reported. Disruptive nocturnal behaviors in a monitored setting may be less pronounced than what patients report in their usual sleeping environment. A diagnosis of TSD should be considered in patients presenting with DNB and TRN following a trauma.
Support (If Any):

0720

ASSOCIATION OF INDIVIDUAL PERIODIC LIMB MOVEMENTS AND NON-SUSTAINED TACHYCARDIA DURING SLEEP: A CASE-CROSSOVER ANALYSIS

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Introduction: Periodic limb movements during sleep (PLMS) and arousals are associated with sympathetic nervous system activation. We hypothesize a temporal relationship of individual PLMS, particularly those with arousal, and non-sustained ventricular tachycardia (NSVT) events.
Methods: A bidirectional case-crossover design (characterized by inherently perfect subject characteristic matching) was used to assess temporal PLMS and NSVT associations in 41 Osteoporotic Fractures in Men Sleep Study participants with in-home polysomnography-identified NSVT events during sleep. Arrhythmias were

annotated blinded to other data. Sleep time was divided into ~30-minute segments. A priori, for each NSVT event (n=96), we selected a preceding 30-second hazard period and three randomly-chosen 30-second control periods from sleep at ~5-minute intervals from the NSVT within the same 30-minute segment and evaluated for PLMS, respiratory events, and arousals. Odds ratios and 95% confidence intervals - OR(95%CI) - were determined by conditional logistic regression; covariates included arousals and respiratory events in the same hazard/control period. Interactions of PLMS and both respiratory event and arousal were examined.

Results: Male participants were 79.8 ± 6.0 years with a PLMS index of 40.6(IQR:21.6,67.1) and apnea-hypopnea index of 17.1(IQR:8.6,26.1). PLMS were not significantly associated with NSVT (OR=1.49, 95%CI 0.70–3.17). PLMS with arousal were associated with NSVT in unadjusted analyses (OR=3.31, 95%CI 1.32–8.30) and after respiratory event adjustment (OR=3.36, 95%CI 1.34–8.46). Arousals were associated with NSVT in unadjusted analyses (OR=2.15, 95%CI 1.22–3.79), but not after PLMS-related arousals were excluded (OR=1.60, 95%CI 0.83–3.07). There were no significant interactions of PLMS and respiratory events or arousals (p=0.69 and p=0.13, respectively). Analysis of one NSVT event per participant yielded similar results.

Conclusion: PLMS with (but not without) arousals are associated with >3-fold higher odds of subsequent NSVT episodes. These findings suggest PLMS-related arousals are physiologically important ventricular arrhythmia triggers. Investigation targeting PLMS with arousals to reduce ventricular arrhythmogenesis is needed.

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0721

TWO TIMES GREATER RISK FOR NEW ONSET MENTAL DISORDERS AMONG PATIENTS WITH PRIMARY RESTLESS LEGS SYNDROME RECEIVING DE NOVO DOPAMINE AGONISTS: A LARGE-SCALE RETROSPECTIVE CLAIMS MATCHED COHORT ANALYSIS

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Introduction: FDA-approved treatments for primary Restless Legs Syndrome (PRLS), a sensorimotor neurological disorder, include a calcium channel l2-δ ligand (gabapentin enacarbil) and dopamine agonists (DAs; pramipexole, ropinirole, and rotigotine). Increased risk for mental disorders among patients receiving DAs for Parkinson's disease is well documented. However, risk among patients with P-RLS, treated at lower indicated DA doses, remains unknown. We compared likelihood for new onset mental disorders between matched cohorts newly diagnosed with PRLS, naïve to DAs, without history of mental disorders, initiating versus not initiating DAs.

Methods: Selected from 6.5-year (7/1/2008–12/31/2014) MarketScan Commercial and Medicare Supplemental claims databases were patients aged ≥18 years with ≥1 RLS claim and ≥2 years of data before and after initial (index) RLS diagnosis. Excluded were patients with ≥1 mental disorder diagnosis or ≥1 pharmacy fill for antidepressants, antipsychotics or DAs in the 2-year pre-index period and patients ever diagnosed with Parkinson's, kidney disease, iron deficiency, or pregnancy. Identified patients were classified into 2 groups: Those receiving (DA+) versus not receiving (DA-) ≥1 DA fill in the 2-year post-index period. Each DA+ patient was matched to a DA- patient on sex, age at index diagnosis, region, employment and illness burden. Parallel follow-up periods were determined for each matched pair. McNemar's test examined group differences in percent of patients receiving mental disorder diagnoses by validated mental disorder severity classifications. If significant (p≤0.05), logistic regression examined odds ratios (OR) and 95% confidence intervals (95%CI).

Results: From 5,419 patients, 1,080 matched pairs were identified. Compared to DA- matched controls, DA+ patients were 2 times more likely (OR 2.0, 95%CI 1.54–2.59, p<0.0001) to receive a mental disorder diagnosis within the follow-up. Specifically, in the post-index period compared to DA- matched controls, DA- patients were 2.2 (OR 2.16, 95%CI 1.34–3.47, p=0.002), 1.8 (OR 1.79, 95%CI 1.31–2.45, p=0.0003), and 1.9 times (OR 1.90, 95%CI 1.30–2.91, p=0.0012) more likely to receive diagnoses for severe, moderately severe and mild mental disorders, respectively.

Conclusion: Compared to DA- matched controls, DA+ patients were at significantly increased risk for developing new-onset mental disorders during parallel follow-up periods.

Support (If Any): Arbor Pharmaceuticals, LLC.

0722

NEURODEGENERATIVE BIOMARKER FREQUENCY IN IDIOPATHIC REM SLEEP BEHAVIOR DISORDER

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Introduction: The majority of patients with idiopathic REM sleep behavior disorder (iRBD) are thought to have prodromal synucleinopathy. 25–60% of iRBD patients have probable neurodegenerative biomarkers such as olfactory, orthostatic blood pressure, cognitive, or motor function impairments. We aimed to describe frequencies of neurodegenerative biomarkers in the Mayo Clinic iRBD prospective registry cohort.

Methods: We included adults diagnosed with iRBD by ICSD-3 criteria, and excluded symptomatic RBD patients (i.e., diagnosis of mild cognitive impairment, dementia with Lewy bodies, Parkinson disease, or multiple system atrophy). We considered clinical neurodegenerative biomarker measures as abnormal when subjects met age-gender defined cut-offs for the brief Smell Identification Test (BSIT) and neurocognitive assessments (Montreal Cognitive Assessment (MOCA), "Kokmen" Short Test of Mental Status (STMS) and King-Devick Test (KDT)), orthostatic systolic blood pressure (SBP) drop >10 mm Hg, or timed up and go (TUG) speed > 7.5 seconds.

Results: 38 iRBD subjects participated. Mean age was 65.4 (range 21 - 84) years, and 12 (31%) were women. Duration of dream enactment was 11+/-16 years. 18 (47%) were receiving antidepressant medications. Mean (range) measure scores were: BSIT 8.8 (4–12); MOCA, 26.2 (20–30); STMS, 34.3 (30–38); KD, 60.2 (39–125.6); SBP drop, 14.64 (1–49); and TUG, 8.5 (5.3–13.8) seconds. The number (%) with abnormal biomarker measures were: BSIT, 6 (16%); MoCA, 6 (16%); STMS, 0%; KD, 12 (32%); SBP drop, 15 (41%); and TUG, 11 (31%). Overall, 31 (82%) had one or more clinical neurodegenerative biomarkers at baseline, and 20 (52%) had two or more biomarkers at

baseline. Antidepressant medication was not associated with abnormality on any of the measures.
Conclusion: 82% of iRBD patients had at least one neurodegenerative biomarker present, suggesting that iRBD is a prodromal synucleinopathy. Further longitudinal analyses of this cohort compared to age-gender matched control subjects is planned.
Support (If Any): Mayo Clinic CCaTS.

0723

OLFACTION AND COLOR DISCRIMINATION DYSFUNCTIONS IN RAPID EYE MOVEMENT SLEEP BEHAVIOR DISORDER: ASSOCIATION WITH MILD COGNITIVE IMPAIRMENT

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Introduction: Rapid eye movement (REM) sleep behavior disorder (RBD) is a parasomnia characterized by undesirable motor activity during REM sleep. RBD patients are at high risk to develop synucleinopathies, such as Parkinson's disease and dementia with Lewy bodies. Moreover, 50% of RBD patients have mild cognitive impairment (MCI). We aimed to compare performance on olfaction and color discrimination tests between RBD patients with MCI (RBD-MCI), RBD patients without MCI (RBD-nMCI) and healthy subjects.
Methods: One hundred and eighty-eight participants, including 59 RBD-MCI patients, 67 RBD-nMCI patients, and 62 healthy subjects underwent a polysomnography, a neuropsychological assessment for MCI diagnosis, and a complete neurological exam. Olfaction and color discrimination were respectively measured by the University of Pennsylvania Smell Identification Test 12 items (UPSIT-12) and Farnsworth-Munsell 100 Hue Color Vision Test (FM-100). One-way analyses of variance with Bonferroni post-hoc tests were performed to assess differences between the three groups.
Results: No significant between-group difference was found for gender. RBD-MCI patients were older than RBD-nMCI patients and were less educated than both controls and RBD-nMCI patients. However, both age and education were not correlated (r&lt 0.30) with UPSIT-12 or FM-100 scores. When comparing the three groups, a difference was found on the UPSIT-12 (p&lt 0.0001) and FM-100 (p&lt 0.005). Post-hoc tests revealed that RBD-MCI patients performed worse than RBD-nMCI patients on both tests. Scores on the UPSIT-12 were poorer for RBD-nMCI patients than controls but were not worse on the FM-100.
Conclusion: Olfaction and color discrimination dysfunctions in RBD are more prominent in patients with concomitant mild cognitive impairment. Our results suggest that the presence of MCI in RBD patients might be associated with a more advanced stage of neurodegeneration, with both altered sensory/perceptual and cognitive neural networks, and a higher risk to develop synucleinopathies.
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0724

EXCESSIVE DAYTIME SLEEPINESS PREDICTS NEURODEGENERATION IN IDIOPATHIC REM SLEEP BEHAVIOR DISORDER

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Introduction: To determine the association of excessive daytime sleepiness (EDS) with the conversion of neurodegenerative diseases in patients with idiopathic REM sleep behavior disorder (iRBD).
Methods: A total of 179 patients with iRBD (79.1% males, mean age = 66.3±9.8 years) were consecutively recruited. Forty-five patients with Epworth Sleepiness Scale score ≥ 14 were defined as having EDS. Demographic, clinical and polysomnographic data were compared between iRBD patients with and without EDS. The risk of developing neurodegenerative diseases was examined using Cox proportional hazards model.
Results: After a mean follow-up of 5.8 years (SD = 4.3 years), 50 patients (27.9%) developed neurodegenerative diseases. There was a significantly higher proportion of conversion in patients with EDS compared with those without EDS (42.2 % vs 23.1%, $P = 0.01$). EDS significantly predicted an increased risk of developing neurodegenerative diseases (adjusted hazard ratios [HR] = 2.56, 95% confidence interval [CI] 1.37–4.77) after adjusting for age, sex, body mass index, current depression, obstructive sleep apnea, and periodic limb movement during sleep. Further analyses demonstrated that EDS only predicted the conversion of Parkinson's disease (PD) (adjusted HR = 3.55, 95% CI 1.59–7.89), but not dementia (adjusted HR = 1.48, 95% CI 0.44–4.97).
Conclusion: EDS is associated with an increased risk of developing neurodegenerative diseases, especially PD, in patients with iRBD. Our findings suggest that EDS is a potential clinical biomarker of α-synucleinopathies in iRBD.
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0725

TIME COURSE FOR PHENOCONVERSION TO A DEFINED NEURODEGENERATIVE DISEASE IN WOMEN WITH IDIOPATHIC REM SLEEP BEHAVIOR DISORDER WITH AND WITHOUT ANTIDEPRESSANT USE

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Introduction: Idiopathic REM sleep behavior disorder (iRBD) is highly associated with neurodegenerative diseases, especially the synucleinopathies, in adults over age 50 years. Several previous studies have examined the strong association between RBD and synucleinopathies in predominantly male patient populations, but relatively

little is known about the clinical course of RBD in women, and the longitudinal influence of antidepressant use on development of a defined neurodegenenerative disease. We aimed to analyze the rate of phenoconversion from iRBD to a defined neurodegenerative disorder, including Parkinson disease, mild cognitive impairment, dementia with Lewy bodies, and multiple system atrophy in women with and without antidepressant use.

Methods: We retrospectively reviewed 77 women with iRBD seen at Mayo Clinic between 1990 and 2016. The Kaplan-Meier method was used to estimate the time of disease-free survival between iRBD symptom onset and phenoconversion to a defined neurodegenerative disease, and to assess associated clinical factors for disease progression.

Results: Phenoconversion to a defined neurodegenerative disease was 22.5% at 5 years, 43.2% at 10 years, 66.6% at 15 years, and 91.5% at 21.7 years. Median follow-up duration after symptom onset was 11.7 years (95%ile range 8–17.7 years), median age of RBD onset was 54.5 years, and median age of neurodegenerative disease development was 64 years. 23% of women had a non-REM overlap parasomnia, and 70.5% were taking antidepressants. Antidepressant users had a median disease-free survival of 16.5 years, compared to 8.9 years for antidepressant non-users (p=0.06).

Conclusion: The risk of phenoconversion to a defined neurodegenerative disorder in women with iRBD is comparably high to previous male predominant cohorts over longitudinal followup from RBD symptom onset, yet appears to be slower than in some prior studies, possibly associated with frequent antidepressant use in our cohort. Further comparative analysis of men with iRBD including both antidepressant users and non-users will be necessary to clarify the impact of gender and antidepressant use on disease-free survival in iRBD.

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0726

MOOD AND SLEEP QUALITY SYMPTOMS ARE NOT LINKED TO MILD COGNITIVE IMPAIRMENT IN RAPID EYE MOVEMENT SLEEP BEHAVIOR DISORDER

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Introduction: Rapid eye movement (REM) sleep behavior disorder (RBD) is a parasomnia characterized by abnormal motor activity during REM sleep. RBD patients are at high risk to develop mild cognitive impairment (MCI) and synucleinopathies, such as Parkinson's disease and dementia with Lewy bodies. We aimed to compare self-reported mood (anxiety, depression) and sleep quality (insomnia and excessive daytime sleepiness) complaints between RBD patients with MCI (RBD-MCI), RBD patients without MCI (RBD-nMCI) and healthy subjects.

Methods: One hundred and fifty-eight participants, including 43 RBD-MCI patients, 52 RBD-nMCI patients, and 97 healthy subjects underwent a polysomnography, a neuropsychological assessment for MCI diagnosis, and a neurological exam. Self-reported questionnaires for mood [Beck Anxiety Inventory (BAI), Beck Depression Inventory II (BDI-II)] and sleep quality [Insomnia Severity Index (ISI), Epworth Sleepiness Scale (ESS)] were also administered. One-way analysis of variance with Bonferroni post-hoc tests were performed to assess differences between the three groups.

Results: No significant between-group difference was found for age, gender, RBD duration, or ESS scores. Between-group differences were found for the BAI ($F(2,171) = 10.34$, $p<0.05$), BDI-II ($F(2,187) = 9.15$, $p<0.05$), and ISI ($F(2,158) = 12.50$, $p<0.05$). Post-hoc analysis revealed that both RBD groups (with or without MCI) reported more anxiety, depressive, and insomnia symptoms compared to healthy subjects ($p<0.05$). However, within RBD, no significant difference on mood and sleep questionnaires was found between those with or without MCI.

Conclusion: Self-reported mood and sleep (insomnia) complaints are frequent in RBD patients, but no association were found with their cognitive status. Further studies are needed to better validate the questionnaires used in the present study in a RBD population, and to determine the predictive value of mood and sleep complaints for the development of synucleinopathies.

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0727

TONIC AND PHASIC CHIN EMG DENSITY IN IDIOPATHIC REM SLEEP BEHAVIOR DISORDER

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Introduction: In 2010, our group published a scoring method for REM sleep phasic and tonic EMG activity in REM sleep behavior disorder (RBD). Cut-off values were reported in a large population of RBD and healthy subjects, but this method was based on 20 sec epochs which limits it current used as a diagnostic tool. The aims of the present study were to confirm results of the previous study in a different RBD cohort using 30 sec epochs, to assess the sensitivity and specificity of cut-off values for tonic and phasic values to diagnose RBD (taken separately or combined), to correlate tonic and phasic values with clinical markers of neurodegeneration, and to look at changes of REM sleep EMG abnormalities over times.

Methods: Fifty-nine patients with a clinical diagnosis of idiopathic RBD and 50 age- and gender-matched healthy subjects were studied in our sleep laboratory. Tonic and phasic EMG activity were recorded and scored according to our method described previously using 30 sec epochs. Receiver operating curves were drawn to find optimal cut-off values for REM sleep EMG parameters. Clinical markers of neurodegeneration were also studied and a subgroup of patients was recorded again after 12 months.

Results: Total correct classification of 89% was found for tonic *or* phasic chin EMG density ≥15%. This correct classification score increased to 97% when both criteria were applied. A significant positive correlation ($r=0.321$) was found between tonic EMG and UPDRSIII. Recordings performed after 12 months showed a significant increase of 20% of tonic EMG density.

Conclusion: This study confirms the value of a scoring method based on chin EMG and establishes cut-off values to be used for the diagnosis of RBD. Results further document the status of tonic and not phasic REM density as a marker of ongoing neurodegeneration and disease progression.

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0728

CHARACTERIZATION OF PATIENTS WITH LONG-TERM IDIOPATHIC REM SLEEP BEHAVIOR DISORDER

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Introduction: Longitudinal studies have shown that the majority of patients with idiopathic rapid-eye-movement sleep behaviour disorder are eventually diagnosed with a neurodegenerative disease, typically Parkinson disease. However, a small group of patients remain free of overt disease after a long period of follow-up. These individuals may not be at risk of neurodegeneration.

Methods: We examined the presence of risk factors and markers of Parkinson disease in patients with polysomnographic-confirmed idiopathic rapid-eye-movement sleep behaviour disorder that remained disease-free after more than ten years of follow-up. Clinical variables were compared with 32 age and sex matched controls.

Results: We identified 20 patients (16 men and four women) with a mean age of 72.9 ± 8.6 (range, 49 to 86) years and a mean follow-up interval of 12.1 ± 2.6 (range, 10.2 to 18.2) years from diagnosis. There were no differences between patients and controls in risk factors such as family history of Parkinson disease, smoking habit, caffeine use, head injury, pesticide exposure and farming. Patients had more often objective smell loss (35% vs. 3.4%, p=0.003), constipation (50% vs. 15.6%, p=0.008), and mild parkinsonian signs (45% vs. 18.8%, p=0.042) than controls. Unified Parkinson's Disease Rating Scale motor score was higher in patients than in controls (5.6 ± 3.5 vs. 2.0 ± 2.1, p<0.0001). The frequency of depression, urinary problems, male impotence and abnormal neuropsychological tests was similar between patients and controls. Dopamine transporter single-photon emission computed tomography showed decreased striatal dopamine uptake in 82.4% of the patients and transcranial sonography found substantia nigra hyperechogenicity in 35.3%. Alpha-synuclein aggregates were found in three of six subjects who underwent colon or submandibular gland biopsies. All 20 patients showed one or more clinical, neuroimaging or histological markers of Parkinson disease.

Conclusion: These observations indicate that prodromal Parkinson disease markers are common among idiopathic rapid-eye-movement sleep behaviour disorder patients with long-term follow-up. Our findings and previous available data challenge the concept that an idiopathic form of rapid-eye-movement sleep behaviour disorder exists.

Support (If Any):

0729

EFFECTS OF CHRONIC CLONAZEPAM ADMINISTRATION ON REM SLEEP INSTABILITY IN RAPID EYE MOVEMENT SLEEP BEHAVIOR DISORDER

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Introduction: Clonazepam is the first-line treatment for idiopathic REM sleep behavior disorder (RBD); however, the way it modifies the clinical manifestations is unknown. The aim of this study was to analyze the differences in quantitative REM EEG features between normal controls and drug-naïve idiopathic RBD patients and idiopathic RBD patients under a long-lasting regular therapy with clonazepam.

Methods: Twenty-nine drug-naïve idiopathic RBD patients (mean age 68.2 years, 6.46 S.D.), 14 idiopathic RBD patients under chronic clonazepam therapy (mean age 66.3 years, 4.88 S.D.) and 21 normal controls (mean age 66.8 years, 7.24 S.D.) were recruited. Polysomnographic recordings were scored for sleep staging and for the evaluation of other motor activities including the computation of the REM sleep Atonia Index. Power spectra were obtained from all segments of sleep EEG (central derivation), by using a 2-second long sliding window, with 1-second steps. Finally, the power values of each EEG band of individual REM sleep spectra (one every second) were normalized with respect to the average power value obtained during sleep stage 2 in the same individual.

Results: In drug-naïve patients, the normalized power values showed, in comparison with controls, a less pronounced REM-related decrease of power in all bands with frequency <15 Hz and an increase in the beta band that appeared to be negatively correlated with the concomitant muscle atonia; in patients treated with clonazepam there was only a partial return of the values of all bands <15 Hz towards the control values. This was not observed for the beta band. The standard deviation values of the normalized power, indicating their degree of variability, were higher for untreated patients in all EEG bands and were almost completely normalized in patients treated with clonazepam.

Conclusion: The REM sleep EEG structure changes found in this study disclose subtle but significant alterations in the cortical electrophysiology of RBD that might represent the early expression of the supposed neurodegenerative processes already taking place at this stage of the disease and might be the target of better and effective future therapeutic strategies for this condition.

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0730

EFFECT OF EVERYDAY ANXIETY AND PSYCHOLOGICAL WELL-BEING ON THE RECALL OF DISTURBED DREAMING

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Introduction: The present study tested a prediction from Levin and Nielsen's (2007) neurocognitive model of disturbed dreaming stipulating that variations in the frequency of bad dreams and nightmares are partly determined by day-to-day variations in emotional stress. The model also suggests that relations between dreams and stress may vary as a function of personality traits.

Methods: 224 adults (186F, 38M, mean age=31.8 yrs; range = 17–74) completed several measures of psychological well-being, including of depression (Beck Depression Inventory-II), general psychopathology (Symptom Checklist-90-R), and nightmare distress (Nightmare Distress Questionnaire). Participants subsequently kept a daily dream log from one to four weeks in which they were required to report all dreams recalled, including their emotional tone and intensity, and noted whether the recalled dream was a bad dream or nightmare (ie, disturbed dreaming). Participants also completed a nightly pre-sleep anxiety scale.

Results: A large majority of participants (83.0%) completed the log for 4 consecutive weeks. Almost half the mornings (45.3%) where accompanied by dream recall and most participants (75.9%) reported at least one disturbing dream in their logs. General equation estimation analyses using a negative binomial distribution were

performed with levels of pre-sleep anxiety, depression, general psychopathology, nightmare distress, age and gender as predictors of disturbed dreaming. The model revealed that higher pre-sleep levels of anxiety predicted a greater probability of recalling a disturbing dream the following morning (B=0.08, t=2.03 p=0.042). Age (B=0.46, t=13.34, p<0.001), nightmare distress (B=0.22, t=5.07, p<0.001) and general psychopathology (B=0.11, t=2.25, p=0.024) also contributed positively to this model, whereas depression and gender did not (ps>0.05).

Conclusion: In line with neurocognitive model put forth by Levin and Nielsen (2007), these results show that everyday levels of perceived stress predict recall of disturbed dreaming beyond the effects attributable to nightmare-related distress, general psychopathology and age. Additional work, however, is required to delineate the role of trait versus state variables play in the frequency and intensity of disturbed dreaming.

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0731

THE RELATIONSHIP BETWEEN VIDEO GAME USE, GAME GENRE, AND LUCID/CONTROL DREAMING

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Introduction: Lucid dreaming has been shown to reduce nightmares and symptoms of PTSD, anxiety, and depression; however, only 20% of adults report regular lucid dreaming and lucidity training techniques are not always successful. Improving induction techniques should enhance lucid dreaming's therapeutic usefulness. Video game play, with a high level of immersion in fictional settings, similar to dreaming, has been associated with greater lucid/control dreaming frequency. To extend past research, we investigated whether time spent gaming, video game engagement, and particular video game genres were related to more lucid/control dreaming.

Methods: 297 students (M=20 years old, SD=1.38) were recruited through campus advertisements and given a chance to win $25 gift cards. Participants read definitions of lucid and control dreaming, completed a demographic questionnaire and the Game Engagement Survey (assessing level of immersion during video game play), and indicated frequency of dream recall, lucid and control dreaming, integration of video game content into dreams, and time spent playing different genres of games.

Results: More time gaming and higher game engagement were not significantly associated with frequency of lucid or control dreaming. However, more time gaming and higher game engagement were significantly associated with more frequent integration of video game content into remembered dreams (time: r(295)=.498, p<.05; engagement (r(129)=.214, p<.05). And more integration of video game content into remembered dreams was significantly associated with increased frequency of both lucid (r(295)=.134, p<.05) and control (r(295)=.183, p<.05) dreaming. More time playing physically interactive games (e.g. Wii Fitness) was significantly associated with more frequent lucid (r(85)=.275, p<.05) and control (r(85)=.307, p<.05) dreaming for gamers (play≥1 day/week) that report remembering their dreams (≥1/week). These relationships persisted in larger participant groups (all participants, gamers, participants with regular dream recall). No other game types showed similarly consistent relationships.

Conclusion: We found more time spent playing physically interactive games was related to more frequent lucid and control dreaming. Future experimental research should examine whether increasing this type of game play could causally enhance lucid dreaming. Specific gaming could provide an easy and inexpensive method of enhancing induction of this potential therapeutic technique.

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0732

NIGHTMARE DISTRESS IS NEGATIVELY CORRELATED WITH REGIONAL CEREBRAL BLOOD FLOW IN FRONTAL AREAS DURING AN IAPS PICTURE-VIEWING TASK

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Introduction: Research has shown that nightmare-related distress (NMD) may better explain the association between nightmares (NM) and psychopathology than NM frequency, but its neurophysiological correlates remain unknown. As part of a brain imaging project exploring the neural correlates of NM in frequent NM sufferers, we investigated if NMD is related to activity in regions hypothesized to be involved in NM production (Nielsen & Levin, 2007). We predicted NMD would correlate with reduced activity (i.e. regional cerebral blood flow) in bilateral prefrontal areas known to down-regulate fear processes governed by the amygdala, i.e., anterior cingulate and medial prefrontal cortices. We also expected NMD to be correlated with reduced activity in the hippocampus and increased activity in the amygdala.

Methods: We used high resolution ^{99m}-Tc-ECD SPECT imaging to assess regional cerebral blood flow (rCBF) in 21 frequent NM sufferers (NM: 24.9±4.5 yrs (18W)) during the viewing of negative pictures from the *International Affective Picture System (IAPS).* We correlated Nightmare Distress Questionnaire (NMDQ) scores with rCBF using a significance threshold of $p < .005$ (uncorrected) and a cluster threshold of $k > 100$.

Results: Significant negative correlations were observed between NMDQ scores and rCBF in bilateral insula (t = 4.1 and 4.37), bilateral anterior cingulate cortex (t = 4.49 and 5.42), left precentral gyrus (t = 3.54), left medial prefrontal cortex (t = 4.63), and bilateral putamen (t = 4.55 and 4.37). No correlations were observed with the amygdala or hippocampus and no positive correlations were found.

Conclusion: Findings partially support our hypothesis. Reduced rCBF in these prefrontal regions involved in affect regulation could reflect a cross-state emotion regulation deficit, which also leads to more distress during dreaming. Our results also reveal reduced activity in regions for which a regulatory role in affective response during dreaming is unclear (insula, putamen), but for which research has demonstrated anatomical and/or functional alterations in PTSD.

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0733

NIGHTMARES AND SLEEP DISORDERS, PROFESSIONAL PERCEPTIONS AND EXPERIENCES

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Introduction: Sleep disorders are prevalent in the general population; however, these conditions are frequently missed and poorly understood by medical practitioners. Additionally, trauma-related nightmares are under assessed by the medical community, especially when considering the high rates of nightmares among trauma exposed populations. Therefore, the present study investigated medical professionals' knowledge of, experience with, and treatment considerations for, sleep disorders, specifically nightmares.
Methods: Eighty-eight medical professionals completed a survey eliciting information in three domains: (a) definitions of nightmares, (b) experience with nightmares, and (c) treatment attitudes for sleep disorders.
Results: Regarding nightmare comprehension, a majority (78%) of the sample incorrectly defined a nightmare. Additionally, 82% of the sample considered sleep problems as a secondary condition caused by another issue. In regards to professional experience with nightmares, 23% of participants worked with patients reporting idiopathic nightmares, and 46% worked with patients reporting trauma-related nightmares. Regarding treatment options, the following percentage of participants would consider psychological treatments as first choice for these conditions: weekly night terrors (51%), weekly/monthly nightmares (50%, 40%, respectively), and monthly night terrors (34%). Furthermore, 59% of participants would consider medication and/or psychological treatments equally for insomnia. Medication or medical devices were first choice for treating sleep paralysis, and difficulties staying/falling asleep.
Conclusion: Overall, a majority of medical professionals in this sample were unable to accurately define a nightmare and had relatively few professional experiences with nightmares. Furthermore, contrary to past research, results also showed psychological treatment would be considered for several sleep disorders, including nightmares. Maybe lack of referrals and assessment are due to lack of knowledge of and experience with, sleep disorders, specifically nightmares? If this is true, then these result are promising, because the may infer a focus on improving sleep disorder literacy may consequentially increase treatment referrals to evidence-based care.
Support (If Any): N/A.

0734

AN INITIAL REPORT ON NIGHTMARES IN ACTIVE DUTY SERVICE MEMBERS WITH SLEEP DISTURBANCES

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Introduction: Sleep disturbances are a common symptom among military personnel. To date, most studies in the active duty population have focused on insomnia and sleep disordered breathing, with a paucity of data on the frequency of nightmares in active duty service members. Previous studies have noted an increased prevalence of nightmares in war veterans compared to the general population. The purpose of this study is to describe the frequency of nightmares in active duty service members (ADSM) referred for sleep evaluation.
Methods: Intake questionnaires were reviewed from 500 consecutive ADSM undergoing evaluation and polysomnogram (PSG) at our sleep center in 2016. Scale scores and item-level data from the Pittsburgh Sleep Quality Index (PSQI) and the PSQI-Addendum (PSQI-A) were used to compare sleep across other underlying factors included on the intake questionnaire to include reported health conditions, medications, sleep hours, history of deployment, Epworth Sleepiness Scale, and Insomnia Severity Index (ISI) scores as well as PSG data.
Results: Approximately 30% of service members seeking sleep evaluation reported having bad dreams at least once a week on the PSQI. In those reporting greater than weekly bad dreams, nearly 50% had frequent nightmares of traumatic experiences on the PSQI-A, 30% reported episodes of terror or screaming during sleep, and 35% had episodes of acting out their dreams (P=0.001). Service members with frequent bad dreams were found to have an increased ISI (mean 20) compared to those without (mean ISI 14, P=0.001).
Conclusion: Bad dreams and nightmares are frequently reported symptoms in ADSM with sleep disturbances when specifically queried. This is likely due to their traumatic experiences from combat. Nightmares should be specifically addressed in ADSM with sleep disturbances, noting they are associated with clinically significant insomnia. Nightmares are likely under-recognized in military personnel and treating this significant sleep disorder can improve the overall sleep and health of this critical population.
Support (If Any):

0735

REPORTS OF ADVERSE CHILDHOOD EXPERIENCES AND PARASOMNIA RELATED EVENTS AND BEHAVIORS IN INVOLUNTARILY UNEMPLOYED ADULTS

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Introduction: Adverse childhood experiences (ACEs) are associated with poor health outcomes and sleep quality in adulthood. Most studies on ACEs and sleep have focused on insomnia, and fewer studies have looked at parasomnias. In this study, we will explore whether a history of cumulative exposure to ACEs is associated with parasomnia related events and behaviors in involuntarily unemployed adults.
Methods: Recently involuntarily unemployed adults (N=39) ages 25–60 completed the ACE survey, and the Checklist of Unusual Events and Behaviors Occurring During Sleep. Logistic regression was used to test whether ACE score was associated with an increased the likelihood of endorsing having ever experienced a parasomnia related event or behavior. Linear regression was used to test whether endorsement of more ACEs predicted more parasomnia related events and behaviors.
Results: ACEs significantly predicted self-reported recurrent disturbing dreams ($\chi^2(1) = 8.524$, $p < .05$) and night terrors ($\chi^2(1) = 6.031$, $p < .05$), but not Bruxism. Linear regression analysis showed ACEs significantly predicted total number of parasomnia symptoms endorsed (B=.187, SE=.074, p<.05).
Conclusion: In involuntarily unemployed adults, ACEs are associated with self-reported disturbing dreams, night terrors, and total number of endorse parasomnia related events. Results highlight the necessity of additional research on the relationship between ACEs and parasomnias. Future research should test whether individuals with ACEs have more parasomnic events as documented on polysomonography, as compared to individuals without ACEs.
Support (If Any): #1R01HL117995-01A1.

0736

POLYSOMNOGRAHIC FINDINGS IN FIVE PATIENTS WITH EXPLODING HEAD SYNDROME

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Introduction: Exploding Head Syndrome (EHS) attacks are characterized by perception of sudden loud banging noises, occasionally accompanied by the sensation of a flash of light. Although these attacks themselves are usually not painful, it is reported that EHS attacks may precede migraine as auras. EHS is classified as a type of parasomnia in the International Classification of Sleep Disorders (ICSD) 3rd edition and its pathophysiology is still unclear. We describe the polysomnography (PSG) characteristics of EHS patients with special emphasis on respiratory events that were followed by EHS attacks.
Methods: The subjects were consecutive 20,926 patients who presented sleep and/or wake problems at our sleep center between April 1998 and March 2013. The diagnosis of EHS was based on ICSD-3 criteria. During PSG, we instructed them to ring a bell when they noticed an attack (heard a sound).
Results: We found 5 cases (0.17%) with EHS. The mean age (2 men and 3 women) was 64.8 ± 16.4 years. Three of them had otorhinolaryngologic diseases (sudden hearing loss, deflected nasal septum and sinusitis). All five subjects rang the bell for their attacks during PSG. The events occurred during stage N1 and N2. In 2 cases, respiratory events preceded the attacks. In 1 case, respiratory effort related arousal was followed by the attack. In the other 2 cases snoring preceded the attacks. One subject noticed the attack during stage W.
Conclusion: Various respiratory events were related to the EHS attacks. A variety of ear dysfunctions or brainstem neural dysfunction during the transition from wakefulness to sleep has been reported as the pathophysiology of EHS. Our PSG findings suggest that checking otolaryngological status on subjects and respiratory events during sleep may be helpful in understanding its pathophysiology and in choosing therapeutic strategies.
Support (If Any): None.

0737

SLEEP-RELATED RHYTHMIC MOVEMENT DISORDER AND SLEEP APNEA IN FIVE ADULT PATIENTS

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Introduction: Sleep-related rhythmic movements (SRRMs) are typical in infancy and childhood, where they usually occur at the wake-sleep transition. However, they have rarely been observed in adults, where they can be idiopathic or associated with other sleep disorders.
Methods: We report a video case series of 5 adults with sleep-related rhythmic movement disorder (SRRMD), 4 of which had a previous history of SRRMs in childhood. All of them underwent a full-night Video-PSG.
Results: A total of 411 RMEs were recorded in our 5 subjects, 78% of them occurred during consolidated sleep, of these, 18% in REM sleep. In the great majority of the cases (81.4%), RMEs were preceded by pathological breathing events. In at least 2 cases, the duration of breathing events associated with RMEs was longer than the one of those unassociated. RMEs retreated after CPAP ventilation in one subject. Four out of five subjects reported a previous history of SRRMD during childhood.
Conclusion: We speculate that respiratory-related arousals could drive the occurrence of motor events in predisposed subjects. We strongly recommend to investigate the sleep-related breathing pattern by means of a full video-polysomnography in adults with SRRMD, particularly in those with a new-onset disorder or a recent aggravation, as well as in those whose RMEs tend to occur in consolidated sleep. This may speak against an unsafe treatment with benzodiazepines, which can aggravate sleep apnea. When sleep apnea is confirmed, treatment with CPAP might be beneficial also for RMEs.
Support (If Any): The SAS-CARE study was supported by grants from the Swiss National Science Foundation (SNF Grant 320030_125069) and SwissHeart.

0738

EFFECTS OF SLEEP DEPRIVATION ON BRAIN PERFUSION PATTERNS IN SLEEPWALKERS' WAKEFULNESS AND SLOW WAVE SLEEP

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Introduction: Several EEG-based studies have documented anomalies in the slow wave sleep (SWS) of adult sleepwalkers. Moreover, previous imaging studies have identified specific brain perfusion patterns in sleepwalkers during post sleep deprivation wakefulness as well as during a somnambulistic episode. However, neuroimaging has yet to be used to investigate sleepwalkers' SWS. The present study measured regional cerebral blood flow (rCBF) with single photon emission computed tomography (SPECT) during sleepwalkers' post sleep deprivation SWS and resting-state wakefulness.
Methods: Following 24 hr period of sleep deprivation, 10 sleepwalkers (7F, 3M; mean age: 28.2 ± 6.9 years) and 10 sex and age-matched controls were injected with a unidose of 99mTc-ECD after 2 minutes of stable SWS within their first sleep cycle as well as during resting-state wakefulness. Participants were scanned after each injection with a high-resolution SPECT. Between group differences in rCBF were assessed using two-sample t-tests separately for SWS and wakefulness. Significance was set at $p<0.005$ at the voxel level uncorrected for multiple comparisons combined with >100 contiguous voxels by cluster.
Results: When compared to controls' rCBF observed during SWS and resting-state wakefulness, sleepwalkers showed significant decreases in several bilateral frontal regions, including the superior frontal, middle frontal and medial frontal gyri. Most of these regions are included in the dorsolateral prefrontal cortex (DLPFC). During SWS, decreased rCBF was also found in sleepwalkers' left postcentral gyrus, insula and superior temporal gyrus. During waking resting-state, decreased rCBF was also found in parietal and temporal regions of sleepwalkers' left hemisphere.
Conclusion: This study was the first to use neuroimaging to investigate sleepwalkers' SWS. Decreased rCBF was found in sleepwalkers' DLPFC and insula, two regions involved in consciousness and in the generation of slow wave activity. The data also reveal altered rCBF

patterns during sleepwalkers' resting-state wakefulness. These findings suggest that prefrontal and insular regions may be implicated in the pathophysiology of sleepwalking.
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0739

GRAY MATTER ABNORMALITIES IN SLEEP WALKING

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Introduction: Non-rapid eye movement (NREM) parasomnias are characterized by recurrent complex behaviors that occures during arousals from slow-wave sleep with an altered state of consciousness. The pathophysiology of NREM parasomnias are not fully understood. This study aimed to determine whether voxel-based analysis of T1 weighted MRI and diffusion tensor imaging can detect alterations of gray and white matter morphometry as well as measures of mean diffusivity and fractional anisotropy in patients with non-rapid eye movement parasomnia.
Methods: Fourteen patients (age: 29±4.2; disease duration 19.2±7.7) with current NREM parasomnias, were recruited consecutively from referrals or follow-up visits at the Sleep Disorders Clinic at the Department of Neurology at the Medical University of Innsbruck, Austria. Diagnosis was confirmed polysomnographically. All patients underwent 3 Tesla MRI and were compared to 14 healthy subjects, matched for age and gender. Statistical parametric mapping was applied to objectively identify focal changes of MRI parameters throughout the entire brain volume.
Results: Statistical parametric mapping localized significant decreases of gray matter volume in the left dorsal posterior cingulate cortex (Brodmann area 23) and posterior midcingulate cortex (Brodmann area 24) in patients with non rapid eye movement parasomnias compared to the control group ($p<0.001$, corrected for multiple comparisons). No significant differences of mean diffusivity and fractional anisotropy measures were found between the non-rapid eye movement parasomnia group and the healthy control group.
Conclusion: In the present study we identified significant gray matter volume loss of the left dorsal posterior cingulate cortex (BA 23) and posterior midcingulate cortex (BA 24) in patients with NREM parasomnias. Recently, the simultaneous co-existence of arousal or wakefulness originating from the motor and cingulate cortices and persistent sleep in associative cortical regions was suggested as a functional framework of sleepwalking. Gray matter volume decline in the dorsal posterior and posterior midcingulate cortex reported in this study might represent the neuroanatomical substrate for this condition.
Support (If Any): no support.

0740

DISORDERS OF AROUSAL: EVALUATION OF NEUROCOGNITIVE FUNCTION IN 69 CONSECUTIVE PATIENTS

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Introduction: Disorders of Arousal (DOA) are a specific subgroup of NREM parasomnia that includes confusional arousals, sleepwalking and sleep terrors, resulting from incomplete arousals from deep sleep. Excessive daytime sleepiness is a recent matter of concern in DOA. High percentage of DOA patients feel abnormally sleepy during the daytime. However, the effects of DOA on neurocognitive function have not been extensively explored. The aim of this study was to analyze neurocognitive functions of DOA patients in comparison to healthy controls.
Methods: 69 patients (62.3% male and 37.7% female, mean age 32.8±14.1) with a diagnosis of DOA have been evaluated by means of an extensive neuropsychological assessment battery and compared to 31 healthy controls matched for sex, age and education.
Results: DOA patients reported significant lower scores ($p < 0.001$) in Corsi block tapping test and Attentive Matrices which respectively investigate visuo- spatial short term working memory and visual selective attention. Furthermore, significant correlations between percentage of N1 and Corsi block tapping performance ($r = -0.418$, $p = 0.022$), as well as between Attentive Matrices and number of awakenings ($r = -0.403$, $p = 0.027$) and sleep efficiency ($r = 0.374$, $p = 0.042$) were found in DOA patients. No differences were found in working memory (Digit Span Backword), short-term verbal memory (Digit Span Forward), long-term verbal memory (Rey Auditory Verbal Learning Test) and visuoconstruction abilities (Rey Figure Copy Test) between patients and controls.
Conclusion: DOA patients exhibited an impairment in visuo-spatial working memory and in selective visual attention. Our data suggests that these impairments could be associated with sleep disruption parameters.
Support (If Any): None.

0741

PREVALENCE AND CHARACTERISTICS OF RESTLESS LEGS SYNDROME IN KOREAN ADULTS: THE STUDY ON TWO-INDEPENDENT POPULATIONS

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Introduction: Restless legs syndrome (RLS) is regarded as a common sleep disorder with a significant impact on quality of life and with a genetic background, more frequently occurring in Caucasian than Asian population. RLS prevalence in Korean adult population is 3.9 - 14.3%, higher than those reported in other Asian countries. A wide range of reported prevalence derives from the differences in the population characteristics and in the methods to define RLS. We aimed to provide the RLS prevalence estimate in Korean adults, compared with previous reports in Korea, Asian and western countries.
Methods: In this study, we included two independent samples of Korean adult populations: group-1 was a nation-wide stratified random

sample of adult population (n = 2,824; aged 19 - 79 years) and group-2 was a community based cohort (n = 2,685; aged 47 - 79 years). The presence of RLS was evaluated with the Cambridge-Hopkins diagnostic questionnaire for RLS (CH-RLSq). We compared sleep profiles, sleep-related symptoms, mood/anxiety, and comorbid medical conditions between RLS and non-RLS groups.

Results: RLS prevalence was 0.42% in the group-1 and 0.86% in the group-2. There were no significant differences of age, sex, and body mass index between RLS and non-RLS groups. In group-1, RLS subjects have depression and insomnia more frequently than those without RLS ($p < 0.05$). In group-2, RLS subjects were more sleepy and depressive with shorter sleep duration, worse sleep quality and more severe insomnia symptom ($p < 0.05$). Underlying comorbidities including smoking, alcohol, hypertension, diabetes, hyperlipidemia, anemia, neurological disorder, or kidney disease were not statistically different between RLS and non-RLS groups.

Conclusion: RLS prevalence in Korean adult was less than 1%, which contrasts with previously reported ones in Korea. Considering the ethnic difference and genetic background of RLS, and the RLS prevalence depending on the diagnostic metrics, a high prevalence of RLS in Korea is questionable.

Support (If Any): None

0742

EPIDEMIOLOGY OF RESTLESS LEGS SYNDROME AND PERIODIC LIMB MOVEMENT IN THE EPISONO COHORT

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Introduction: Restless legs syndrome (RLS) and periodic limb movement (PLM) are sleep related movement disorders associated with several medical conditions and a poor quality of life. The aim of the present study was to determine the prevalence of RLS and PLM as well as to establish the predictive factors related to both sleep disturbances in a representative sample of general population.

Methods: This is a cross-sectional study performed in an adult population-based sample of 1,042 participants from EPISONO cohort (Sao Paulo, Brazil). RLS was assessed according to the International Restless Legs Syndrome Study Group criteria. PLM was diagnosed by polysomnography using cut-off value of PLM index (PLMI) ≤15/h and >15/h. All volunteers underwent polysomnography, answered questionnaires and had their blood collected for quantification of iron, ferritin and inflammatory markers as well as DNA extraction for investigation of *MEIS1, BTBD9* and *MAP2K5* polymorphisms.

Results: Prevalence of RLS was 4.9% (9.2% women; 4.3% men) and PLMI>15/h was 2.4% (2.4% women; 3.4% men). Those with PLMI>15/h were older and had a higher frequency of obstructive sleep apnea, and higher levels of TNF-alpha and IL-6. RLS individuals showed poor quality of life and worse subjective sleep quality. No association between RLS and PLMI>15/h was found. Age was predictor of both sleep disturbances. Fatigue and anxiety were independently associated with RLS while single marital status, insomnia, and TNFα levels were predictors of PLMI>15/h. No significant differences in the frequencies of genotypes were observed for the 3 polymorphisms analyzed.

Conclusion: RLS is more prevalent than PLM in the Brazilian population. Although poor quality of life only affected individuals with RLS, the presence of PLMI>15/h suggested its role as a possible inflammatory marker.

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0743

ASSOCIATION ANALYSIS OF MAP2K5 VARIANTS WITH RESTLESS LEG SYNDROME IN THE KOREAN POPULATION

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Introduction: Restless legs syndrome (RLS) is a neurological disorder characterized by unpleasant sensations in the legs and a strong urge to move them. Because its symptoms occur primarily when a person is relaxing, it usually interferes with sleep and is considered a sleep disorder. Previous studies of RLS have reported the presence of a positive family history suggesting a genetic involvement in the etiology of RLS. Moreover, recent genetic researches have reveled several genes, such as *MEIS1*, *BTBD9* and *MAP2K5*, as potentially associated with RLS. The *MAP2K5* gene has been also identified as a possible RLS susceptibility gene in genome-wide association analyses. The goal of the present study is to evaluate the association of *MAP2K5* variants with RLS in the Korean population.

Methods: Based on previous results, we selected four single nucleotide polymorphisms (SNPs), rs6494696, rs12593813, rs11635424 and rs1026732, in the *MAP2K5* gene on chromosome 15. The study included 268 RLS patients and 229 healthy controls. We performed case-control association and case-control haplotype analyses of the four *MAP2K5* variants.

Results: The genotype distributions of all four SNPs followed the Hardy-Weinberg equilibrium. Case-control association study analyses were performed with recessive, dominant, genotype, and allele models, and no significant genetic differences were found between patients with RLS and healthy controls with respect to all four SNPs. However, rs6494696, rs12593813, rs11635424 and rs1026732 showed significant association (overall P = 1.37E-39; permutation P = 0) in a case-control haplotype analysis with the expectation-maximization algorithm.

Conclusion: The haplotype analysis results suggest that *MAP2K5* variants rs6494696, rs12593813, rs11635424 and rs1026732 may confer susceptibility for RLS in the Korean population. Association analysis revealed a probable genetic difference between Korean and Caucasian populations in the degree of *MAP2K5* involvement in RLS pathogenesis.

Support (If Any):

0744

DIURNAL VARIATION OF DEFAULT MODE NETWORK IN PATIENTS WITH RESTLESS LEGS SYNDROME

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Introduction: Restless Legs Syndrome (RLS) is a neurological disorder with a primary symptom of an abnormal sensation whose level of expression is circadian-dependent. Changes in the default

mode network (DMN) in the morning in RLS patients have been found. If these changes are pertinent to the disease expression then they should show a diurnal difference to maintain consistency in the clinical expression of the disease. The purpose of this study was to elucidate the potential neural mechanisms underlying the circadian aspect of RLS symptom expression by assessing for diurnal changes in DMN.

Methods: Fifteen drug-naïve subjects with idiopathic RLS and 15 age and gender-matched healthy subjects had fMRI scans in the morning and evening. The comparison of default mode network (DMN) between morning-evening within groups and between RLS and controls was conducted. We used MRI's (structural images, resting state functional images), Korean versions of International RLS scale (K-IRLS), and other sleep questionnaires.

Results: The mean age of the RLS patients and controls was 57.40 ± 10.34, and 58.13 ± 10.77 respectively. The K-IRLS was 26.40 ± 6.91 and the RLS duration was 124.07 ± 126.90 months. There were alternations in the DMN connectivity in RLS compared to the healthy controls in daytime and evening, which showed the disturbances and changes in the DMN. In particular, RLS showed sustained increased connectivity in the parietal lobule both in daytime and evening. In addition, they showed variations of connectivity in the thalamus, which were increased in the daytime and reduced in the evening. In addition, there were negative correlations between the thalamic connectivity and the Korean versions of the international RLS scale symptom severity subscore and the quality-of-life subscore.

Conclusion: The results indicated disturbances of the DMN in RLS subjects that influence the thalamic relay sensory associated circuit. This suggests RLS subjects may have deficits in controlling and managing sensory information supporting the hypothesis that RLS is a disorder of somatosensory processing.

Support (If Any):

0745

RESTLESS LEGS SYNDROME / WILLIS EKBOM DISEASE IN BARIATRIC SURGERY PATIENTS

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Introduction: Iron deficiency occurs in approximately 51% of patients following bariatric surgery. Iron deficiency is a risk factor for restless legs syndrome/Willis Ekbom Disease (RLS/WED); yet this disease has not been systematically studied in the bariatric surgery population. Our objectives were to prospectively analyze presence and severity level of RLS/WED in patients before and after undergoing bariatric surgery for weight loss.

Methods: Consecutive adult patients scheduled for bariatric surgery for treatment of obesity between October 2014 and February 2016 were enrolled. Subjects completed validated questionnaires to assess presence and severity of RLS/WED (Cambridge-Hopkins Questionnaire 13 and International Restless Legs Syndrome Study Group Rating Scale (IRLS)) during baseline and follow-up visits.

Results: In 101 total subjects, 79% were females. Mean body mass index was 45.65 (SD +/- 7.7). Baseline RLS/WED was present in 21% of patients with a mean IRLS score of 15 (SD +/- 9.0). Three months following surgery, an additional 17% of subjects who presented for followup had developed RLS/WED (8/47); at 6 months an additional 8.8% (3/34); and at 12 months an additional 27% (3/11) had developed RLS/WED. Pre-surgical hemoglobin was below 12.0 g/dL in 8% (7/91). At baseline, 32% (32/101) of subjects were on a proton pump inhibitor and 39% (40/101) were on an antidepressant. Sleep studies were performed in 50% of patients (50/101) and 84% were diagnosed with obstructive sleep apnea. Of the 37 subjects who underwent in-lab polysomnography, mean periodic limb movement index was 20.47/h (SD +/- 34.5).

Conclusion: Bariatric surgery patients may be at higher risk for RLS/WED than the general population and their disease may be unrecognized. Long-term follow-up to identify new or worsening cases will be important, particularly given high risk of iron deficiency in this population. Routine screening for RLS/WED should be considered in bariatric surgery patients.

Support (If Any):

0746

REVIEW OF A MULTISENSOR, LOW COST, AND UNOBTRUSIVE APPROACH TO DETECT MOVEMENTS IN SIT AND SLEEP

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Introduction: Movement measurements in the Suggested Immobilization Test (SIT) and sleep recordings are typically measured by polysomnography (PSG) with electromyography (EMG). We investigated the viability of an alternate home-based recording system, SleepSmart, which combines sensing technologies integrated in a bedsheet and 3D video to detect movements.

Methods: Pilot study: 19 participants were administered the SIT in the Biomechanics Lab; the subject lay on an angled bed for 30 minutes and slept for up to 90 minutes. We used a combination of the Kinect videography system enabling conventional 2D and novel 3D-technology, a portable EMG device, and a mattress topper sheet fitted with flexible sensors. EMG data was recorded for both tibialis anterior muscles. The goal was to perform pilot testing on the integrated system to fine tune the procedure and equipment.

Results: Main findings: The 3-D video recordings enabled the study of movement developments, a novel feature not captured by 2-D video-recordings and/or EMG. Pitfalls in the EMG setup, overall protocol design, and data synchronization were encountered. Several requirements were identified to optimize the test-setup: (1) A millisecond-level time stamping system was needed to sync data between multiple modalities; this mechanism will support identification of movement characteristics (development and peak) for Periodic Limb Movements (PLM). (2) Reflective or light-absorbing artifacts should be removed to maintain video data integrity. (3) With the demonstrated effectiveness of the video-data characterization feature, the mattress-sensor framework should implement machine learning algorithms to automatically identify movement events.

Conclusion: Based on findings, the mattress sensors are being replaced with newer sensors to improve performance. The switch from force-sensing resistors (FSRs) to accelerometers incorporates detection of physiological signals (heartbeat and breathing rate). Identification algorithms will include sleep apnea events. More pilot testing will be conducted to validate changes.

Support (If Any): Kids Brain Health Network (previously NeuroDevNet), AIT Austrian Institute of Technology, BC Children's Hospital Foundation.

0747

CRANIAL ELECTROTHERAPY FOR MILITARY BENEFICIARIES WITH RESTLESS LEG SYNDROME

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Introduction: Restless Legs Syndrome (RLS) causes uncomfortable dysesthesias, greatly influencing sleep quality and overall health. Since 2006, RLS rates in military beneficiaries have increased every year. Side effects of pharmacologic treatment options hamper operational readiness. Leading causation theories for RLS point to dopamine deficiency in the central nervous system. Cranial Electrical Stimulation (CES) is a non-invasive treatment affecting activity in dopaminergic regions of the brain. It does not interact with medications or contribute to polypharmacy. The purpose of this study was to determine the feasibility of CES treatment in military beneficiaries with RLS and gather preliminary data comparing differences in RLS symptom severity and quality of life.
Methods: Double-blind, placebo-controlled trial. Individuals were randomized to one of three groups: control, sham device, or active CES device. Measurements of RLS symptom severity, sleep, and quality of life were collected over 8 weeks and group differences over time were analyzed using linear mixed models.
Results: There were no significant group differences at baseline. Symptom severity decreased over time ($p = 0.091$), regardless of treatment group. Among those participants not already taking a dopamine agonist, there were clinically and statistically significant decreases in symptom severity in the CES group versus the control group after controlling for overall quality of life ($p = 0.02$). Adequate blinding was confirmed. Recruitment, particularly in females, was confounded by low ferritin levels (excluded per protocol). Though all groups initially improved, only the CES group demonstrated continued, progressive decreases in symptom severity over time suggesting longer treatment duration may be required. Pre-existing dopamine agonist therapy impacted responsiveness to treatment and should be analyzed more rigorously in future studies.
Conclusion: This study demonstrates preliminary support for CES as a non-pharmacological option for RLS, but additional evaluation is needed. Feasibility data from this study should be used in planning future research.
Support (If Any): TriService Nursing Research Program: Grant: HT9404-13-1-TS02, Program Number: N13-003. **Tripler Army Medical Center IRB Oversight/Approval:** # 52H13.

0748

REDUCTION IN RESPONSE TO GABAPENTIN ENACARBIL IN RLS PATIENTS PREVIOUSLY TREATED WITH DOPAMINERGIC AGENTS: A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED STUDY

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Introduction: Long-term treatment with dopaminergic agents (DAs) frequently leads to loss of response and augmentation. Both complications probably reflect a drug-induced change in the pathophysiology of RLS by which therapeutic response to DAs is reduced. The question is whether long-term DA treatment might also dampen the response to non-DA treatments.
Methods: We performed a randomized, double-blind, cross-over, placebo-controlled study on two groups of RLS patients: treatment-naive patients (group A) and non-augmented patients treated with dopaminergics for the last 5 consecutive years (group B). Following wash-out from any previous CNS-active drugs, patients were randomized into one of two groups for two consecutive two-week treatment periods with gabapentin enacarbil (GBPen) and placebo. Treatment was administered at 7PM at a fixed dose of 600 mg/day. RLS severity was measured weekly by means of the International Restles Legs Syndrome Scale (IRLS) and Clinical Global Improvement (CGI). Also, an M-SIT was performed between 6pm and midnight at the end of each treatment condition.
Results: There were no differences between groups in age, duration of disease, ferritin levels, or family history. In Group A, there was an improvement under gabapentin enacarbil compared to placebo at all endpoints (change in IRLS: -11.09 ± 4.68, $p<0.001$; CGI: -2.00 ± 1.08, $p<0.01$; MSIT: 18.00 ± 31.19, $p<0.1$). In contrast, patients in group B improved less (IRLS: -5.54 ± 4.84, $p<0.001$; CGI: -1.00 ± 1.08, $p<0.05$; MSIT: -3.38 ± 22.43, n.s.). Improvement was greater at all endpoints in Group A compared to Group B ($p<0.01$).
Conclusion: Our study shows that the response to alpha-2 delta ligands is reduced in patients previously treated over the long-term with DAs. Our finding has strong implications for the initial choice of treatment in RLS, and it supports the notion that initial treatment should not be started with DAs.
Support (If Any): The study was supported by an unrestricted grant from XenoPort Inc.

0749

SLEEP LOADING IMPROVES VISUAL SEARCH RESPONSE TIME AND REDUCES FATIGUE IN PROFESSIONAL BASEBALL PLAYERS

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Introduction: Sports performance relies on quick visual decision-making and reaction time. In baseball, a fastball takes only 400 ms to travel from pitcher to hitter. This requires visual search strategies to distinguish amongst different types of pitches and react quickly. Fatigue over a season, however, can negatively impact performance and pitch recognition. This study aims to examine the effects of short-term sleep extension on cognitive performance and daytime functioning.
Methods: In this randomized controlled trial during a 4-week training camp, seventeen professional male baseball players from a Major League Baseball organization completed a two-day baseline of habitual sleep. Athletes were then randomized to 1) sleep extension (SE) to 10 hours for five nights or 2) controls maintaining habitual sleep for five nights. Pre- and post-cognitive tests included Digit Symbol Substitution Task (DSST) and an adaptive visual search task. Profile of Mood States (POMS) and Epworth Sleepiness Scale assessed mood and daytime sleepiness.
Results: SE (n=8) increased reported sleep time by 1.1 hours/night (7.0 ± 0.9 vs. 8.1 ± 0.8 hours) vs. controls (n=9) reported 6.9 ± 0.8 hours/night. Actigraphy indicated SE obtained an additional 0.6 hours/night (6.3 ± 0.8 vs. 6.9 ± 1.0 hours). SE resulted in 122 ms (13.0%) faster DSST response time (p=0.01) and 66 ms (709 ± 81 vs. 643 ± 83 ms) faster response time associated with selective attention when confronted with distractors, F(1,14)=6.22, p=0.03. POMS Fatigue decreased 39.7%, F(1,14)=10.84, p<0.01, and Tension decreased 33.8% (p=0.04). Controls demonstrated increased Fatigue (25.3%) and Tension (19.6%). SE decreased daytime sleepiness 36.8% via Epworth, 7.1 ± 1.6 vs. 4.5 ± 3.5, F(1,14)=6.23, p=0.03.
Conclusion: Sleep extension for one hour for five nights resulted in faster cognitive processing, reduced fatigue, and decreased daytime sleepiness in professional baseball players. Short-term sleep loading is a practical intervention that enhances response time and daytime functioning.
Support (If Any): N/A.

0750

SLEEP DURATION AND QUALITY ARE ASSOCIATED WITH PERFORMANCE ON A COGNITIVELY TAXING GAIT TASK

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Introduction: Completion times on gait tasks have been associated with risk for falls. While there is some evidence that sleep apnea is associated with worse performance on gait tasks, the association of sleep duration and quality—independent of sleep apnea—with gait task performance is not well understood.
Methods: A subset of Wisconsin Sleep Cohort Study subjects (n=631; 45% female; mean [range] age=65[45–82] years) participated in a protocol to assess gait, including: 1) the Timed Up & Go (TUG) task; and 2) the Timed Up & Go while counting backward by 3s and stepping over obstacles (TUG-CB,O). Subjects underwent overnight polysomnography and completed questionnaires including information about usual sleep habits and sleepiness. The following outcomes were regressed on nighttime and nap sleep duration, sleep efficiency and wake after sleep onset (WASO): 1) seconds to complete the TUG; 2) seconds to complete the TUG-CB,O; and 3) the difference in completion time between the TUG-CB,O and the TUG (ΔTUG), a measure of the "cognitive cost" of the obstacle avoidance and counting backwards tasks on the TUG. Results were adjusted for apnea hypopnea index (AHI), age, gender, BMI, alcohol and caffeine consumption, smoking, cardiovascular disease, and diabetes.
Results: Shorter sleep duration (≤6 h vs 7–8 h) was associated with longer TUG-CB,O completion time (p<0.1) and greater ΔTUG (p<0.05). Longer sleep duration was not significantly associated with gait task performance. Taking longer naps was associated with longer completion times on TUG (p<0.05) and TUG-CB,O (p<0.01) and a larger difference ΔTUG (p<0.05). Lower sleep efficiency (p<0.05) and greater WASO (p<0.1) were both associated with greater ΔTUG. AHI was associated with longer completion times on the TUG and TUG-CB,O (p<0.05) in each of the models.
Conclusion: Sleep duration and quality are associated with performance on gait tasks. The difference between the "baseline" TUG completion time and the TUG-CB,O, which adds two simultaneous cognitively taxing tasks, was consistently associated with sleep duration and quality predictors, suggesting that sleep deficits may affect cognitive functioning in a way that contributes to physical functioning.
Support (If Any): NIH grants: National Heart, Lung, and Blood Institute (R01HL62252); National Center for Research Resources (1UL1RR025011).

0751

EXPLORING SELF-REPORTED STRESS DURING SLEEP EXTENSION AND SLEEP DEPRIVATION

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Introduction: Previous work has demonstrated that sleep loss increases negative mood while sleep extension improves mood. Though these studies have assessed multiple dimensions of mood, few have specifically targeted emotional stress. This is the first study to use a high fidelity measure to track acute self-reported stress across three conditions: normal sleep, sleep extension, and sleep deprivation.
Methods: Self-reported fatigue and stress were assessed using the Karolinska Sleepiness Scale (KSS) and the Stress Visual Analogue Scale (SVAS), respectively. Eight healthy adults (4 females) ranging from 20 to 28 years of age participated in the study. The KSS and SVAS were administered every two hours from 0700 to 2100 during the three sleep conditions: 1) Baseline Sleep: the day following two weeks of normal//baseline sleep, 2) Sleep Extension: the day following 7 consecutive nights of extended sleep (10 hours TIB), and 3) Sleep Deprivation: the day following one night of total sleep deprivation. The data were analyzed with a 3 (Sleep Condition) x 8 (Time of Day) mixed linear model. Additionally, KSS and SVAS scores were correlated across baseline, extension, and sleep deprivation days.
Results: A main effect of Sleep Condition revealed increased fatigue and stress during sleep deprivation relative to sleep extension. Interestingly, although fatigue was significantly higher for sleep deprivation compared to baseline, this effect was not significant for stress. Nevertheless, fatigue and stress scores were significantly correlated across sleep conditions.
Conclusion: The present preliminary findings suggest that the SVAS instrument is sensitive to changes in stress levels experienced by

individuals under extended sleep vs. sleep deprivation conditions. In addition, there is a significant, positive correlation between self-reported fatigue and stress across the various sleep conditions.
Support (If Any): Department of Defense Military Operational Medicine Research Program (MOMRP).

0752

THE EFFECT OF SLEEP ON OVERNIGHT MEMORY RETENTION IN OLDER ADULTS

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Introduction: Little is known for the effect of sleep on declarative memory retention in older adults. This investigation sought to determine the impact of sleep on overnight memory retention in community dwelling older adults. To this end, we administered list learning memory test in the evening before polysomnography (PSG) and examined the retention of memory in the next morning in the older adults without dementia. In addition, we also compared two different sessions of list learning memory in the evening and next morning.
Methods: Participants were 71 community-dwelling older adults without dementia. We evaluated PSG, word list recall at three time points: 1) 5 minutes delay, 2) overnight delay in the next morning, and 3) 5 minutes delay of alternate list in the next morning. All participants completed PSG and standard sleep questionnaires.
Results: 36 women and 35 men, mean age 70.0±0.9 years participated. Duration of slow wave sleep (stage 3 and 4 combined) was positively associated with better list learning score with significance in all three points, but not with retention rate. Other sleep parameters, including sleep efficiency, apnea-hypopnea index, average oxygen saturation, were not associated with retention rate of word list recall overnight. Total sleep time is negatively associated with retention rate marginally. Further, timing of administration of exam did not show significant difference.
Conclusion: Slow wave sleep was associated with better list learning score, but not with retention rate. Other sleep parameters were not associated with retention of list learning memory.
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0753

REPETITIVE SLEEP RESTRICTION AND SLEEP DISRUPTION LEADS TO ELEVATED SLEEPINESS AND FATIGUE THAT FAIL TO RESOLVE WITH A SINGLE NIGHT OF RECOVERY SLEEP

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Introduction: Repeated exposure to insufficient sleep (due to sleep restriction or disruption) is a common occurrence related to complaints of fatigue. However, the cost of this behavioral pattern on subjective well-being and the time required to recuperate remain unknown. In order to investigate the effects of repeated cycles of short or disturbed sleep, we conducted two experimental studies comparing the effects of repeated sleep restriction (SR) and sleep disruption (SD) on feelings of fatigue and sleepiness.
Methods: Participants (N=57) completed a Control condition of 8hr sleep opportunity every night (N=20 (10 males), ages 21–50) or either 3 nights of restricted sleep (SR: N=21(10), 21–53) or restricted and disrupted sleep (SD: N=15(8), 20–42) repeated three times with a single recovery night of 8hr sleep opportunity between each block; and a final recovery period of 2 nights of 8hr sleep opportunity. Participants slept 4h/night (0300-0700) in SR and slept from 0000-0600 hours with 20min interruptions every 40min of the sleep period (total sleep time: 4h/night) in SD. Participants rated their perceived level of fatigue and sleepiness every 2 hours across periods of wakefulness throughout both studies. Average daily ratings from SR, SD and Control were compared.
Results: Both SR and SD resulted in significantly higher ratings of fatigue and sleepiness compared to baseline or Control sleep. Ratings were significantly greater for SD compared to SR. Ratings following recovery nights were comparable between SR and SD. Sleepiness was comparable to baseline ratings following two nights of recovery sleep while fatigue remained elevated.
Conclusion: Sleep disruption resulted in greater feelings of fatigue and sleepiness, which could indicate a greater health and safety risk. Both fatigue and sleepiness were elevated during experimental nights. Sleepiness recovered faster than fatigue following multiple recovery nights. Sleep schedules need to account for cumulative effects of sleep loss that cannot be counteracted by only one night of recovery, particularly for feelings of fatigue.
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0754

ASSOCIATIONS BETWEEN SLEEP EFFICIENCY AND COGNITIVE FUNCTION IN THE MULTI-ETHNIC STUDY OF ATHEROSCLEROSIS (MESA)

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Introduction: There is evidence that interrupted sleep can accelerate the aging process and increase the risk for future development of cognitive impairment and dementia. The goal of the present study was to test the hypothesis that sleep fragmentation will correlate with cognitive performance and to determine the role of APOE-l4 as an effect modifier for this association.
Methods: We included 2048 men and women of the racially and ethnically diverse population of the MESA Sleep Cohort, who had in home polysomngraphy (PSG) as well as 7-day actigraphy performed between 2010 and 2013. PSG-derived indices included total sleep time, sleep maintenance efficiency, periodic limb movement index (PLMI) and percent sleep time in desaturation <90%. From actigraphy, we derived measures of average sleep duration. Participants underwent neuropsychological testing that included the Cognitive Abilities Screening Instrument (CASI), Digit Symbol Coding Test (DSCT), Digit Span Test Forwards and Digit Span Test Backwards. Multivariate linear regression models were used to assess the association between indices of sleep disruption and cognitive function.
Results: The mean age of the sample was 68.4 years (46.4 % males). Correlation analyses revealed a significant association between sleep efficiency and Digit Span Test Forwards (0.01) and Digit Symbol (0.008) score after adjusting for age, gender, race/ethnicity and education. These associations remained significant after further adjustment for sleep duration. After additional adjustment for overnight

hypoxemia and PLMI the association between sleep efficiency and Digit Span Test Forwards remained significant (p=0.005), but was only borderline significant for the Digit Symbol score (p=0.06). There was no significant interaction between the presence of the APOE-ε4 allele and these associations.
Conclusion: Reduced sleep efficiency is associated with poorer performance in processing speed, attention and short-term memory, and associations are evident even after considering sleep duration, overnight hypoxemia and periodic limb movements. These associations were not modified by APOE-ε4.
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0755

LONGITUDINAL ASSOCIATIONS OF RISK FACTORS WITH INSOMNIA SEVERITY IN OLDER PERSONS

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Introduction: The identification of risk factors associated with increased insomnia severity over time merits further evaluation in older persons, as this will inform therapeutic priorities.
Methods: Our analytical sample was drawn from the Precipitating Events Project (PEP), involving 386 community-dwelling persons aged ≥75 years who underwent assessments at 18-month intervals, including: Insomnia Severity Index (ISI [range of 0–28]) and the potential insomnia risk factors of age, female sex, race/ethnicity, obesity, smoking status, education, primary sleep disorders (restless legs syndrome [RLS] and sleep-disordered breathing [SDB]), cardiorespiratory conditions, neuropsychologic impairments, and medication use, based on self-report or validated questionnaires. Accordingly, using PEP data and multivariable generalized estimating equation (GEE) modeling, we evaluated the longitudinal associations between insomnia risk factors (time-varying where appropriate) and insomnia severity over time. In addition, mean ISI scores over time were evaluated in survivors and decedents.
Results: At baseline, the mean (standard deviation [SD]) for age was 84.4 (4.6) years; 67.4% were female, 11.7% were African-American, and the mean (SD) for ISI was 7.0 (5.5). Participants were followed over 9 years (mean [SD] of 4.5 [3.4] years of follow-up), and 276 participants (71.5%) died over the follow-up period. Significant associations with insomnia severity over time were found for RLS, SDB, depressive symptoms (Center for Epidemiologic Studies Depression scale (CES-D) score ≥16), and number of medications used (p-values <0.05), but not for female sex, race/ethnicity, obesity, smoking status, education, cardiorespiratory disease, cognitive impairment (Folstein Mini-Mental Status Examination score <24), or age (p-values >0.10). Lastly, no statistically significant differences were found for the mean ISI scores over time in survivors vs. decedents (p-values >0.30).
Conclusion: In community-dwelling persons aged ≥75 years, insomnia severity over time was significantly associated with primary sleep disorders (RLS and SDB), depressive symptoms, and medication use, but not with sociodemographic factors, cardiorespiratory diseases, cognitive impairment, or advancing age. These results inform priorities in insomnia management among older persons that, importantly, are likely to be modifiable.
Support (If Any): Work supported by grants from the National Institute on Aging T32AG019134 and the John A. Hartford Foundation.

0756

SHORT SLEEP DURATION DRIVES ACCELERATED AGING IN THE UNITED STATES ESPECIALLY AMONG RACIAL/ETHNIC MINORITIES

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Introduction: According to the Center for Disease Control and Prevention (CDC), 3 out of 4 Americans have a heart age (age, sex, systolic blood pressure, treatment for hypertension, smoking, diabetes, HDL cholesterol, total cholesterol and 10-year cardiovascular risk) that is five times greater than their chronological age. Non-Hispanic blacks and Hispanics are even at greater risk with an average heart age 11 times greater than their chronological age. Evidence linking short sleep duration with cardiovascular disease (CVD) may inform future behavioral strategies to reduce CVD risk, heart age, and accelerated aging (heart age greater than chronological age), especially among racial/ethnic minorities who are at greater risk of poor sleep and CVD.
Methods: Using data from 2011–2012 and 2013–2014 National Health and Nutrition Examination Survey (NHANES), we investigated whether short sleep duration (<7 hrs/24 hr. period) was associated with accelerated aging and whether this association differed across race/ethnicity. Heart age was calculated based on the Framingham Study Heart Age Calculator, a well-established composite CVD risk predictor.
Results: The majority of the population were women (52%) with a high school degree or more (63%). Sixty-six percent were Non-Hispanic (NH)-white, 12% were NH-black, and 15% were Hispanic. NH white adults were more likely than non-Hispanic black and Hispanic adults to sleep at least 7 hours everyday (67.6% vs 50.3% and 63.1%, respectively p<0.05). NH- white adults had lower mean accelerated age (7.2 years) than NH- black adults (8.8 years) and Hispanic adults (10 years) (p<0.05). Regression models showed: a) accelerated aging was significantly associated with race/ethnicity; b) short sleep duration explained 14% of the association between race and accelerated aging; c) accelerated aging was significantly associated with short sleep; and d) race explained 14% of the association between short sleep and accelerated aging.
Conclusion: Compared with non-Hispanic Whites, non-Hispanic black and Hispanic adults have greater levels of heart age and accelerated aging, and short sleep duration significantly contributes to this difference. Future studies should investigate the longitudinal effects of improved sleep on heart age and accelerated aging.
Support (If Any): NIH/NINDS U54NS081765 NIMHD R01MD00 7716 NHLBI R25HL105444.

0757

PURPOSE IN LIFE AND SLEEP DISTURBANCE IN OLDER ADULTS

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Introduction: Research indicates an association between positive psychology and physiological functioning, proposing that individuals high in purpose in life have better health and engage in more healthy behaviors. Research also suggests that purpose in life can be protective against numerous negative health outcomes including sleep

disturbances, however, it is unclear if this relationship extends beyond poor sleep quality. This study examines the relationship between purpose in life, sleep quality, and the presence of sleep disorders in a community-based bi-racial sample of older adults.

Methods: Participants from two cohort studies, (n=825; 77% female; age range 61–100; M=79.02 ± 7.46) consisting of older African Americans (52%) and Whites (48%) without dementia at baseline, completed annual evaluations including assessments of various health and psychosocial parameters. Evaluations included a 32-item questionnaire assessing sleep quality (modified PSQI), symptoms of Sleep Apnea, Restless Leg Syndrome (RLS) and REM Behavior Disorder (RBD) and Purpose in life, a 10-item measure modified from Ryff & Keyes's scales of Psychological Well Being.

Results: In regression analyses controlling for age, sex, race, education, and depressive symptoms, higher levels of purpose in life were associated with better sleep quality at baseline (R^2=.128, p<.001). Using longitudinal follow-up data, higher levels of purpose in life were associated with lower risk of sleep apnea at baseline (OR=.630, p=.001), 1-year follow-up (OR=.719, p=.001), and 2-year follow-up (OR=.604, p=.007), and reduced symptoms of RLS at 1-year (OR=.524, p=.012) and 2-year follow-up (OR=.396, p=.004).

Conclusion: Findings suggest that higher levels of meaning and purpose in life among older adults is related not only to better sleep quality but also to reduced risk of sleep apnea and RLS. These results also highlight the benefits of positive psychology on sleep health over time. Future research would benefit from the inclusion of hypothesized mechanisms like healthy behaviors to further understand these associations.

Support (If Any): N/A.

0758

REDUCED SPINDLE FREQUENCY AND DENSITY IN STAGE 2 NREM SLEEP IS ASSOCIATED WITH INCREASED CSF P-TAU IN COGNITIVELY NORMAL ELDERLY

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Introduction: Sleep may play a role in AD pathogenesis, but the timing, role, and extent to which sleep disturbances in late-life are associated with increasing burden of AD neuropathology remains unclear. Sleep spindles have been implicated in sleep quality. Wakefulness is mediated by an arousal system beginning in the brainstem and continuing on to the diencephalon and innervating the thalamus, the region where sleep spindle oscillations are generated. In AD pathology, hyperphosphorylated tau (P-Tau) protein accumulates in the brainstem, from where it spreads to the entorhinal cortices, hippocampi and other brain regions. These tau aggregates may interfere with the sleep-wake cycle resulting in down-regulation of sleep spindles and associated sleep disruption. Increased CSF P-tau and T-tau levels are likely related to the formation of neurofibrillary tangles in the brainstem and limbic system (Braak stages I-IV).

Methods: 49 cognitively normal (CDR=0) elderly (66.95 ± 7.76 years) subjects completed a structural MRI, lumbar puncture (LP) and nocturnal polysomnography (NPSG) within 4.65 ± 6.81 months of the LP. From the NPSG, spindle frequency and density were analyzed for stages NREM1, NREM2 and NREM3, using an automated optimization algorithm which decomposes the EEG as a sum of transient and oscillatory components. This was used to detect the spindles and a Fourier analysis was performed to evaluate the spindle frequency in Hz.

Results: Spindle frequency and density in NREM2 sleep were inversely associated with CSF P-tau (r= -0.355, p<0.05; r=-0.476, p<0.05) and CSF T-tau (r=-0.405, p<.05; r=-0.542, p<.05) using partial correlation controlling for age and ApoE4 allele. There were no associations between spindle frequency or density and CSF P-tau or CSF T-tau in stages NREM1, NREM3.

Conclusion: The association of spindle frequency and density in NREM2 to CSF P-tau and CSF T-tau in cognitively normal elderly suggest either that tau pathology may produce an early downstream effect on sleep spindles, or that changes in sleep spindles can identify a process relating to tau pathology. Whether the association of tau to spindles is a non-specific effect of tau on increasing sleep fragmentation in general remains an area of active investigation.

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0759

BIDIRECTIONAL ASSOCIATIONS BETWEEN WHITE MATTER INTEGRITY AND SLEEP QUALITY IN THE ELDERLY. THE ROTTERDAM STUDY

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Introduction: White matter microstructure may underlie the structural and functional brain differences observed in people with sleep complaints. Insomnia patients were shown to have lower white matter integrity measured by diffusion tensor imaging (DTI), compared to healthy controls. However, previous findings are based on cross-sectional data of small, clinical samples and cannot be generalized to the general population.

Methods: In the Rotterdam Study, 2808 participants (mean age 59.3 ± 7.7, 54.4% women) underwent repeated brain MRI imaging, and filled in the Pittsburg Sleep Quality Questionnaire at baseline and follow-up. Average follow up was 5.6 years. Using diffusion tensor imaging, we studied the strength and direction of the longitudinal associations between white matter microstructure (global and tract specific) and sleep quality in elderly people from the general population.

Results: Higher global mean diffusivity (MD) at baseline predicted a decrease in sleep quality, which was driven by a lower fractional anisotropy (FA) (β=-0.05, p-value=0.009) and higher MD (0.05, p-value=0.009) in the uncinate fasciculus and several other association tracts. Sleep complaints at baseline were not associated with global diffusion metrics, but predicted an increase in MD in the parahippocampal part of the cingulum (β=0.07, p-value=0.004) across the follow up.

Conclusion: Low white matter integrity across the brain predicts a decrease of sleep quality in the elderly. Vice versa, bad sleep quality at baseline is related to a decrease in white matter integrity, but this effect seems to be specific for limbic tracts around the hippocampus. This tract has previously been implicated in aging and cognitive decline. This study provides evidence for bidirectional associations between sleep quality and white matter microstructure in the aging brain.

Support (If Any): ERAWEB scholarship grant financed by the European Commission was granted to DK (grant agreement 2013–2548/001-001-EMA-2). Financial support was recived by Erasmus Medical Center, The Netherlands Organization for Health Research and Development, the Dutch Technology Foundation STW, which is part of the Netherlands Organisation for scientific research (NWO) and partly funded by the Dutch Ministry of Economic Affairs.

0760

LIFESPAN TRAJECTORIES OF SLEEP QUALITY PREDICT MORTALITY IN THE MIDLIFE IN THE UNITED STATES STUDY

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Introduction: Meta-analyses demonstrate that sleep prospectively predicts mortality. However, few studies have assessed whether trajectories of sleep across the lifespan predict mortality. The current study tests whether trajectories of total sleep time (TST) and sleep onset latent (SOL) across 9 years predict mortality in a population-based study of adults.
Methods: Participants are 4,670 adults (55.8% women) from the longitudinal Midlife in the United States (MIDUS) study including MIDUS 2 (2004–2006; Mage = 55.6; range 30–84) and MIDUS 3 (2013–2014; Mage = 64.0, range 39–93) with complete mortality information and at least one sleep assessment. TST and SOL were assessed via self-report at MIDUS 2 and 3. Mortality was assessed through October 2015 based on informants and the National Death Index. Age at death or censoring was calculated. Covariates included sex, education, minority race/ethnicity, body mass index, number of chronic health conditions, smoking status (current, former, never), and alcohol use (at risk, moderate, none).

Latent variable models were used to simultaneously model lifespan trajectories of sleep with a random intercept and slope and use the intercept and slope to predict age at death in a cox regression. Models were run separately for TST and SOL.
Results: A quadratic relationship emerged between TST intercept and mortality ($p<.001$); however, the lifespan trajectory of TST did not predict mortality ($p = .18$). Examining SOL, longer initial SOL predicted higher mortality (HR = 1.40, $p<.001$ for a 1 SD difference in SOL intercept). Conversely, a more positive trajectory of SOL uniquely predicted lower mortality (HR = 0.77, $p = .019$ for a 1 SD difference in SOL slope). Adjusting for covariates did not change the magnitude or significance of results.
Conclusion: Change in SOL across the lifespan uniquely predicted of mortality, beyond initial levels of SOL and covariates including health behaviors and chronic conditions. Results for initial TST were consistent with prior literature. Interestingly, lifespan trajectories of TST were unrelated to mortality. Findings highlight the importance of individual differences in lifespan trajectories of sleep quality for health. Epidemiologic studies may benefit from assessing sleep quality at multiple points across the lifespan.
Support (If Any):

0761

ROLES OF MULTIPLE SLEEP HEALTH CHARACTERISTICS IN PREDICTING ALL-CAUSE MORTALITY AMONG OLDER MEN

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Introduction: Sleep health is a multivariate construct including domains such as duration, timing, continuity, regularity, quality, and sleepiness. Most studies consider sleep characteristics in isolation, ignoring the multidimensional nature of sleep. We examined several approaches for using multivariate sleep to predict time to all-cause mortality in the Osteoporotic Fractures in Men (MrOS) sleep study.
Methods: Participants included 2,899 men (mean 76.3 years) who completed self-report and actigraphic sleep assessments. This sample was followed for up to 11 years with 37% mortality. We selected the following characteristics to represent each sleep health domain: actigraphy-assessed total sleep time (duration), actigraphy-assessed sleep midpoint (timing), actigraphy-assessed minutes awake after sleep onset (WASO; continuity), actigraphy-assessed pseudo-F (PsF, regularity), self-reported sleep quality (quality), and the Epworth Sleepiness Scale (sleepiness). Characteristics were considered continuously (after standardizing), categorically (high- versus low-risk based on a priori cut points), and in aggregate (number of high-risk sleep characteristics). Hazard ratios [HRs, (95%CI)] from multivariable Cox regression, survival trees, and variable importance measures from random survival forests were used to identify which sleep characteristics predicted mortality, accounting for other established risk factors.
Results: More irregularity as captured by PsF [1.11 (1.03, 1.20)], greater WASO [1.15 (1.08, 1.23)], and additional high-risk sleep characteristics [1.12 (1.07, 1.18)] were significant predictors based on Cox models, considered either continuously or categorically. Survival trees indicated that having WASO>98.6 minutes was a risk factor [1.71 (1.32, 2.22)]. Random survival forests indicated PsF, total number of high-risk characteristics, and WASO were important risk factors for mortality.
Conclusion: Greater number of high-risk sleep characteristics, irregular sleep, and more WASO predicted increased mortality risk. Results may be specific to older men in the MrOS study and all-cause mortality. Similar analyses should be performed with other outcomes and populations, especially women. Future studies should elucidate the mechanisms underlying these relationships.
Support (If Any): NHLBI provides funding for the MrOS Sleep ancillary study "Outcomes of Sleep Disorders in Older Men" under the following grants: R01 HL071194, R01 HL070848, R01 HL070847, R01 HL070842, R01 HL070841, R01 HL070837, R01 HL070838, and R01 HL070839. MLW is supported by K01 MH096944. SFS is supported by T32 MH019986.

0762

ACCURACY OF CONSUMER MONITORS FOR MEASURING SLEEP ACROSS SEVEN NIGHTS

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Introduction: Sleep and fitness trackers available to the consumer market show promise for measuring sleep. However, there are few published studies examining their accuracy compared with well-validated actigraphy devices for multiple nights outside the sleep laboratory. The purpose of this study was to evaluate the reliability and validity of several commercially-available devices compared to a well-validated actigraphy device.
Methods: Healthy adults (N=40, mean age= 42 ± 14, 50% female) wore a Fitbit Flex, Jawbone Up24, Misfit Shine, and Actiwatch-2 (AW-2) on the same wrist for seven consecutive 24-hour periods.

Outcome variables included total sleep time (TST), wake after sleep onset (WASO), and sleep efficiency (SE) averaged over 7 nights. Both "Normal" and "Sensitive" sleep-recording Fitbit modes were examined. Each commercial monitor was compared with AW-2 using paired t-test and Bland-Altman concordance analyses. Clinical acceptance was defined a priori as ≤60 minutes difference between devices for TST and WASO, and ≤10% difference for SE.

Results: Fitbit (normal), Jawbone, and Misfit were in the clinically acceptable range for TST, with Fitbit (normal) and Misfit overestimating by 2 minutes and 60 minutes, respectively; and Jawbone underestimating by 15 minutes compared with AW-2 (m=406±47 minutes). Fitbit (sensitive) overestimated by 160 minutes. All devices met clinically acceptable criteria but underestimated WASO by 13 minutes (Jawbone), 21 minutes (Fitbit sensitive), 23 minutes (Fitbit normal), and 25 minutes (Misfit) compared to AW-2 (m=38±15 minutes). Jawbone and Fitbit (normal) met clinically acceptable criteria for SE, with both devices overestimating by 4% and 5%, respectively compared to AW-2 (m=85±6%). Misfit overestimated by 12% and Fitbit (sensitive) underestimated by 30%.

Conclusion: Fitbit (normal) and Jawbone accelerometers provided clinically comparable result for TST, WASO, and SE when compared to AW-2. Misfit met criteria for TST and WASO but not SE. Fitbit (sensitive) performed poorest. Further research is needed to reevaluate these findings with newer models.

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0763

AUTOMATED PIPELINE FOR SPECTRAL ANALYSIS OF EEG DATA: THE NATIONAL SLEEP RESEARCH RESOURCE TOOL

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Introduction: The National Sleep Research Resource (NSRR, www.sleepdata.org) features thousands of polysomnograms (PSGs) that can be analyzed for further understanding how variations in physiological signals associate with health outcomes. Quantitative EEG analysis may help characterize physiological variation. However, analysis of large datasets collected in uncontrolled settings requires a robust pipeline including artifact detectors. To promote community-wide use of PSG data, we developed an open-source, automated pipeline for spectral analysis of sleep EEGs and tested the level of agreement with traditional analysis.

Methods: We used data from the C3-A2 EEG lead in a sample of PSGs from 161 women participating in the Study of Osteoporotic Fractures. The traditional approach used manual artifact removal on 4-s basis and application of commercial spectral analysis software. Automated analysis included spectral power-based artifact detection on 30-s basis and generation of summary figures for adjudication. We compared automatic and manual artifact detection epoch-by-epoch and then compared the average EEG spectral power density in six frequency bands obtained with the two approaches using correlation analysis, Bland-Altman plots and Wilcoxon test.

Results: The automated artifact detection algorithm had high specificity (96.8 to 99.4% in NREM, 96.9 to 99.1% in REM depending on the criterion for comparing 4-s with 30-s epochs) but lower sensitivity (26.7 to 38.1% in NREM, 9.1 to 27.4% in REM). However, we found no clinically or statistically significant differences in power density values, and results were highly correlated (Spearman's r>0.99). Large artifacts (total power >99th percentile) were removed with sensitivity up to 90.9% in NREM, 87.7% in REM, specificity 96.6% and 96.9%.

Conclusion: The automated pipeline generated similar results to those obtained with standard approach, while reducing analysis time 100-fold. This Matlab toolset, publicly available on the NSRR website, can be used to analyze thousands of recordings, allowing for its application in genetics and epidemiological research.

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0764

REFERENCE DATA FOR POLYSOMNOGRAPHIC AND SUBJECTIVE SLEEP IN HEALTHY ADULTS

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Introduction: Reference data for sleep in healthy individuals are needed for the interpretation of polysomnography and subjective sleep parameters. The aim of this analysis was to provide polysomnographic and subjective reference data for two consecutive nights based on a large sample of healthy adults.

Methods: The sample was selected from the archival database of the Sleep Center at the Clinic for Psychiatry and Psychotherapy, Medical Center - University of Freiburg, and consisted of 239 healthy adults aged 19 to 83 years, including 103 males and 136 females, who were divided into five age groups.

Results: Means, standard deviations and percentiles are provided for PSG-derived sleep onset latency, total sleep time, sleep efficiency, wake time after sleep onset, REM latency, number of wake periods, percentages of time spent in different sleep stages, and arousal index for the first and second night. Periodic limb movement index and apnea hypopnea index are provided for the first night. In addition, means and standard deviations for the subjective estimation of sleep onset latency, total sleep time, sleep efficiency, wake time after sleep onset and sleep quality are provided for the same two nights.

Conclusion: Potentials and limitations of the usage of reference data in sleep research and sleep medicine are discussed. We conclude that the informative value of sleep reference data in healthy individuals is limited due to high interindividual and intraindividual variation within sleep variables and lack of research into potential consequences of deviations from the normal range.

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0765

THE EFFECT OF RACE AND AGE ON CLINICAL MSLT VALUES

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Introduction: The MSLT is the gold-standard for sleepiness assessment, yet relatively little is known about how race, gender, and age influence MSLT results. In conditions with symptom overlap (e.g., idiopathic hypersomnia, narcolepsy type 2), diagnosis depends heavily on the MSLT, and demographic features that affect results could have important diagnostic implications.
Methods: PSG and 5-nap MSLTs, performed 2008–2015, were extracted from SleepMed's clinical repository. Split-night and PAP titration studies were excluded, as were patients working shifts/nights. Sleep onset was defined as the first of epoch of any sleep stage. Demographic variability was assessed with mixed-model ANOVA and multiple logistic regression.
Results: The final sample was 2893 patients, with mean age 36 years (range 1–90; 71% Caucasian; 64% female). African-Americans (AA) had shorter MSLs (6.5 vs. 7.5 min; p<.01) and were more likely to have MSLTs suggestive of narcolepsy (≥2 SOREMs/MSL≤8 min) than Caucasians, controlling for habitual sleep duration, PSG sleep duration, RDI, and sex (OR:1.43; p<.01). AA males had a high rate of REM in naps 1–3 (27%), compared to Caucasian females (<15%). Advancing age (≥45 years) accounted for variance in REM tendency, but not sleep latency. Those ≥45 years were less likely to have ≥2 REMs than those younger (OR: 0.49; p<.001) and were 80% more likely to have ambiguous MSLT results (1 REM & MSL≤8 min), controlling for sleep duration, RDI, and sex (p<.01). Children <13 years had higher MSLs than those older (11.6 vs. 7.5 min; p<.001).
Conclusion: Age, gender and ethnicity influence MSLT measures. The high rate of abnormal MSLTs in AA males might reflect a race-related narcolepsy risk, increased REM propensity, or diagnostic delay. The low rate of REM in Caucasian women may be attributable to REM-suppressant medications; these analyses are ongoing. The finding of attenuated REM tendency in older individuals highlights the need for circumspect MSLT interpretation.
Support (If Any): NIH K23 NS083748 (LMT)

0766

RELATIONSHIP BETWEEN SLEEP DURATION AND SELF-REPORTED HEALTH-RELATED QUALITY OF LIFE AMONG US ADULTS WITH NO MAJOR CHRONIC DISEASES, 2014

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Introduction: Current literature shows a bidirectional association between sleep duration and health-related quality of life (HRQOL) among those with chronic diseases such as coronary heart disease (CHD), cancer, chronic obstructive pulmonary disease (COPD), diabetes, or asthma. However, research on the relationship among adults with no history of chronic conditions is limited.
Methods: Using the 2014 Behavioral Risk Factor Surveillance System, we analyzed self-reported data from 172,528 adult respondents aged greater or equal to 18 years with no reported history of nine chronic conditions (CHD, stroke, cancer, COPD, diabetes, asthma, arthritis, depression, or chronic kidney disease). Multivariable logistic regressions were constructed to assess relationships between sleep duration and three self-reported HRQOL after adjustment for sociodemographics, body mass index, and smoking status.
Results: Among respondents with no chronic conditions reported, 8.3% usually slept for less than or equal to 5, 22.5% for 6, 32.6% for 7, 29.4% for 8, 4.2% for 9, and 2.7% for greater than or equal to 10 hours in a 24-hour period. Poor/fair general health was reported by 6.9%; 4.0% reported physical health was not good greater than or equal to 14 days; and 5.3% reported mental health was not good greater than or equal to 14 days; and 2.1% reported 14 or more days of activity limitation in the past 30 days. There were U-shaped relationships of sleep duration to the HRQOL indicators. Compared to adults sleeping 7 hours, those who slept less than or equal to 5 hours or greater than or equal to 10 hours were significantly more likely to report poor/fair general health (adjusted prevalence ratio (PR) [95% confidence interval]=1.71 [1.50–1.95] and 1.37 [1.06–1.77], respectively), physical health not good greater than or equal to 14 days (1.78 [1.50–2.12] and 1.28 [0.86–1.93], respectively), mental health not good greater than or equal to 14 days (2.84 [2.48–3.26] and 1.64 [1.19–2.26], respectively), 14 or more days of activity limitation (2.62 [2.48–3.26] and 1.64 [1.19–2.26], respectively).
Conclusion: Our results indicate that public attention and physician-counseling on sleep and mental health are needed to improve quality of life even among adults with no history of nine chronic conditions.
Support (If Any):

0767

CALENDAR DAY TYPE ACCOUNTS FOR INTRAINDIVIDUAL VARIABILITY IN NONRESTORATIVE SLEEP

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Introduction: Nonrestorative sleep, characterized by lack of refreshment from the previous sleep bout, is an understudied sleep complaint that has recently become more accessible via the newly validated restorative sleep questionnaire (daily version; RSQ). Within-subjects variation in self-reported restorative sleep across multiple daily samplings may be related to factors reflecting school or work schedules, as captured by calendar day of questionnaire administration. The present study used multilevel modeling to determine whether completing the RSQ on weekdays versus weekends accounted for intraindividual variability (IIV) in restorative sleep over consecutive days.
Methods: Psychology undergraduates (N = 164) completed the RSQ online each day for two weeks. Submitted RSQs were electronically time-stamped to record the calendar day of their completion. The data were modeled using a two-level repeated measures structure to predict RSQ with 14 time points (level 1) nested within 164 individuals (level 2). A random intercept model with no predictors (Model 1) was estimated to determine the proportion of total variance in RSQ scores attributable to the nesting structure. Subsequently, dummy-coded calendar day type (weekdays = 0, weekends = 1) was entered as a predictor at level 1 to examine whether nonrestorative sleep differed significantly on weekdays compared to weekends within subjects (Model 2).
Results: Model 1 revealed that 58.7% of total variance in RSQ scores was attributable to IIV, indicating that day-to-day variation in restorative sleep within the same individual exceeded variation between individuals. When day type was added in for Model 2, it accounted for 2.1% of the IIV in RSQ ($p < .001$). Mean RSQ across participants was 4.8 points higher on weekends than on weekdays, indicating more restorative sleep. Based on the -2LL criterion, Model 2 was the best fitting model, $\chi^2(1) = 40.1$, $p < .001$.

Conclusion: Day type explained a small but significant portion of IIV in daily RSQ score, such that participants rated the previous night's sleep bout as more restorative on weekends compared to weekdays. Future studies must explore other variables correlated with IIV in daily measures of sleep disturbance, as well as whether calendar schedule moderates their influence.
Support (If Any): None.

0768

BAYESIAN NETWORK MODELING OF DAYTIME AND NIGHTTIME SLEEP ARCHITECTURE

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Introduction: The complex pattern of sleep stages over a night (sleep architecture) exhibits abnormal patterns in disorders such as apnea and depression. Quantifying variability in sleep architecture caused by benign versus harmful factors may provide a powerful diagnostic tool. Current measures of sleep architecture, such as stage proportions, fail to capture the dynamics of human sleep stage transitions.
Methods: Here, we investigate the effect of individual (age, sex, BMI) and previous sleep factors (time of day, time spent in a stage) on alternate measures of sleep architecture: transition probabilities (the likelihood of transition from one state to another) and stage duration distributions. We fit various discrete Bayesian networks to large amounts of sleep data (>9000 nights/naps) to determine the relational structure between variables.
Results: We find, in accordance with the literature, that sex, age, but not BMI significantly influence sleep stage durations. Specifically, older men have shorter bouts (more fragmentation) of REM sleep (11% more bouts < 6 minutes) and Slow Wave Sleep (2% more bouts < 6 mins) compared to older women. Older males and females had more fragmented sleep across all stages, although this pattern was stronger for males (older vs younger females = 3%, older vs younger males = 5% more < 6 minutes). Interestingly, transition probabilities are unaffected by sex, age, and BMI. Additionally, we find that the identity of the next stage is dependent on only the last two states.
Conclusion: These findings demonstrate low complexity in sleep stage transitions, which can be useful for future work on a higher resolution continuous Bayesian network capable of predicting sleep stage sequences. Future work will also use Bayesian network modeling to characterize differences between healthy and unhealthy sleep architecture patterns.
Support (If Any):

0769

DEVELOPMENT AND INITIAL VALIDATION OF A BRIEF MEASURE OF CONTROL OVER SLEEP

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Introduction: Insufficient and poor quality sleep are important public health concerns. A brief measure of sleep self-efficacy may be helpful in developing successful sleep interventions.
Methods: The BRief Inventory of Sleep Control (BRISC) was developed as part of the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) study, a community-based study of N=1007 adults aged 22–60. Subjects were asked: "How much control do you have over:" with the following 4 items: "When you go to sleep," "When you wake up," "How much you sleep," and "How well you sleep." Response options were "0=None at all," "1=A little control," "2=Some control," "3=A lot of control," and "4=Complete control." Total BRISC scores were computed as an average of item scores. Item and total scores were compared to sleep quality (Pittsburgh Sleep Quality Index[PSQI]), insomnia (Insomnia Severity Index[ISI]), sleepiness (Epworth Sleepiness Scale[ESS]), and sleep duration (NHANES weekday sleep [TST]). Internal consistency was assessed with Cronbach's alpha. Concurrent validity was assessed with regressions adjusted for age, sex, race/ethnicity, and education.
Results: Mean BRISC score was 1.92 (SD=0.92). Cronbach's alpha was 0.80. Each 1-point increase (higher control) was associated with a 2.19pt decrease on PSQI ($p<0.0001$), a 3.12pt decrease on ISI ($p<0.0001$), a 1.37pt decrease on ESS ($p<0.0001$), and 0.53 more hours of sleep ($p<0.0001$). For item-1 (bedtime) each 1pt increase was associated with improved PSQI (B=-1.16pts,$p<0.0001$), ISI (B=-1.68pts,$p<0.0001$), ESS (B=-0.65pts,$p<0.0001$), and TST (B=0.33hrs,$p<0.0001$). Similar results were seen for item-2 (waketime) (B=-1.00,-1.32,-0.77,and 0.26 for PSQI, ISI, ESS, and TST, respectively; all $p<0.0001$), item-3 (sleep duration) (B=-1.67,-2.29,-0.87,and 0.40 for PSQI, ISI, ESS, and TST, respectively; all $p<0.0001$), and item-4 (quality) (B=-1.62,-2.45,-1.09,and 0.32 for PSQI, ISI, ESS, and TST, respectively; all $p<0.0001$).
Conclusion: The BRISC is a reliable and valid screening tool to estimate self-perceived control over sleep across multiple domains. It is brief, simple, and strongly associated with overall self-reported sleep quality, insomnia, daytime sleepiness, and sleep duration.
Support (If Any): K23HL110216 and R21ES022931.

0770

THE FORD INSOMNIA RESPONSE TO STRESS TEST IN THE FRAMINGHAM HEART STUDY

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Introduction: The Ford Insomnia Response to Stress Test (FIRST) is a 9-item self-report measure of trait vulnerability to sleep reactivity. It is biologically plausible that increased stress reactivity can have pervasive effects on sleep and health. The FIRST has shown acceptable reliability and validity, is predictive of future sleep dysfunction, and has been related to objective measures of sleep reactivity. To date, several critical aspects of this measure remain unexplored, including: 1) normative data in an unselected population, and 2) its relation to demographic, psychiatric and medical comorbidities.
Methods: The FIRST was administered to 2,548 individuals of the Framingham Heart Study's Offspring and Omni cohorts (1,406 females). Descriptive statistics were conducted to determine the mean, median, standard deviation, and range of the FIRST. Between groups comparisons assessed the difference between gender and medical diagnoses: hypertension, obesity, diabetes, COPD, asthma, ischemic heart disease, stroke, congestive heart failure, anxiety, and depression. Pearson correlations assessed the relation between the FIRST and age, depression (Center for Epidemiologic Studies Depression Scale; CES-D), and quality of life (12-Item Short Form Health Survey; SF-12).

Results: The average age of the sample was 70.0 (SD=8.5; range 44–95). FIRST scores ranged from 0–27, with a mean of 8.30 (SD=5.9) and a median of 7. There were significant differences for gender (women > men, p<.0001), COPD (p= .02), asthma (p=.03), anxiety (p<.0001), and depression (p<.0001). The FIRST correlated with age (r=-0.08), depression (r=0.34), and quality of life (r=-0.29), with all p-values <.0001.
Conclusion: This study provides useful normative data for the FIRST. Higher sleep reactivity is related to younger age, gender, depression, and poorer quality of life. Future analysis will assess relationships with cognition, biological markers such as endothelial function and inflammation.
Support (If Any): NHLBI N01 HC 25195.

0771

THE NATIONAL SLEEP FOUNDATION'S SLEEP HEALTH INDEX

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Introduction: Sleep health is essential for overall health and well-being. Therefore, a validated subjective assessment of sleep health would be an important research tool, particularly when objective measures of sleep are not feasible. As such, the National Sleep Foundation (NSF) spearheaded the development of the Sleep Health Index® (SHI).
Methods: The development of the SHI involved a task force of sleep experts who identified key sleep domains. From an extensive list of items they provided, an initial draft of survey questions was created and questions were further refined using cognitive testing and pretesting. The resulting 28-question survey was administered via random-sample phone interviews to a nationally representative sample of adults in 2014 (n=1253) and 2015 (n=1250). These two surveys were combined to create the index. A factor analysis linked 14 questions to three discrete domains: sleep quality, sleep duration and disordered sleep. These were assembled as sub-indices, then combined to form the overall SHI with scores ranging from 0 to 100 (higher score reflects better sleep health).
Results: Americans earned an SHI score equivalent to a C grade (score 76), with sub-index scores of B- (score 81) in disordered sleep, C+ (score 79) in sleep duration and D+ (score 68) in sleep quality. In regression analyses, the strongest independent predictors of sleep health were self-reported stress (β=-0.26) and overall health (β=0.26), which were also the strongest predictors of sleep quality (β=-0.32, β=0.27 respectively). The 2014 and 2015 surveys produced virtually identical results.
Conclusion: The current 14-item SHI is a valid, reliable research tool that robustly measures the sleep health status of adults in the U.S. Given its inclusion of three separate but related elements of sleep health - duration, disorders and quality - SHI provides the information that is too often lacking in the determination of one's general health: sleep health.
Support (If Any): The Sleep Health Index® is funded and supported by the National Sleep Foundation.

0772

STANFORD AND VISUAL ANALOG SCALE PILOT CORRELATIONS WITH PSYCHO VIGILANCE TEST AND REACTION TIME RESPONSE - IN A NON-SLEEPY HEALTHY YOUTH

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Introduction: Sleepiness in clinical care is identified by utilization of questionnaires and offers at best a qualitative estimate of the parameter. There is need for an objective, physiological tool to quantify alertness. We propose to compare A) PVT reaction time of three devices with a visual analog scale (VAS), B) the Stanford Sleepiness Scale
Methods: A subject obtained an observational data. Data collected included sleepiness questionnaires a visual analog scale for sleepiness. Concurrently, objective physiological vigilance, reaction time (primary outcome in mSec) was measured using an iPhone mobile application and 2 web based psycho-vigilance test. Statistical Analysis: We used Statview Version 5.01 (SAS institute Inc. Cary, NC) for analysis. We described continuous data by mean ± standard deviation, and categorical data by percent. Spearman's rank correlations were constructed between the Stanford sleepiness scale questionnaire, the VAS and the physiological measurements.
Results: Data was obtained during a 30 days span. The Florida-PVT had a mean of 328 mSec ± 15 SD. The Harvard-PVT had a mean of 346 mSec + *16* SD. The iPhone had a mean of 319 mSec ± 62 SD. The measurements' mean of all three were included inside the ± 1.96 SD of each other. The VAS had a mean of 4 ± 1.6 SD and the Stanford a mean of 3.9 ± 1.2 SD. We found the Spearman's rank correlation coefficient between the VAS with the three measurements noted in Fig 1. The R for Harvard-PVT was 0.17, Florida-PVT was 0.18 & for the iPhone Reaction Time was 0.8. We found the Spearman's rank correlation coefficient between the Stanford with the three measurements noted in Fig 2. The R for Harvard-PVT 0.3 was, Florida-PVT was 0.35 & for the iPhone Reaction Time was 0.08.
Conclusion: These tools represent the best sample available of easy to use affordable physiological-objective testing for alertness-arousal reaction time.
Support (If Any):

0773

INTERRATER RELIABILITY FOR SLEEP STAGE SCORING FROM ELEVEN JAPANESE LABORATORIES

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Introduction: Interrater reliability (IRR) of sleep stage scorings has an essential impact on the reading of polysomnographic studies (PSGs) for clinical trials. This is the first investigation on IRR for sleep stage scoring between experienced scorers from plural Japanese laboratories where the Japan Association of Polysomnographic Technologists (JAPT) member belongs to.
Methods: Forty experienced sleep technologists from eleven sleep laboratories, which mean experienced years were 9.2, were enrolled in this study. A normal sleep sample of the adult included 999 epochs. One of specific scoring software (NightOwl Professional, NoruPro Light Systems, Inc. Japan) were used to eliminate a visual difference in indication between software. Mean epoch agreement

between scorers, standard deviation (SD) and coefficient of variation (CV) of each laboratory were reported for the IRR and summarized by the central analyst. The conservative R&K rule was used in the three laboratories, and the AASM scoring manual used in the eight.

Results: The overall sleep stage agreement averaged 86.5% (min.80.9% to max. 92.6%) from the all laboratories. Agreements increased from the R&K (82.6%) to the AASM (87.4%) for all sleep stages, and CV decreased from the R&K (4.39%) to the AASM (3.55%). With regard to stages, the agreement was highest for stage R, followed by stage N2, stage W, stage N3 and stage N1. The CV was lowest for stage R, followed by stage N2, stage W, stage N1 and stage N3.

Conclusion: In spite of the first investigation of the JAPT, it was recognized high IRR more than the previous report. Also it came out according to the previous reports that the IRR of the AASM manual was higher than the R&K and unevenness of stage scoring between scorers was recognized in stageN1 and N3.

Support (If Any): non

0774

COMPARISON OF WRISTBAND-BASED AND ECG-BASED SLEEP ANALYSES

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Introduction: Nowadays, the concept of sleep health management is well accepted, and consumer sleep technologies are commonly utilized in mobile devices including high-end wristbands and smartwatches. However, most wearable devices on the market are entertainment-oriented, and cannot generate reliable sleep assessments; their accuracy of sleep evaluation has not been studied systematically. The objective of this study is to compare the result of sleep analysis obtained by a wristband with the result from a well-accepted ECG-based sleep analysis approach, known as Cardiopulmonary Coupling (CPC).

Methods: HUAWEI FIT (Honor Watch S1), which implemented an algorithm based on heart rate variability developed by Nanjing Fengsheng Yongkang Software Technology Co., Ltd. (NFYST), was used. In the study, 200 subjects (100 males, 50%) were recruited, from three Chinese cities (Dongguan, Suzhou and Nanjing), with an age range of 18-45years (median age 27yr). All subjects made records for the test night, including time for bed, time to fall asleep and wake-up time in the morning.

Results: The subjects reported total sleep time (TST) ranged from 135 to 550 minutes (median TST = 401min). The data from wristband and ECG recordings were extracted and analyzed by the NFYST algorithm and CPC analysis, respectively. To investigate the accuracy of the classification obtained by wristband, six measures were calculated, and the median of six measures are stable sleep detection (83.71%); unstable sleep detection (74.53%); REM sleep detection (81.01%); stable sleep duration (88.09%); unstable sleep duration (89.77%); REM sleep duration (83.04%). The results show that the classifications obtained by wristband and CPC analysis are consistent.

Conclusion: Sleep quality evaluation obtained from a wristband can be accurate on the identification of sleep states. Further applications for detecting sleep disorders are worth studying. Portable or wearable devices may play an important role in monitoring sleep quality or sleep disorder screening at home.

Support (If Any): None.

0775

SLEEP STAGE ESTIMATION USING A NON-CONTACT BIOSENSOR

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Introduction: Polysomnography is a gold standard sleep evaluation mainly conducted in sleep labs. Repetitive evaluation of sleep quality at home could be useful in the management of insomnia especially when there is discrepancy between subjective and objective sleep. The aim of the study was to evaluate the characteristic of a non-contact sensor in identifying sleep stages.

Methods: Fifteen patients who underwent diagnostic polysomnography (PSG) at the university sleep laboratory were recruited. Non-contact biosensor measuring heart rate, respiration and body movement was laid under a bed mattress. Sleep stages were scores based on a AAMS standard procedure for PSG, and sleep stage analysis for the non-contact device was made using a previously reported method (Harada et al., 2016). Pattern of hypnogram obtained from standard PSG and non-contact device was compared. The study was approved by the institutional review board and written informed consent was obtained.

Results: Recordings were successfully completed in all cases. On average, non-contact device obtained heart rate and respiration data in 89.2% and 70.6% of the recording time respectively. Non-contact device mostly identified the sleep architecture trend, but non-contact device tend to overestimate slow wave sleep, especially in patients with repetitive arousals or awakenings.

Conclusion: Non-contact sensor equipped under the bed mattress was able to identify clinically useful sleep quality data. Some modification in the detection of respiration signal and the analysis argorhythm idetifying brief awakenings may be necesarry.

Support (If Any):

0776

SLEEPHEALTH MOBILE APP STUDY: BRINGING THE SLEEP LAB TO YOU

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Introduction: Conducting research using personal smartphones is a novel approach to the study of health and disease that is only beginning to be meaningfully explored. The SleepHealth Mobile App study utilized Apple's open source ResearchKit framework to deploy a smartphone app based research study directly to participants with the aim of developing a better understanding of the relationship between sleep habits and daytime functioning.

Methods: SleepHealth launched March, 2016 on the Apple App Store. Users downloaded the app, learned about the study via study website and the app, and signed up using an electronic informed consent process. The study was comprised of questionnaires and activities that assessed sleep quality and daytime functioning. This included sleep habits, AM/PM check-ins, alertness and sleepiness tracking, and a nap tracker.

Results: Since launch, SleepHealth was viewed 47,847 times and downloaded 17,699 times, resulting in 9,499 total participants.

Our sample was approximately 76% male with a mean age of 36.9 (SD=13.1). 40% believed that they had a sleep problem, and about 40% had mentioned this to a clinician. 50% reported that they did not take naps, and about 60% reported that they were very dependent on their alarm clocks, suggesting they may be sleep deprived. 55% reported having flexible work hours. Of note, 65% of our sample had never participated in a research study before.
Conclusion: Our experience to date shows that use of a mobile application to conduct a study of sleep and daytime functioning is feasible and scalable. Clear advantages of using the ResearchKit platform are costs, ease of deployability, participant reach, and ability to query participants on a daily basis outside of a traditional laboratory setting. Limitations are that the research is not being carried out in a controlled environment and is currently limited to Apple users.
Support (If Any): N/A.

0777

VALIDATION OF THE SLEEP-WAKE SCORING OF A NEW WRIST WORN ALERTNESS MONITORING DEVICE

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Introduction: The MyCadian (MC) is a wrist-worn device designed to monitor alertness. The current study was designed to test the reliability of MC sleep-wake scoring.
Methods: Participants were 27 adult, good sleepers who underwent one night of polysomnography (PSG) while wearing MC and the validated Actiwatch 2 (AW; Phillips Respironics) on their nondominant wrist. PSGs were manually stage scored. All data were rendered in binary fashion (0=wake, 1=sleep) for each 30 second epoch. After excluding missing data (n=3 missing AW, n=2 missing MC, n=2 with partial night MC), 20 participants had full night data on all three devices with 17,734 total epochs. With PSG as the gold standard, pooled epoch-by-epoch agreement for sleep vs. wake was calculated for MC and for AW using percent agreement and Cohen's kappa statistic. Positive predictive values for PSG scored sleep epochs and PSG scored wake epochs as well as sleep continuity statistics were calculated.
Results: Percent agreement with PSG scored epochs of wake and sleep was 91.3% for MC and 87.7% for AW. The kappa statistic was 0.67 for MC and 0.50 for AW. Positive predictive values for sleep stages were 94.4% and 90.8% for MC and AW, respectively, and 74.5% and 65.6% for wake stages. Both devices tended to underscore wake and overscore sleep epochs compared to PSG. Descriptively, compared to PSG, sleep latency was higher with MC and wake after sleep onset higher with AW. Total sleep time and sleep efficiency were somewhat more similar across devices.
Conclusion: Reliability of MC compared to PSG scoring was similar to or slightly more favorable than reliability of AW. The 0.67 kappa statistic for MC is consistent with a high level of agreement with PSG. Findings suggest that MC provides reliable sleep-wake scoring during a nocturnal sleep period for good sleepers.
Support (If Any): CurAegis Technologies provided the test device and the actigraphy units to the study free of charge for the duration of the study. **Disclaimer:** The authors' views or opinions do not necessarily represent those of the Department of Veterans Affairs or the United States Government.

0778

VALIDATION OF MINUTE-TO-MINUTE SCORING FOR SLEEP AND WAKE PERIODS IN A CONSUMER WEARABLE DEVICE

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Introduction: Actigraphs are portable wrist-worn devices that record tri-axial accelerometry data. The data can then be used to approximate amount and timing of sleep and wake. Actigraphs are used both clinically and in research studies. The expense of such devices, however, limit their utility. Tri-axial accelerometer-based consumer wearable devices have gained worldwide popularity and hold potential for a cost effective alternative to the more expensive devices for sleep research. The lack of independent validation of minute-to-minute accelerometer data for these consumer wearable devices has hindered their utility and acceptance.
Methods: We studied a new consumer-grade wearable device, Arc ($50, Huami Inc., Mountain View CA) for which minute-to-minute tri-axial accelerometer data (vector magnitude) were made available. Twelve healthy participants wore on their non-dominant wrist both an Arc and a clinical actigraph (Actiwatch Spectrum, Philips, Bend OR) continuously over a period of 48 hours in free-living conditions. Time-stamped data from each participants were aligned and the Cole-Kripke algorithm was used to determine sleep or wake for each 60s epoch (automatic thresholding was used for scoring). Receiver operating characteristic curves were plotted to optimize the relationship between the two devices.
Results: Treating the Actiwatch as a gold-standard for determination of "sleep" and "wake", Arc has an average sensitivity [TP/(TP+FN)] of 99.8 ± 0.05% (SEM), specificity [TN/(TN+FP)] of 85.1 ± 2.9% and precision [TP/(TP+FP)] of 99.5 ± 0.2% for the determination of sleep. For wake detection, Arc has a sensitivity of 85.1 ± 2.7%, specificity of 99.8 ± 0.05% and precision of 94.5 ± 1.3%.
Conclusion: Preliminary results indicate that high degrees of agreement in minute-to-minute data scoring for sleep and wake periods were found between a consumer-grade and research-grade actigraph. Concomitant validation of the Actiwatch and of the Arc consumer-grade device against overnight polysomnography will be an important next step.
Support (If Any): NHLBI T32.

0779

WRIST-WORN ACTIVITY MONITORING DEVICES OVERESTIMATE SLEEP DURATION AND EFFICIENCY IN HEALTHY ADULTS

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Introduction: The use of activity monitors for sleep measurement purposes has increased in research and consumer settings. However, validation of such monitors is lacking. This study examined agreement on total sleep time (TST) and sleep efficiency (SE) between polysomnography and three activity monitors - Actiwatch Spectrum Pro (ACT), Fitbit One (FB) and Jawbone UP2 (JB). Differences between polysomnography and each activity monitor, and differences between research-grade ACT and commercial devices FB and JB, were examined.

Methods: Twenty-two healthy adults (M_{age} =29.3, SD_{age}=11.4) had one night of sleep measured by polysomnography and each activity monitor simultaneously in a laboratory. Minute-by-minute data were extracted and compared. Wilcoxon signed-ranks tests assessed statistical differences between measures, and Bland-Altman analyses examined clinically meaningful differences between measures, using cut-offs of ±30 minutes for TST and ±5% for SE.
Results: Compared to polysomnography, all activity monitors significantly overestimated TST and SE. Differences between polysomnography and each monitor were also clinically meaningful, as Bland-Altman upper and lower limits of agreement for TST exceeded clinical cut-offs for ACT (-64.7min-+166.1min), FB (-66.1min-+189.2min), and JB (-103.6min-+186.2min). Similarly, upper and lower limits of agreement for SE exceeded clinical cut-offs for ACT (-13.0%-+34.0%), FB (-13.1%-+38.5%), and JB (-20.7%-+37.9%). Compared to ACT, only FB significantly overestimated TST and SE. However, differences between ACT and each of FB and JB were clinically meaningful. For FB, Bland-Altman upper limits of agreement exceeded clinical cut-offs for TST (-18.7min-+40.2min) and SE (-3.8%-+8.1%). For JB, upper and lower limits of agreement exceeded clinical cut-offs for TST (-100.4min-+79.3min) and SE (-20.1%-+16.0%). Agreement between devices decreased as TST and SE decreased. All monitors demonstrated poor specificity (18.8–35.6%), but high sensitivity (94.2–99.2%).
Conclusion: Results suggest these models of ACT, FB, and JB cannot be used interchangeably with polysomnography. When activity monitors must be used, such as in field settings, FB and JB cannot replace research-grade ACT. Overall, users should account for each monitor's potential to overestimate or underestimate TST and SE to an unacceptable degree. Future research should examine within-subject variability over time to determine whether monitors can be used to track long-term sleep patterns.
Support (If Any): N/A.

0780

WEARABLE SLEEP EPIDEMIOLOGY IN THE FRAMINGHAM HEART STUDY

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Introduction: Wearable devices for sleep assessments offer a cost-effective and convenient alternative to traditional measures of sleep. Devices are now available to measure oxygenation, respiration electrocardiogram, and electroencephalogram in the home environment. This study assessed standard (oximetry) and novel (cardiopulmonary coupling) measures of sleep state in a well-established epidemiology cohort.
Methods: Data were collected from 846 participants of the Framingham Heart Study's second generation and Omni cohort (mean age: 67.9; 484 female). Sleep studies were mailed to each participant, with a single-lead ECG device manufactured by MyCardio, LLC (www.sleepimage.com), an oximetry device manufactured by Nonin, and a brochure to direct the application of the devices. The FDA approved M1 measures electrocardiogram, body position, trunk activity, and snoring. The analysis uses cardiopulmonary coupling to generate the following measures: high and low frequency coupling (HFC and LFC, stable and unstable NREM, respectively), and a biomarker of high loop gain (narrow-band elevated low frequency coupling). The mean, standard deviation, and intra-class correlation coefficient (ICC) were calculated for HFC, LFC, oxygen desaturation index (ODI), and time with oxygen saturation below 90%.
Results: A total of 972 participants agreed to participate. 126 participants were unable or refused to complete the study. 830 and 836 participants obtained at least 4 hours of data with the M1 and oximetry device for at least one night, respectively. 574 participants wore both devices for 2 consecutive nights (803 wore M1, 695 wore Ox for 2 consecutive nights). The mean (SD) were as follows: HFC 43.5%(18.8), LFC 37.28%(17.03), ODI 8.3(8.5), oxygen saturation below 90% 48.1(77.24) minutes, and 52.5% of the sample had narrow band coupling. The ICC for these variables ranged from 74.5%-99.9%, suggesting high night to night data and physiological signal stability. Associations with common medical co-morbidities will be presented.
Conclusion: The results suggest that home/wearable assessment of sleep is 1) feasible, cost-effective, and yields reliable results; 2) inter-individual differences are stable; 3) measures can be readily repeated; 4) in-person visits are not required, markedly simplifying data collection. Both standard and novel measures can be collected.
Support (If Any): NHLBI N01 HC 25195, BIDMC Chief Academic Officer's Innovation Grant.

0781

A UNIQUE NON-CONTACT METHOD TO ASSESS SLEEP QUALITY BY DETECTING BODY MOVEMENTS VIA MONITORING AIR-BORNE PARTICLES IN AN ULTRACLEAN SPACE

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Introduction: Although polysomnography (PSG) is the gold standard test for diagnosing sleep disorders, it is labor-intensive and requires a variety of monitoring devices that may affect sleep quality. We recently proposed a novel Clean Unit System Platform (CUSP) to establish a dust/microbe-free environment for various purposes. Tent-type CUSP enables us to detect fluctuation in air-borne-particle counts as bio-kinetic signals reflecting body movements during sleep, which we designated as "kinetosomnogram" (KSG). Our goal is to investigate whether the KSG is of any use in evaluating sleep quality.
Methods: We validated air-cleansing capacity of the tent CUSP and recorded changes in particle counts (sum of all particles with diameter > 0.5μm) in response to various body movements. A volunteer with a PSG equipment stayed in the tent CUSP overnight to record a KSG (the experiments were repeated three times). The KSG was compared with PSG sleep stages, and was subjected to power spectral analysis.
Results: Air quality was improved from 50000–150000/cubic feet (cf) to 0–300/cf in 5 minutes. A bout of body rolling causes a surge of air-borne particles with a peak of 3000–6000/cf in a minute, and raising a hand or a leg does the same with a peak of 1000–2000/cf. Each surge in the KSG appears to have a corresponding arousal response (stage W) in the PSG. Moreover, there is a significant peak of power spectral density at 80–100 minutes suggesting of REM periods.
Conclusion: The tent CUSP provides us with ultraclean environment for sleep and would be of significant help to assess sleep quality in a non-invasive and non-contact manner.
Support (If Any): This work is, in part, supported by Gant-in-Aid for Challenging Exploratory Research [15K15280] from Japan Society for the Promotion of Science (JSPS).

0782

DEVELOPMENT AND USER TESTING OF A TECHNOLOGY ASSISTED INTERVENTION TO EXTEND SLEEP DURATION

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Introduction: It is estimated that 29% of adults sleep <6 hours on weeknights. Short sleep duration contributes to the development of chronic illnesses, increased risk for injury and economic costs. Few studies have evaluated interventions to extend sleep and existing sleep extension studies have not focused on interventions to motivate lasting behavior change. The rapidly expanding popularity of wearable sleep tracking devices provides an opportunity to engage users in their own behavior change. The purpose of this study is to describe the development and testing of a technology assisted sleep extension intervention and provide initial user testing data.
Methods: The intervention included a smartphone application, wearable sleep tracker and brief telephone. The theoretic basis of the intervention used concepts from cognitive behavioral therapy and motivational interviewing to target bedtime procrastination and sleep irregularity. We conducted user testing and collected feedback from 10 participants and evaluated adherence and sleep duration outcomes of two participants who completed the four week intervention. Participants wore actiwatches during the intervention period and completed the Epworth Sleepiness Scale at baseline and week 4.
Results: Results suggested that users enjoyed the use of the wearable sleep tracker and found the application visually pleasing. The brief telephone coaching was viewed as helpful and feasible. Feedback from participants suggested changes in notifications and reminders may improve the experience of the intervention. Among the intervention completers, baseline sleep duration was 5.8 and 4.3 hours, ESS was 7 and 18. They completed 100% of the coaching sessions and wore the device 50 and 80% of nights. Sleep duration improved by 1.6 and 1.7 hours per night from week 1 to week 4 and ESS decreased by 7 and 9 points.
Conclusion: Results from user testing demonstrate that we developed an enjoyable and feasible technology assisted intervention to extend sleep duration. Future studies will develop refinements in notifications and test the intervention in larger samples.
Support (If Any): 1K23HL109110 and a pilot grant provided by the Center for Behavioral Intervention Technology (CBITS) at Northwestern University.

0783

DOES THE NIGHT SHIFT MODE FOR YOUR TABLET LIMIT MELATONIN SUPPRESSION?

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Introduction: Self-luminous electronic devices emit white light, including optical radiation at short wavelengths that can suppress nocturnal melatonin production. Software applications that change the spectral composition of an iPad screen to reduce short-wavelength light now exist. The goal of the study was to investigate whether iPads in the Night Shift mode suppresses melatonin.
Methods: A within-subjects study (n=6) took place on four nights, one week apart. Experimental conditions employed were: 1) orange-tinted glasses (filtered optical radiation below 525 nm) and iPad, 2) 40 lux of short-wavelength ("blue") light goggles (peak λ = 475 nm) and iPad, 3) iPad with Night Shift at "more warm" setting, and 4) iPad with Night Shift mode at "less warm" setting. The slide for brightness setting was set to the highest. The orange glasses served as a control condition since it removed short-wavelength radiation; the blue-light goggles were known to suppress melatonin. Participants used the device for 2 h. One saliva sample was collected in dim light and two samples were collected 1 h and 2 h later, while participants were using the device. Light meters calibrated in terms of circadian-effective light exposures characterized the stimulus.
Results: Melatonin suppression was calculated using the orange-tinted glasses condition as the dark control night. Analyses of variance revealed a significant main effect of lighting conditions ($F_{2,10} = 17.1$; $p = 0.001$). Mean SEM melatonin suppressions after 1 h and 2 h respectively were: blue light goggles = 35% 8% and 52% 4%, Night Shift "less warm" = 16% 9% and 20% 8% and Night Shift "more warm" = 8% 5% and 12% 6%. On average, light levels at the cornea from both Night Shift conditions were below 15 lux.
Conclusion: Setting the Night Shift mode to "more warm" is not sufficient to completely prevent melatonin suppression from tablets. Currently, the Night Shift mode only allows user to slide between "more warm" and "less warm". Changing the brightness setting, which is not part of the Night Shift mode, may be more effective at reducing melatonin suppression.
Support (If Any): nothing to report.

0784

SLEEP VALIDITY OF A NON-CONTACT BEDSIDE MOVEMENT AND RESPIRATION-SENSING DEVICE

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Introduction: Expanding recognition of sleep's importance has created a vast commercial market for sleep monitoring devices. Device reliability is generally presumed, despite low performance: typically, high sleep-detecting sensitivity (≥95%) but poor wake-detecting specificity (≤40%). To describe the validity of a novel device and illustrate the impact of algorithm changes in a fast-adapting market, we compared versions 1 (V1) and 2 (V2) of the S+ by ResMed bedside monitor against PSG.
Methods: Healthy adult sleepers underwent standard PSG, time-synchronized with the non-contact bedside device. Epoch-by-epoch V1 (N=27) and V2 (N=22) validity, and within-subject changes from V1 to V2 (N=22), were tested. Subjects were 41% female, 97% Caucasian, 15% married, aged 29.1(±12) years with a BMI of 27(±6); they had 16(±3) years education and median income $65,000.
Results: Total sleep time [TST] per PSG was 338(±57) minutes with normal sleep architecture. Full sleep staging agreement of V1 was 61(±9)%, while V2 was 62(±7)%. For sleep/wake comparison, sleep sensitivity of V1 and V2 were 93(±6)% and 94(±4)%, while wake specificity of V1 and V2 were 70(±19)% and 73(±20)%. Specificity of V1 and V2 for WBSO were 88(±16)% and 90(±15)%; for WASO they were 51(±23)% and 53(±22)%, respectively. Analysis of within-subject changes follows: overall sleep sensitivity of V2 was significantly lower (p=.026); WBSO specificity did not differ; V2 WASO specificity was significantly higher (p=.022). Stage-specific results and an actigraphy comparison will be presented at the meeting.
Conclusion: Relative to other published evaluations of commercially available, wearable sleep-tracking devices, this bedside device better identifies WBSO - a major challenge in this industry. There is still room to improve WASO specificity of this and all commercial sleep trackers. 100% accuracy is an unrealistic goal; rather, devices should approach PSG human inter-scorer reliability of ~81% for wake specificity.

Support (If Any): Equipment, supplies, participant compensation, and student stipends were provided by ResMed. The faculty supervisor received no salary support or compensation from ResMed.

0785

CYTOKINES, SLEEP, AND DAYTIME SLEEPINESS

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Introduction: A link between sleep disturbances, chronic inflammation and psychiatric disorders has been demonstrated previously. The aim of this study was to investigate the relationship between saliva cytokine concentrations, sleep and daytime sleepiness in healthy young adults.

Methods: N=36 students of Utrecht University, the Netherlands, were examined after a normal night of sleep (without previous day alcohol consumption). Previous night sleep quality was assessed using the Groningen Sleep Quality Scale. Daytime sleepiness was assessed with the Karolinska Sleepiness Scale (KSS), and single item ratings (0, absent, to 10, extreme) of sleepiness and being tired. In addition, the Fatigue-Inertia subscale of the Dutch version of the Profile of Mood States (POMS) scale was completed. Saliva was collected to determine cytokine concentrations of GM-CSF, IFN-γ, TNF-α, IL-1β, IL-2, IL-4, IL-5, IL-6, IL-8 and IL-10. Sleepiness related outcomes were associated with cytokine levels using nonparametric Spearman correlations.

Results: A total of N=36 healthy subjects completed the study (38.9% men). Mean (SD) age was 21.1 (1.8) years of age. No significant correlation was found between saliva cytokine concentrations and previous night sleep quality. Total sleep time correlated significantly with TNF-α (r=-0.339, p=0.043). POMS Fatigue-Inertia scores were significantly correlated with IFN-γ (r= 0.554, p= 0.000) and IL-2 (r= 0.485, p= 0.003). KSS scores were significantly correlated with IFN-γ (r= 0.489, p= 0.002), IL-2 (r= 0.471, p= 0.004), and TNF-α (r=0.368, p=0.027). The single item sleepiness ratings were significantly correlated with IFN-γ (r= 0.373, p= 0.025) and IL-2 (r= 0.353, p= 0.035). The single item being tired ratings were significantly correlated with IFN-γ (r= 0.448, p= 0.006) and IL-2 (r= 0.396, p= 0.017). Correlations with other cytokine concentrations did not reach significance.

Conclusion: A significant association was observed between saliva concentrations of pro-inflammatory cytokines (IL-2, IFN-γ and TNF-α) and daytime outcomes of sleepiness. This study confirms previous findings that, also in healthy young adults, daytime sleepiness and immune functioning are interrelated.

Support (If Any): This study was funded by Utrecht University.

0786

OBJECTIVELY MEASURED SLEEP DURATION, SLEEP DISTURBANCES AND INFLAMMATION IN OLDER WOMEN

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Introduction: Extreme sleep durations and disturbances have been linked with various adverse health outcomes, but the underlying mechanisms are unclear. Chronic systemic inflammation is suggested as a potential pathway, but few population-based studies have assessed the association between objective-measured sleep parameters and different inflammatory markers.

Methods: We studied 1073 older Caucasian women (mean age 83.7 years) who had inflammatory markers measured from blood serum and sleep parameters assessed through wrist actigraphy for a minimum of 3 consecutive 24-hour periods (starting from the day of blood collection, mean 4.1 ± 0.7 days). A subset of 408 women also underwent in-home polysomnography with measurement of nocturnal hypoxemia. Multivariable linear regression models were used to examine the relationship between sleep parameters and (natural) log-transformed inflammatory markers.

Results: After adjustment for age, Body Mass Index, depressive symptoms, alcohol drinking, exercise, comorbidities and mini-mental state examination score, short (<5h) and long (>8h) sleep duration were associated with 25% (β= 0.25, 95%CI=0.07–0.43) and 19% higher levels of C-reactive protein (CRP), compared to those with a sleep duration of 5-8h. Compared to women in the highest quartile of sleep efficiency (>85.8%), those in the lowest quartile (<72.5%) had 19% (β= 0.19, 95%CI=0.01–0.37) higher interleukin-6 (IL-6) levels. Women in the highest quartile (>97min) of wake after sleep onset (WASO) time had 11% higher CRP, 24% higher IL-6 and 6% higher tumor necrosis factor receptor-1 (TNF-R1) levels, compared to those in the lowest quartile (<42.8min). Sleep latency or nocturnal hypoxemia was not associated with any of the inflammatory markers. Results were similar after further adjustment for use of sleep medications, nonsteroidal anti-inflammatory drugs and steroids.

Conclusion: Objectively measured sleep durations and sleep disturbances, particularly WASO, were associated with higher levels of inflammatory markers in older women. Further studies are needed to examine whether chronic inflammation could mediate the association between sleep and risk of adverse health outcomes in the elderly.

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0787

PERCEIVED IMMUNE FUNCTIONING AND SLEEP

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Introduction: The interaction between sleep and biomarkers of immune functioning (e.g., altered cytokine profiles) has been shown previously. The aim of this study was to investigate the relationship between perceived immune functioning and sleep in healthy young adults.

Methods: Students of different Dutch universities participated in an online survey. Subscales of the SLEEP-50 questionnaire were completed to assess narcolepsy, insomnia, and circadian rhythm disorder (CRD). Total Sleep Time (TST), sleep quality, and number of nightly awakenings were assessed as well. Perceived immune functioning was assessed with the Immune function questionnaire (IFQ), and rated on a scale ranging from 0 (very poor) to 10 (excellent). Associations

between sleep outcomes were related to perceived immune functioning using nonparametric Spearman correlations.
Results: A total of 2489 healthy students (16.8% men) completed the survey. Their mean (SD) age was 21.2 (2.1) years old. Perceived immune functioning, as assessed with the IFQ, correlated significantly with scores of insomnia (r = 0.282, p = 0.000), narcolepsy (r = 0.229, p = 0.000), and CRD (r = 0.166, p = 0.000). In line, perceived immune functioning assessed with the 1-item rating also correlated significantly with scores of insomnia (r = -0.193, p = 0.000), narcolepsy (r = -0.135, p = 0.000), and CRD (r = -0.136, p = 0.000). TST did not correlate significantly with perceived immune functioning. The number of nightly awakenings correlated significantly with both the IFQ score (r = 0.185, p = 0.000), and the 1-item perceived immune functioning rating (r = -0.108, p = 0.000). Significant associations were also found between sleep quality and both the IFQ score (r = -0.209, p = 0.000) and 1-item perceived immune functioning rating (r = 0.199, p = 0.000).
Conclusion: Significant associations were observed between perceived immune functioning and various sleep parameters. These results confirm previous findings of a bi-directional relationship between sleep and immune functioning, and suggest that a healthy immune status may contribute to improved sleep, and vice versa.
Support (If Any): The study was funded by Utrecht University.

0788

SLEEP QUALITY IS ASSOCIATED WITH PHYSICAL FUNCTIONING DURING ACUTE HOSPITALIZATION AND PREDICTS FUNCTIONAL RECOVERY FOLLOWING HOSPITALIZATION IN OLDER ADULTS

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Introduction: Poor sleep quality, a frequent problem in older adults, has been shown to be associated with reduced physical function and wellbeing. However, little is known about the relationship between sleep quality and the recovery of physical function after hospitalization. Thus, we conducted this study to examine the association between sleep quality and functional recovery after an acute hospitalization in community dwelling older adults.
Methods: Older adult patients (N=27, mean age= 74 ± 8 years) were recruited during an acute hospitalization (average length of stay 3.9 days) with Cardiovascular (56%), Pulmonary (22%), or Metabolic (13%) admission diagnosis. Testing was performed prior to discharge (baseline) and 1-month post-discharge. Functional performance was measured using the Short Physical Performance Battery (SPPB) which consists of three tests of lower body function: a short timed walk at usual gait speed, five repeated chair stands, and a standing balance exercise. Each of the three performance measures was scored from 0 to 4, with 0 indicating inability to complete the test and 4 indicating the highest level of performance. Sleep quality was measured using Pittsburgh Sleep Quality Index (PSQI) global score.
Results: Pearson correlations revealed significant associations between PSQI and SPPB total (r = -.40, p=.044) and SPPB usual gait speed (r=-.52, p=.007) scores at baseline. Separate regression models revealed baseline PSQI score predicted change scores from baseline to 1-month post-discharge for SPPB standing balance (β=.55, p=.012) and SPPB usual gait speed (β=.60, p=.005); with a trend toward significance for SPPB total (β=.43, p=.057) score.
Conclusion: For older adults, poorer sleep quality is associated with worse physical functioning during acute hospitalization. Baseline sleep quality also predicted recovery of physical functioning following hospitalization. These results suggest that interventions to improve sleep quality might help enhance functional recovery from hospitalization and increase physical function levels.
Support (If Any): National Institutes of Health K23NR014008 (PI: Nowakowski), National Dairy Council 1229 (PI: Volpi), and UTMB Pepper OAIC P30AG024832 (PI: Volpi).

0789

CIRCADIAN RHYTHMICITY IN THE ICU: URINARY MELATONIN EXCRETION OF ADULT ICU PATIENTS

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Introduction: The circadian rhythm is an internal body cadence, responsible for regulation of sleep in all mammals. In humans, this clock is altered by several factors, including light and secretion of the hormone melatonin. Within the intensive care unit (ICU) population, it is well evidenced that patients suffer from circadian dysregulation, often for long periods of time.
Methods: A prospective cohort pilot study of five subjects was undertaken to enable a greater understanding of sleep in medical ICU in Manitoba, Canada. From a total of thirty-six urine samples per subject, excretion of 6sulphatoxymelatonin (aMT6s), the urinary metabolite of melatonin was analyzed.
Results: T-test comparison (p=0.05) of mean aMT6s (ng/mL) demonstrated significant differences in the nighttime excretion between subjects in this study and healthy individuals. No significant differences were observed when compared with mean aMT6s of ICU subjects in previous literature.
Conclusion: Significant aberrancies in nighttime urinary melatonin excretion can be observed when compared to healthy individuals in adult medical ICU patients.
Support (If Any): NA

0790

SLEEP DURATION AND PHYSICAL ACTIVITY AS PREDICTORS OF MEASURES OF ADIPOSITY: NHANES 2009–2012

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Introduction: Short (<7hrs) and long (≥9hrs) sleep duration, as well as low levels of physical activity are independently associated with measures of adiposity, but there is limited research on the interaction between sleep duration and physical activity as predictors of measures of adiposity. The aim of the study was to investigate the combined roles of sleep duration and moderate-intensity physical activity on measures of adiposity.
Methods: Adults (n = 6,094, >20yrs) from the 2009–2012 National Health and Nutrition Examination Survey (NHANES) were assessed for their habitual sleep duration (<7, 7–8.9, ≥9hrs) and moderate-intensity physical activity (MPA) levels during a typical week (<150 vs. ≥150 min per American Heart Association recommendations). Body mass index (BMI; coded as <25, 25–29.99, ≥30) and waist circumference (cm; coded as <80 vs. ≥80 for women and <94 vs. ≥94 for men)

were also assessed. Weighted, multinomial logistic regression analyses were conducted to assess whether measures of adiposity could be predicted by sleep duration and physical activity duration groups (<6hrs sleep + ≥150min MPA, <6hrs sleep + <150min MPA, 7–8.9hrs sleep + ≥150min MPA [reference], 7–8.9hrs sleep + <150min MPA, ≥9hrs sleep + ≥150min MPA, ≥9hrs sleep + <150min MPA) adjusting for demographics (age, sex, race/ethnicity, education, household income), as well as self-reported diabetes, stroke, heart attack, congestive heart failure, and coronary heart disease.

Results: Compared to participants who slept 7–8.9hrs and had ≥150 minutes of MPA, participants reporting <7hrs of sleep had significantly greater odds for obesity (BMI≥30) whether they met guidelines for MPA (OR:1.47, 95%CI: 1.08–1.99) or not (OR:1.56, 95%CI: 1.23–1.98). Participants who reported ≥9hrs of sleep and ≥150 min of MPA had significantly less odds for obesity (OR:0.58, 95%CI: 0.34–0.99). There were no relationships with waist circumference.

Conclusion: Short sleep duration was associated with a greater prevalence of obesity regardless of time spent engaged in MPA. Conversely, long sleep duration and greater MPA was associated with less likelihood of obesity. Future research is needed to understand whether the interaction between sleep duration and physical activity is associated with changes in measures of adiposity over time.

Support (If Any): none

0791

SLEEP HEALTH OF DIVISION 1 COLLEGIATE VARSITY ATHLETES AND IMPACT OF TRAVEL FOR COMPETITION

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Introduction: Sleep is increasingly recognized to be important for optimal athletic performance and for injury prevention and recovery. Little is known about the sleep health of collegiate athletes and we therefore conducted two sleep surveys as well as objective sleep assessments during home and away games.

Methods: Sixty-seven (sample 1) and eighty-two (sample 2) moderate altitude adapted collegiate athletes from a cross-section of varsity sports (men's and women's basketball, cross country, lacrosse, football, men's and women's golf, skiing, soccer, tennis, track and field, and volleyball) completed the sleep survey. Objective sleep of fifteen women's volleyball players was also monitored (Actiwatch Spectrum, Philips) for one week during a home game series at 1655m with matches scheduled at 8PM Friday and 12PM Sunday local time, and one week during an away game at 29m that required westward travel across one time zone and an 8PM Friday local time match.

Results: Athletes in both survey samples reported significant sleep problems and daytime symptoms: 56–59% reported poor sleep quality (PSQI>5); 25–42% reported excessive daytime sleepiness (ESS≥ 10); 54–61% reported obtaining the sleep they needed to feel at their best less than half the time or never; 54–65% reported sleep problems while traveling. Objective sleep assessments during the travel week showed sleep of the women's volleyball team was longest on the day of the away competition (8.9 ± 0.2h), intermediate at home on days prior to travel (7.3 ± 0.2h), and shortest on the travel day home (5.7 ± 0.4h) (all day comparisons $p<0.05$). Total sleep time did not significantly differ during the home game week, but a significant reduction in sleep efficiency from baseline (90.5 ± 0.6%) was observed the day of the home match Friday night (87.7 ± 1.3%) and the Saturday night (86.3 ± 3.0%) before the Sunday afternoon match ($p<0.05$).

Conclusion: Collegiate varsity athletes show clinically relevant sleep problems and daytime consequences, and evidence of sleep disturbance while traveling for competition. Additional research is necessary to determine implications of our findings for collegiate athlete health and to determine if improving sleep can enhance athletic and academic performance or influence injury prevention/recovery.

Support (If Any): Pac-12 Conference, Undergraduate-Research-Opportunities-Program CU-Boulder with HHMI.

0792

SLEEP OPTIMIZATION IMPROVES MOOD DIFFERENTLY BETWEEN CANADIAN NATIONAL TEAM CURLERS AND ROWERS

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Introduction: Elite athletes are at-risk for insufficient sleep, but research on sleep interventions in this population is limited. The current study utilized three different sleep optimization interventions with curlers and female heavyweight rowers to see if optimal sleep would affect mood states differently.

Methods: N=15 Canadian National Team curlers (mean age 30.7 ± 4.5; 8 females) and 11 Canadian Women's heavy-weight National Team rowers (mean age 26.0 ± 3.1) completed the Profile of Mood States at two time points during their competitive season; once before the sleep interventions (baseline; BL), and once after the 3.5-week sleep intervention (SI) phase. The sleep interventions consisted of increasing nighttime sleep, napping, and reducing the negative effects of technology use by putting away electronic devices an hour before bedtime. All interventions were the same between sports except the rowers additionally wore blue-blocking glasses in the two hours before bedtime. Data were analyzed with independent samples t-tests to compare differences in POMS sub-scales of tension-anxiety, depression, fatigue, vigor, and total scores between both sports at baseline. Paired sample t-tests by sport were used to compare changes in the sub-scales and total mood scores between baseline and post-intervention.

Results: At BL, the rowers had higher levels of tension-anxiety (t_{24}=2.51, p=0.019), fatigue (t_{24}=2.90, p=0.008), depression (t_{24}=2.18, p=0.039), and total mood symptoms (t_{24}=2.14, p=0.043) when compared to the curlers. The rowers reduced depression symptoms after the SI phase (t_{10}=2.84, p = 0.018). The curlers reduced fatigue (t_{14}=2.63, p=0.020), increased vigor (t_{14}=2.97, p=0.010), and reduced total mood symptoms (t_{14}=2.70, p=0.017) after the SI phase.

Conclusion: In this sample of elite athletes from two different National Team sports, the rowers had poorer mood symptoms at BL and did not improve mood states as much as the curlers after the SI phase. It is likely that stress related to the preparations for the Rio 2016 Summer Olympics hindered the effectiveness of the interventions in the rowers. Further research is needed to assess the interventions across the Olympic quadrennial preparation cycle and to determine the optimal implementation strategy for different teams and athletes.

Support (If Any): Own the Podium and Mitacs Accelerate.

0793

PRELIMINARY RESULTS OF A SLEEP HEALTH INTERVENTION IN STUDENT ATHLETES: CHANGES IN SLEEP, ENERGY LEVEL, AND MENTAL WELL-BEING, AND BODY WEIGHT

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Introduction: Student athletes are at high risk of sleep problems, perhaps due to over-scheduling and difficulty balancing academics and athletics. Although many athletics programs use nutrition, physical activity, and stress reduction programs to improve quality of life for student athletes, few are employing sleep interventions. The present study evaluated a relatively simple sleep health intervention to see if it improved sleep, energy level, stress, and weight.
Methods: This single-group pilot of a sleep health intervention was conducted across the Fall semester among student athletes. It included an intake survey, a 90min education session, 10 weeks of daily sleep diary, sleep/fitness tracker use, and text message reminders, 24/7 access to peer support and study staff for questions, and a follow-up survey at the end of the study. N=40 students were enrolled, though only N=35 have yet completed the follow-up survey. For those that completed baseline and follow-up surveys, paired t-tests (one-tailed due to lack of power in this pilot study) examined changes in Pittsburgh Sleep Quality Index (PSQI, total score, bedtime, waketime, sleep latency, sleep duration), Insomnia Severity Index (ISI), GAD7 anxiety scale, drowsy driving in the past 30 days, (CIRENS energy scale; energy level in the morning, night, and total), and body weight.
Results: The intervention resulted in reduced sleep latency (12mins,p=0.0002), advanced waketime (32mins,p=0.033), lower PSQI score (1.3pts,p=0.04), lower ISI score (3.5pts,p=0.0007), lower GAD score (1.6pts,p=0.025), decreased drowsy driving (67%,p=0.009), increased morning energy (19%,p=0.05), increased evening energy (22%,p=0.027), increased total energy level (16%,p=0.019), and decreased weight (19.2lbs,p=0.038). No changes were seen for other variables.
Conclusion: A relatively simple intervention based on education and monitoring in a small group of student athletes produced measurable improvements in sleep, energy level, mental health, and reductions in body weight.
Support (If Any): K23HL110216 and NCAA Innovation Grant

0794

EXPOSURE TO INFRARED ENERGY DURING SLEEP IMPROVES NOCTURNAL SLEEP AND REDUCES DAYTIME NAPPING IN AMATEUR ATHLETES

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Introduction: Exposure to infrared energy improves local blood flow, promoting recovery from exercise. We examined the impact of infrared energy exposure during the night on the nocturnal sleep and daytime activity of adults who regularly participated in cross-fit training.
Methods: The 'intervention' bedsheets were imprinted with Far-Infrared Emitting Ceramics (cFIRs) which transforms body warmth into the emission of infrared energy. Seventeen athletes (median age 40 years, range 22–66; 9 male, 8 female) were randomly assigned to sleep with the intervention sheets for 5 weeks. Another 12 athletes were randomly assigned to sleep on identical appearing control sheets for 5 weeks (median age 30 years, range 17–58; 4 males, 8 females). The 5-week intervention period was preceded by one week of observation with actigraphy, and the 5-week randomized period was followed by a one-week 'washout'. Measures included weekly assessment of the Insomnia Severity Index (ISI), the Epworth Sleepiness Scale (ESS), the Patient Health Questionnaire-9 (PHQ9), and the Profile of Mood State (POMS) Fatigue and Vigor subscales. Participants completed daily dairies. Actigraphy was recorded, but will be the subject of a later report.
Results: The ISI scores were lower (better) for the intervention group, with a lower average post-randomization score during the intervention ($p<0.001$). The difference in ISI scores was evident by the first week and sustained across the period of randomization. PHQ9 scores were also lower (better), but this was explained by the single insomnia item in the PHQ9. The proportion of participants taking naps was lower in the intervention group ($p<0.001$). No other measures were statistically significant, but the following variables showed a numerical (non-significant) advantage for the intervention group: POMS-fatigue, sleep latency, number of awakenings, wake after sleep onset, and total sleep time.
Conclusion: This group of cross-fit athletes experienced improvements in self-reported sleep and reduced napping time after exposure to infrared energy during the night. This study is consistent with the premise that infrared energy exposure has a health benefit in humans.
Support (If Any): This work was supported by Multiple Energy Technologies (MET). All authors are either employees or consultants for MET.

0795

IMPORTANCE OF SLEEP DATA IN PREDICTING NEXT-DAY STRESS, HAPPINESS, AND HEALTH IN COLLEGE STUDENTS

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Introduction: Perceived wellbeing, as measured by self-reported health, stress, and happiness, has a number of important clinical health consequences. The ability to model and predict these measures could therefore be immensely beneficial in the treatment and prevention of mental illness. However, predicting self-reported health, stress, and happiness is a difficult problem often requiring large, multi-modal datasets. We show that the accuracy for predicting next-day wellbeing is improved when including simple sleep features.
Methods: Data from 144 college students were collected during a 30-day study. Participants wore two sensors to collect actigraphy and physiology data, installed a data logger on their smartphone, and filled out online surveys. Participants self-reported daily on three wellbeing measures (stress - calm; sad - happy; sick - healthy) using a visual analog scale (later scored 0 to 100). The top and bottom 40% of scores were assigned positive and negative labels, respectively. A hierarchical bayes machine learning algorithm was trained to predict each next-day wellbeing label on two data sets: (1) including self-reported sleep features (e.g., self-reported sleep latency, bedtime, and wake time), and (2) discarding sleep features. Both data sets include approximately 20 features computed from wearable sensors, phone, and online surveys. In total, 2,769 days of data were used.

Results: Without including the sleep features, hold-out test accuracies for stress, happiness, and healthy were 79.62%, 78.24%, 83.55%, respectively. When including sleep features, the accuracies were improved for the stress and happy predictions to 80.67%, 80.40%, respectively; however the healthy prediction accuracy worsened slightly to 83.12%. Using McNemar's test we find that including sleep features does not significantly improve the classifiers for the stress or healthy prediction, but does significantly improve the classifier for the happy prediction ($p<0.15$).
Conclusion: The inclusion of sleep features improved the prediction of next-data self-reported stress/calm and happy/sad metric of individuals above a classifier using features from smartphones and wearables. Future studies of personalized prediction of happy/sad and stress/calm ought to consider including self-reported sleep features in order to improve prediction.
Support (If Any): MIT Media Lab Consortium, NIH (R01GM105018, K24HL105664), Samsung Electronics, and Canada's NSERC program.

0796

SLEEP AND CARDIOMETABOLIC HEALTH: SHOULD COLLEGE STUDENTS BE CONCERNED?

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Introduction: Sleep is a major lifestyle factor that changes when a student begins college. Sleep duration and quality have been shown to influence cardiometabolic risk factors. In this epidemiological study, we investigated the association of sleep with cardiometabolic measures in a college student population using a sleep extension protocol.
Methods: We studied an undergraduate student population (n=48; 69% F) ages 18–23 (20.56 ± 1.17) for 14 days in real-life conditions. We excluded for any sleep or cardiometabolic disorders. Sleep measures included sleep duration assessed by actigraphy and sleepiness assessed by daily-questionnaires and in-lab surveys including Epworth Sleepiness Scale (ESS). Cardiometabolic measures included blood pressures (BP), report of physical activity and nutritional choices. There were 2 conditions: habitual sleep (week 1, day 1–7) and sleep extension (week 2, day 8–14). Surveys and BP readings were collected during lab visits days 7 and 14. Daily-questionnaires consisted of 5 questions assessing nutrition, sleepiness and physical activity. Analysis was completed using ANOVA for survey data and multi-level modeling was used for daily-questionnaire data; both were adjusted for age and gender.
Results: Sleep extension protocol showed a significant difference in actigraphically-assessed sleep duration between week 1 and week 2 ($p<.0001$). Mean ± SD sleep duration in week 1 (6.23 ± 0.59 hours) significantly increased with the sleep extension condition (7.16 ± 0.57 hours). Sleep duration was significantly associated with daily sleepiness ratings ($p<.0001$). Average sleepiness measured by global ESS scores was also marginally less at week 2 than week 1 ($p=.05$). No association was seen with BP, self-reported physical activity or nutritional choices. Further analyses of actigraphy data for sleep and physical activity patterns are underway.
Conclusion: We found a significant association between sleep duration and sleepiness ratings such that in the sleep extension condition (week 2) participants reported less sleepiness in ESS scores for the week and in daily questionnaires. These findings indicate that sleep extension is feasible in college students to improve sleep health, which can lead to improved daytime function.
Support (If Any): This study was supported by grants from The Pennsylvania State University.

0797

THE CORRELATION BETWEEN NAPS AND OTHER SLEEP INDICES IN COLLEGE STUDENTS

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Introduction: College is a common time to nap frequently given self-chosen class schedules and the absence of parental supervision. Napping has been shown to correlate with students' high achievement yet, there is little research on how naps affect other sleep indices. Knowledge of how naps affect total sleep time, sleep efficiency, sleep onset latency, and other important sleep indices, can offer insight into when, and for whom, naps can be beneficial.
Methods: Fifty-four college students (age: M=19.58, SD=1.49; gender: 82.7% female) used actigraph watches (Actigraph Corp.) for an average of 7 days, recording their wake- and sleep-related movement. They completed sleep diaries each morning regarding their sleep the night before. Sleep diaries were used to inform actigraphy data calculated by Actilife software, specifically to obtain sleep-onset latency. Three participants provided unusable actigraphy data and were excluded from analyses.
Results: Number of sleep periods over the course of one week (range: 6–15) was used as the measure of naps and correlated with actigraphy measures. More sleep periods correlated with less total sleep time (r = -.451, p = .001), less time awake after sleep onset (r = -.353, p = .011), fewer awakenings (r = -.498, p < .001), and increased sleep efficiency (r = .287, p = .041). There was also a trending correlation with shorter sleep onset latency (r = -.244, p = .084).
Conclusion: The findings suggest that those students who are napping more are not getting enough sleep during the night and are incurring greater sleep debt, and hence greater sleep drive. This would explain an increased number of naps during the week, as well as greater efficiency of sleep during the hours they do sleep at night.
Support (If Any): None.

0798

MEMORY FOR NOCTURNAL AWAKENINGS: TIME COURSE AND AUTONOMIC AROUSAL

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Introduction: Memory is weaker for stimuli presented closer to sleep onset. Cortical arousal, which is greater in people with insomnia, is associated with less of this amnesia. This lower amnesia has in turn been suggested to explain sleep misperception in insomnia. Previous research has examined memory immediately prior to sleep onset and the influence of cortical arousal, primarily using daytime nap paradigms. The goal of this study was to explore the time course of memory across an awakening from nocturnal sleep and the influence of autonomic arousal.
Methods: Forty healthy participants (mean age 20.28, SD=2.31; 65% female) completed one night of polysomnography. After five minutes of continuous N2 sleep in the third NREM period, participants were woken, kept awake for 15 minutes, and then allowed to return to sleep. Throughout this period of wakefulness, auditory word stimuli were presented every 30 seconds. In the morning, participants completed recognition testing. Stimuli were divided by which third of the awakening they were presented and recognition was compared. Greater autonomic arousal was operationalized as lower parasympathetic control

of cardiac rate (respiratory sinus arrhythmia; RSA), derived from electrocardiogram.
Results: There was a significant difference in recognition of stimuli by which third of the awakening they were presented, $F(2, 117)= 30.25$, $p<.0001$. Recognition for the first third (M=62%, SD=18%) was greater than the middle third (M=44% SD=21%), which in turn was greater than the final third (M=31%, SD=14%), Bonferroni-corrected post-hoc comparison p's<.01. Recognition of stimuli presented during the final third was negatively correlated with RSA, $r(40) = -.32$, $p<.05$. Recognition of stimuli presented during the first and middle thirds were not associated with RSA, p's>.4.
Conclusion: Memory was strongest for stimuli presented in the first third of an awakening from sleep and weakest for stimuli presented in the final third, closest to sleep onset. This suggests that the effect of primacy, but not recency, holds for stimuli presented during awakenings from sleep. Lower autonomic arousal was associated with weaker memory, but only for stimuli presented during the final third of the awakening when recognition was lowest.
Support (If Any): University of Arizona GPSC grant RSRCH-512 FY'15.

0799

MORNINGNESS-EVENINGNESS TENDENCY AND SLEEP ARCHITECTURE OF AFTERNOON NAPS IN UNIVERSITY STUDENTS IN UNIVERSITY STUDENTS

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Introduction: The aim of this study was to investigate the effects of morningness-eveningness tendency on the sleep architecture of afternoon naps in university students after adjustments for sex, body mass index, nighttime total sleep time, caffeine consumption habits.
Methods: This study had a cross-sectional descriptive correlational design. Polysomnography was used to record the sleep architecture of 52 students invited to take an afternoon nap in the laboratory. Two questionnaires were used to collect their sleep-related information. The morningness-eveningness questionnaire evaluated the morningness-eveningness tendency. Daily sleep diary collected individual's sleeping and waking times during the prior week.
Results: After adjustments for potential factors, the non-morning tendency (non-MT) participants had significantly shorter sleep onset latency during nap than did the morning tendency (MT) participants with. We observed that among non-MT participants, students with short nocturnal sleep duration in previous day had significantly longer percentage of slow wave sleep and rapid eye movement in naps; and the difference was not found among MT participants.
Conclusion: This study was the first to examine the association between the morningness-eveningness tendency and sleep architecture of afternoon naps in young adults. This study suggests that compared to participants with MT, the sleep architecture of nap in non-MT participants was affected by previous nocturnal sleep, and they are more likely to fall asleep during naps.
Support (If Any): NA

0800

WANT TO IMPROVE COLLEGE STUDENT SLEEP? MAKE IT AN ASSIGNMENT

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Introduction: College students are notoriously bad sleepers. Many factors contribute to poor sleep in college students. Some of which are non-modifiable (being away from home), while the majority are behavior based (sleep schedule, screen time, exercise & diet). However, it is very difficult to motivate college students to change their behavior. One great motivator of college students is their grade (GPA). We have seized upon this motivation and implemented a lifestyle change assignment that focuses on improving sleep.
Methods: Undergraduate freshmen at a large public research-one University in the southern United States who were enrolled in a freshman signature course (Sleep: Are We Getting Enough?) participated. During the month of November, students selected a specific sleep related behavior (e.g. caffeine intake, electronic use) that they would change during the assignment period (1 month). November was chosen specifically because it includes major testing and visits home for Thanksgiving. These challenges provide an opportunity to practice a lifestyle change during stressful times. Students completed an initial lifestyle change plan, three ongoing weekly progress reports, and one final reflection. Goal attainment scaling was used by the students to structure and evaluate their lifestyle change goals.
Results: 256 students completed this assignment. Students identified barriers and facilitators to achieving their lifestyle change goals. A majority of students self reported a 'significant' improvement in their sleep quality over the course of the assignment. Data analysis is ongoing. Specific barriers and facilitators to goal attainment will be presented. Additionally, data gathered regarding lessons learned about the lifestyle change process will be discussed.
Conclusion: College students are able to make positive changes to improve their sleep; however, the motivation to do so is often extrinsic. The most effective way to improve sleep quality in college students may be to 'attach a grade' to the activity.
Support (If Any): none

AQ1

0801

IDENTIFYING CURRENT PRACTICES AND OPPORTUNITIES FOR STRENGTH-BASED INTERVENTIONS TO IMPROVE UNIVERSITY STUDENTS' SLEEP HABITS ANDOUTCOMES: A CAMPUS-WIDE SURVEY

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Introduction: For many students sleep deficiency is a routinely accepted part of university. This is concerning; we know that sleep deficiency exerts a significant toll on students' physical and emotional health, and decreases their capacity for critical academic skills including learning, memory and problem solving. Research clearly demonstrates the relationship between sleep deficiency in college and university students and risk-taking behaviours such as drink driving, mental health conditions including suicidality, depression and anxiety, decreased self-efficacy, substance misuse, binge drinking and excessive caffeine consumption, smoking and high rates of social media use. Many university students bring poor sleep habits and pre-existing sleep disorders into their pursuit of higher education. Compounding these pre-existing factors are new social and financial pressures, increased anxiety, and sleep-disruptive living environments. Students sacrifice sleep in pursuit of higher grades and academic achievement regardless of evidence that self-reported sleep quality and frequency significantly predict grades.
Methods: We carried out a campus-wide anonymous internet survey determining students' self-reported sleep patterns, sources of

advice for sleep problems, current sleep promoting practices, and preferred mechanisms to receive new information assisting with sleep problems.
Results: 1,294 students (78.0% undergraduates; 87.5% living off-campus, 77.5% female) from the University of Alberta, Canada participated. 30.5% reported sleeping less than 6.5 hours a night; 66.5% stated they had insufficient sleep; 80.6% reported they had not sought help. Those that did seek help turned to family/friends and physicians for the most part. The three most frequent behaviours students used to aid sleep were reading a book, listening to music, and adjusting the heat. Participants' preferences for receiving more information were predominately short-online video clips with an option to contact someone for one-to-one more personalized advice.
Conclusion: Although widely reported, students seldom sought help for sleep problems. Students already practice several sleep strategies (reading books for example) that, employing a strengths-based behavioural change intervention, could potentially be modified providing evidence-based sleep promoting strategies.
Support (If Any): Department of Occupational Therapy, Faculty of Rehabilitation Medicine, University of Alberta

0802

DETERMINING UNIVERSITY STUDENT SLEEP PATTERNS AND OPTIONS FOR INTERVENTION: AN INTERNATIONAL COLLABORATION

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Introduction: Disordered sleep, is considered a complex condition and has a significant impact on physical and mental health, cognition, learning and overall wellbeing. However, many higher education students accept sleep deficiency as a part of the 'job description', and chronic sleep deficiency is high across most campuses. In a study conducted by the University of Alberta, Canada in 2016, a campus-wide survey of 1294 students determined their self-reported sleep patterns, where they sought advice for sleep problems, current sleep practices, and preferred methods for receiving helpful sleep information. The paper reports an Australian replication of that Canadian study with the aim of identifying cross-cultural similarities and differences.
Methods: An anonymous electronic survey distributed to all levels of university students at Edith Cowan University, Australia over a three month period. Using the same methodology as the Canadian study to collect data on an Australian population, contextual differences and similarities in sleep habits will be identified between Australian and Canadian tertiary students.
Results: The 2016 study identified concerning sleep problems in Canadian students, with significant numbers of students reporting sleeping less than the recommended number of hours, having insufficient sleep, and not seeking help for sleep problems. The Australian replication study is currently underway and findings to-date indicate some unique cultural differences. Implications of the full findings will be discussed.
Conclusion: Canadian and Australian populations are often assumed to be culturally and socio-politically alike. This research will shed light on the accuracy of this assumption by determining basic sleep knowledge and sleep habits of tertiary students, and their preferred methods for dissemination of sleep health promotion messages. Importantly, this knowledge will help to inform the development of student sleep awareness and intervention strategies in both countries.
Support (If Any): Edith Cowan UniversityUniversity of Alberta

0803

WHY SLEEP MATTERS: THE MACROECONOMIC COSTS OF INSUFFICIENT SLEEP

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Introduction: The Centers for Disease Control and Prevention (CDC) has declared insufficient sleep a 'public health problem'. According to the CDC, more than a third of American adults are not getting enough sleep on a regular basis. However, insufficient sleep is not exclusively a U.S. problem, but also affects other industrialised countries such as the United Kingdom, Japan, Germany or Canada. A robust and growing literature has documented the public health consequences of insufficient sleep, in terms of increased morbidity and mortality. However, to date, there has been no comprehensive and cross-national study of the economic implications of sleep loss.
Methods: Using a macroeconomic modelling approach, we develop a general equilibrium model (so called 'Overlapping Generations Model') that simulates various agents in an economy, including individuals, firms and the government, and their interactions over time. In our model, the effect of insufficient sleep is translated into the supply of effective labour units in the economy, which in turn, is affected through three mechanisms related to mortality and productivity: increased mortality risk associated with insufficient sleep which reduces the size of the working population; increased worker absenteeism or presenteeism (i.e., reduced performance while at work), and sub-optimal school performance in younger years which hinders skill development. The human capital effect is taken into account by modelling shifts in the skill distribution at the point in time when individuals enter the labour market.
Results: Our findings suggest that the relative estimated loss of economic output is highest for Japan (1.86 to 2.92 % of GDP), followed by the U.S (1.56 to 2.28 % of GDP), the UK (1.36 to 1.86 % of GDP), Germany (1.02 to 1.56 % of GDP) and Canada (0.85 to 1.56 % of GDP). This represents large annual macroeconomic costs related to insufficient sleep across five OECD countries ($ 457 billion to $ 680 billion in total).
Conclusion: Substantial research has documented the public health consequences of sleep loss; however, these findings are the first, on a global-scale to demonstrate the significant economic consequences of sleep loss.
Support (If Any):

0804

THE IMPACT OF PERCEIVED HEALTH AND SLEEP ON WELLBEING

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Introduction: Poor sleep quality has a negative impact on daily activities such as driving and job performance, and may also negatively impact mood. Poor sleep quality therefore often translates in poor general health ratings. The aim of this study was to investigate the impact of perceived health and sleep quality on wellbeing of healthy young adults.
Methods: An online survey was completed among university students in The Netherlands. The SLEEP-50 questionnaire subscales

of insomnia, narcolepsy, and circadian rhythm disorder (CRD) were completed, and total sleep time and nightly awakenings were recorded. Sleep quality and perceived general health were rated on a scale ranging from 0 (very poor) to 10 (excellent). The 5-item World Health Organization Well-Being Index (WHO-5) was used to assess psychological well-being. The outcomes were associated using nonparametric Spearman correlations.

Results: N=2489 healthy students (16.8% men, mean ± SD age 21.2±2.1 years old) completed the survey. Perceived general health was significantly associated with SLEEP-50 scores on insomnia (r = -0.278, p = 0.000), narcolepsy (r = -0.181, p = 0.000), and CRD (r = -0.195, p = 0.000), and sleep quality (r = 0.319, p = 0.000). In line, the WHO-5 wellbeing score was significantly associated with SLEEP-50 scores on insomnia (r = -0.411, p = .000), narcolepsy (r = -0.236, p = 0.000), CRD (r = -0.236, p = 0.000), and sleep quality (r = 0.401, p = 0.000). No significant associations were found with total sleep time, or the number of nightly awakenings.

Conclusion: Significant associations were observed between perceived general health, sleep quality, and wellbeing. The current findings confirm that, also in a healthy young population, good sleep contributes significantly to psychological wellbeing.

Support (If Any): The study was funded by Utrecht University.

0805

THE ROLE OF SLEEP EXTENSION AND DEPRIVATION ON EMOTIONAL ATTENTIONAL BIASES IN HEALTHY ADULTS

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Introduction: Previous research has revealed that some pathologies display exaggerated bias towards threatening stimuli, particularly in individuals with anxiety and trauma related disorders compared to normal controls. Sleep loss is often associated with negative changes in mood and emotional control. The dot-probe task is a hallmark behavioral measure of attentional biases towards emotionally charged stimuli. To our knowledge, no study has used the dot-probe to measure emotional attentional biases in healthy subjects subjected to sleep deprivation and extension. In the current study, we sought to assess the effect of a week of sleep extension and one night of sleep deprivation on emotional attentional biases.

Methods: Seven healthy adults (4 females) ranging from 20 to 28 years of age participated in the study. A dot-probe task using various emotionally salient faces presented for 250 ms was utilized to measure attentional biases. The task was administered at approximately 7:40 PM following three different time points: 1) baseline, 2) after 7 nights of a 10 hr time-in-bed sleep extension period, 3) at the end of a 40 hour sleep deprivation period. Emotional biases were calculated by subtracting mean baseline reaction times (neutral-neutral trials) from mean emotion reaction times (emotion-neutral trials). A day (3) by emotion (4) repeated measures ANOVA was performed.

Results: Preliminary results revealed no significant effect of sleep manipulation condition (day: baseline, sleep extension, sleep deprivation) or emotion (sad, angry, disgust, happy) on attentional biases. Additionally, no interaction between day and emotion was found.

Conclusion: These preliminary results indicate that emotional biases (as measured by the dot-probe) may be insensitive to sleep loss and extension. It is important to note that our sleep deprivation period consisted of only one night. Future work should explore the impact of longer sleep debt on emotional attentional biases.

Support (If Any): Department of Defense Military Operational Medicine Research Program (MOMRP)

0806

THE ROLE OF SLEEP PARAMETERS AND INSOMNIA STATUS IN PREDICTING PERCEIVED STRESS

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Introduction: Although stress is associated with sleep disturbances, few studies have examined whether sleep/wake parameters predict perceived stress. Poor sleep can negatively impact daily perceptions. The current study seeks to determine if insomnia status, sleep/wake parameters, and sleep/wake variability predict perceived stress in college students.

Methods: Data was collected for a parent study assessing college students with and without insomnia. Participants (N = 247; 59.5% female; M age = 20.2 years, SD = 2.4) completed one week of daily sleep diaries, the Perceived Stress Scale (PSS), and a clinical diagnostic interview. We conducted a multiple regression using sleep diary parameters (means and standard deviations of circadian midpoint, terminal wakefulness [TWAK], number of awakenings [NWAK], sleep quality [SQ], sleep onset latency [SOL], and wake time after sleep onset [WASO]) as predictors of perceived stress, controlling for insomnia status.

Results: The omnibus regression was statistically significant, with sleep parameters accounting for 38% of variance in perceived stress, $F(9, 136) = 9.32$, $p < .001$, $R2 = .38$. Greater perceived stress was significantly predicted by greater daily fluctuations in sleep timing ($\beta = .24$, $t = 3.54$, $p = .001$), greater mean NWAK ($\beta = .24$, $t = 3.22$, $p = .002$), and insomnia diagnosis ($\beta = .43$, $t = 4.34$, $p < .001$). No other sleep parameters were statistically significant ($ps > .05$). Interaction effects and structure coefficients will be examined in the final presentation.

Conclusion: This study indicates perceived stress is predicted by the variability in sleep timing and number of awakenings when insomnia diagnosis was accounted for. Restless sleep with more awakenings and irregular sleep timing may contribute to increased perceived stress, although causality is yet unexplored in this sample. Future studies should incorporate study designs that can assess causality in the complex relationship between sleep/wake parameters and perceived stress across varied populations.

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0807

COMPARING MOOD FOLLOWING SLEEP EXTENSION AND SLEEP DEPRIVATION

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Introduction: The Profile of Mood States (POMS) scale is a validated measure that assesses changes in mood across different domains. Sleep deprivation studies in particular have shown increases in negative mood subscales of the POMS. In contrast, sleep extension studies have shown improvement in vigor and fatigue. However, to our knowledge, mood changes following sleep extension and sleep deprivation have not been studied in the same participants. The current study sought to investigate the effects of baseline sleep, extended sleep, and sleep deprivation on mood.

Methods: Self-reported mood was assessed using a modified POMS that included seven categories: Fatigue, Vigor, Restlessness, Depression, Anxiety, Anger, Happiness. Eight healthy adults (4 females) were administered the POMS in 4-hour increments (1100, 1500, and 1900hrs) during three sleep conditions: 1) Baseline Sleep:

day following two weeks of normal//baseline sleep, 2) Sleep Extension: day following 7 consecutive nights of extended sleep (10 hours time-in-bed), and 3) Sleep Deprivation: day following one night of total sleep deprivation. The data were analyzed with a 3 (Sleep Condition) x 3 (Time of Day) mixed linear model.

Results: There was a significant main effect of day for vigor ($p = 0.01$), fatigue ($p < 0.001$), anger ($p = 0.001$), and happiness ($p = 0.02$), such that fatigue and anger increased and vigor and happiness decreased following sleep deprivation compared to baseline and extension. Mood was not significantly different between baseline and sleep extension.

Conclusion: These preliminary findings mirror the literature in that participants reported higher negative mood and lower positive mood following sleep deprivation compared to baseline, however, no mood changes were reported for sleep extension compared to baseline in the same group of participants. These results suggest that the impact of total sleep deprivation on mood is much greater than the impact, if any, of sleep extension on mood.

Support (If Any): Department of Defense Military Operational Medicine Research Program (MOMRP)

0808

SOCIAL JET LAG; ASSOCIATIONS WITH SLEEP DURATION AND QUALITY AMONG HEALTHY ADULTS

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Introduction: Social jet lag (SJL) is a discrepancy between an individual's intrinsic circadian preference and their actual sleep times imposed by occupational and social obligations. Greater SJL has been associated with poorer sleep. Many previous studies have relied on self-report measures of SJL. The goal of this study was to examine associations between objectively measured social jet lag with sleep, circadian timing, and daytime sleepiness among healthy adults with habitual sleep duration ≥ 6.5 hours.

Methods: This was a secondary analysis of a larger study of circadian timing and health. Participants included adults aged 18–50 with habitual sleep duration ≥6.5 hours who completed 7 days of wrist actigraphy. Social jet lag was calculated as the difference in midpoint of sleep between work days and free days. Objective sleep variables included: sleep onset and offset times, sleep midpoint, and sleep duration. Self-report measures included the Epworth Sleepiness Scale (ESS) and Pittsburgh Sleep Quality Index (PSQI). Dim light melatonin onset (DLMO) was evaluated in the clinical research unit. Data were analyzed using bivariate correlations.

Results: Participants included 82 adults (n=48 female), with an average age of 26.5 years, SD= 6.9. The average sleep duration on work days and free days was 7.0 hours (SD= 0.9 hours) and 7.5 hours (SD= 1.3 hours), respectively. The average SJL experienced between work days and free days was 0.86 hours (SD= 0.8 hours). 10.8% of participants (n=9) had SJL >2 hours. Greater social jet lag was associated with later sleep onset time on free days ($r= 0.36$, $p= 0.001$) and higher ESS scores ($r= 0.25$, $p= 0.02$). SJL was not associated with sleep duration on work or free days, sleep timing on work days, sleep midpoint, or DLMO.

Conclusion: This study demonstrates that SJL, even among healthy adults with at least 6.5 hours sleep duration, is associated with sleepiness and sleep start times. Lack of association with DLMO and wake time on free days suggests that SJL is not associated with sleep duration or objective measures of biological timing among a sample of healthy adults.

Support (If Any): 1K23HL109110

0809

SOCIAL CAPITAL AND SOCIAL CONNECTEDNESS RELATED TO SLEEP DURATION, INSOMNIA SYMPTOMS, AND DAYTIME SLEEPINESS

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Introduction: Social capital refers to quality of networks of relationships among people who live and work together. Poor social capital predicts adverse outcomes, including cardiovascular disease, diabetes, and increased mortality. Little is known about how social capital relates to sleep health. The current study explored the relationship between social capital and sleep duration, insomnia symptoms, and daytime sleepiness.

Methods: A sample of 1,007 participants from the Sleep Health and Activity, Diet and Environment Study (SHADES) was used. Social Capital was assessed as number of group/club memberships, neighborhood helping behavior, willingness to improve their neighborhood, sense of community belongingness, and trust of others in a community. Sleep duration was assessed with the NHANES questionnaire asking participants to report bed/wake time, then categorized as very short (<5hrs), short (5-6hrs), healthy (7-8hrs), and long (>8hrs). Insomnia was assessed with the Insomnia Severity Index and categorized as none, mild, and moderate-severe. Sleepiness was assessed with the Epworth Sleepiness Scale. Logistic regression examined whether sleep variables and social capital measures were associated.

Results: Compared with healthy sleepers, decreased likelihood of group membership was seen for very short (OR=0.50;95%CI[0.26,0.98];p<0.05) and long (OR=0.41;95%CI[0.18,0.93],p<0.05) sleepers. The belief that neighbors rarely/never help each other was more commonly reported by very short (OR=1.96;95%CI[1.11,3.46],p<0.05) and short (OR=1.64,95%CI[1.14,2.37],p<0.01) sleepers, relative to healthy sleepers, as well as those with moderate-severe insomnia (OR=1.04,95%CI[1.01,1.08],p<0.05) and sleepiness (OR=1.04;95%CI[1.01,1.08];p<0.05). A decreased sense of belongingness was felt by very short (OR=0.57,95%CI[0.35,0.93],p<0.05) and short (OR=0.65;95%CI[0.49,0.86];p<0.01) sleepers, those with moderate-severe insomnia (OR=0.55,95%CI[0.39,0.78],p<0.01) and sleepiness (OR=0.95[95%CI[0.93,0.98];p<0.01). Decreased likelihood of trust was reported by short sleepers (OR=0.74,95%CI[0.54,1.00],p<0.05) and those with moderate-severe insomnia (OR=0.57,95%CI[0.40,0.82],p<0.01) and sleepiness (OR=0.96;95%CI[0.94,0.99];p<0.05). Moderate-severe insomnia was also associated with the belief that neighbors help each other (OR=0.64;95%CI[0.45,0.90];p<0.05).

Conclusion: Measures of poor sleep health (short duration, insomnia, sleepiness) are associated with fewer group memberships, low perceived community belongingness, trust, or intention to engage in neighborhood improvement.

Support (If Any): This work was supported by funding from the NIH (R21ES022931, R25HL116378).

0810

SLEEP AND HEALTHY ACTIVITY, DIET, ENVIRONMENT, AND SOCIALIZATION: THE SHADES STUDY

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Introduction: Identifying the relative contribution of predictors of insufficient sleep can help identify fruitful intervention targets. The goal of this study was to broadly assess the relative contributions of a large number of sleep predictors in a real-world setting.

Methods: Survey data were collected from N=1,007 adults aged 22–60 from the Philadelphia area. Sleep duration was measured using the Sleep Timing Questionnaire, with a 5/2 weighted average of weekday/weekend computed sleep duration. Regression analyses involved hierarchical models assessing relative contributions of a number of domains to sleep duration: demographics (age, gender, race and BMI); overall health (health rating, fatigue, diabetes, and hypertension); mental health (depression, anxiety, and ratings of satisfaction with life, financial situation, health, relationships and sleep); diet (unhealthy diet); activity level (vigorous and moderate activity and sitting); substance use (smoking status, alcohol use, drug use); disturbed environment (sleep environment); socioeconomic status (income quintile, education, social standing in community and U.S., food security, ability to afford basics); social functioning (social support); occupational stress (trouble at work); and measures of underlying sleep disorders (insomnia, poor sleep quality, daytime sleepiness, sleep apnea risk). Neighborhood-level crime rates, demographics, and quality, and relative pollution and traffic levels were also assessed.

Results: Combined, 27.29% of the variance in sleep duration ($p=3.9x10^{21}$) was explained. In individual models, the variables that contributed significant variance included underlying sleep disorders ($R^2=0.154$,$p=1.2x10^{-28}$), mental health ($R^2=0.092$,$p=6.6x10^{-17}$), socioeconomic status ($R^2=0.043$,$p=0.001$), demographics ($R^2=0.029$,$p=0.0003$), social functioning ($R^2=0.024$,$p=1.8x10^{-6}$), neighborhood-level crime ($R^2=0.021$,$p=0.048$), overall health ($R^2=0.019$,$p=0.01$), physical activity ($R^2=0.015$,$p=0.003$), occupational stress ($R^2=0.008$,$p=0.006$), and diet ($R^2=0.006$,$p=0.014$). In a combined model, the following were significant unique contributors: underlying sleep disorders, health, demographics, and disturbed environment.

Conclusion: Poor sleep quality and mental health are the strongest predictors of insufficient sleep, though overall health, activity, diet, the environment, and social functioning are all related to less sleep in a real-world setting.

Support (If Any): R21ES022931 and K23HL110216

0811

A PILOT STUDY ASSESSING WHETHER THE CONSUMPTION OF A PROTEIN-RICH BREAKFAST IMPROVES APPETITE CONTROL, EATING BEHAVIOR, AND SLEEP QUALITY COMPARED TO SKIPPING BREAKFAST IN HEALTHY YOUNG PROFESSIONALS

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Introduction: Previous research has documented the detrimental effects of breakfast skipping on daily appetite control, satiety, & eating behaviors and the improvements in these outcomes following the consumption of a high-protein (HP) breakfast in overweight/obese adolescents. While relatively unexplored, observational studies have also illustrated other health-related detriments with breakfast skipping, including poor sleep quality. Thus, the purpose of this study was to extend the current evidence and examine the effects of consuming a HP breakfast vs. breakfast skipping on appetite control, food intake, and sleep quality in healthy young professionals.

Methods: Thirteen adults (age: 23.5±0.9y; BMI: 23.6±0.6kg/m^2) completed the following randomized cross-over design. The participants consumed a HP breakfast (350kcal; 30g Protein, 35g Carbohydrate, 10g Fat) or skipped breakfast (SKIP) for 7d/pattern. On day 7, a tightly controlled 8h clinical testing day was completed including repeated assessments of perceived hunger, fullness, desire to eat, and prospective food consumption (PFC). Daily food intake & food choice were assessed with an ad libitum packout. Sleep quality was assessed via daily actigraphy & daily sleep diaries.

Results: Daily hunger, desire to eat, and PFC were decreased (all $p < 0.05$) following the HP breakfast vs. SKIP. Daily fullness tended to increase ($p = 0.067$) following the HP breakfast vs. SKIP. The consumption of the HP breakfast tended to decrease total daily food intake (1831±284kcal) vs. SKIP (2251±365kcal, $p = 0.087$), through reductions in ad libitum carbohydrate and fat intake. Although the HP breakfast led to less total sleep time (TST) vs. SKIP ($p < 0.05$), no differences in sleep efficiency (TST/Sleep Period) were detected. Further, perceived sleep quality and sleep onset tended to improve following the HP breakfast vs. SKIP ($p = 0.060$–0.077).

Conclusion: Collectively, the daily consumption of a HP breakfast tended to improve appetite control, reduced food intake, and may support improvements in some aspects of sleep health in healthy professionals.

Support (If Any): Internal Grant

0812

A PRELIMINARY COMPARISON OF FOOD CONSUMPTION, APPETITE, AND EXERCISE SELF-REPORTS IN CHRONIC AND EXPERIMENTAL SLEEP RESTRICTION GROUPS

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Introduction: Previous research has examined sleep restriction (SR) in relation to increased daily caloric intake, suggesting that chronic SR is a significant risk factor for weight gain and obesity. However, few studies have examined behavioral factors that contribute to this weight gain, and no studies have differentiated chronic SR vs. short term SR on these measures. We examined behavioral self-report measures among participants who engage in chronic natural sleep restriction (NSR) and participants who are experimentally sleep restricted (ESR) to elucidate these underlying differences.

Methods: Twelve female participants completed a screening interview to assess for psychopathology and sleep disorders. Participants were then assigned to either an NSR (n=6) or ESR (n=6) group based on sleep diary measures and one week of actigraphy monitoring. NSR participants averaged less than 7 hours TST, and ESR participants averaged between 7–9 hours TST. ESR participants then decreased their TST by 90 minutes per night for 1 week. Self-reported behavioral measures evaluating food consumption, appetite, and exercise duration (vigorous, moderate, and light intensity) were collected for both groups during the monitoring week and for the ESR group during the experimental week.

Results: Findings suggest no significant differences between ESR and NSR groups based on subjective measures of food consumption ($U=17.5$,$n_1=n_2=6$,$p=.936$) and appetite ($U=7.5$,$n_1=n_2=6$,$p=.087$) during monitoring week. No significant differences were observed between groups when comparing final day NSR ratings during

monitoring week with final day ESR ratings during SR week for food consumption (Z=-.736, n=6,p=.461) or appetite (Z=-.816,n=6,p=.414). Lastly, no significant differences were found between groups based on self-reported exercise duration (vigorous intensity: NSR_M=8.25,SD=6.43,ESR_M=13.93,SD=13.54,t=-.928,moderate intensity: NSR_M=10.44,SD=9.72,ESR_M=11.43,SD=8.79,t=-.185, and light intensity: NSR_M=49.14,SD=34.54,ESR_M=26.67,SD=11.73,t=1.509; all p>.18).

Conclusion: Contrary to previous research examining these measures, no differences were found between the NSR and ESR groups. Results suggest that weight gain secondary to sleep restriction, both chronic and short term, may not be the result of behavioral changes. Given these preliminary non-significant findings, further evaluation of the sample is being conducted currently through an examination of changes in participant concentrations of ghrelin and leptin; which are hunger and satiety biomarkers.

Support (If Any): NSU President's Faculty Research and Development Grant

0813

ENHANCING SLOW WAVE ACTIVITY VIA AN AUTOMATED PHASE LOCKED ACOUSTIC STIMULATION

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Introduction: Slow wave activity (SWA) is essential for cortical reorganisation and cognitive function. In healthy young adults, slow wave sleep (SWS) occupies ~18% of TST, declining 2–3%/decade, with a marked reduction in SW amplitude. Given the importance of SWA in maintaining optimal brain function, enhancing SWA is a clear target for improving cognitive function.

Methods: Nine healthy adult men aged 35–47 years participated in a randomized, double blind, cross-over study involving two nights in the laboratory (baseline/night 1 + experimental/night 2) on two occasions, with at least one week in between. Participants wore an automated device delivering auditory tones phase locked to the slow wave to enhance slow wave activity during the STIM condition, but not in the SHAM condition. PVT was administered bi-hourly and measures of executive function 2–4 hours post habitual wake. Data were scored for SWS and power spectra in the delta (0.5-4Hz) and slow oscillations (<1Hz).

Results: Relative to SHAM, STIM significantly increased power spectra for both delta and slow oscillation frequencies, largely due to increased power spectra in the 3rd (slow oscillation) and 4th (delta & slow oscillation) SWS cycle. While this increase was observed over central derivations, this was most apparent at frontal sites. At the individual level, ~80% of participants exhibited enhanced SWA, which ranged from a 5.1–33.5% increase (in power spectra). Large effect sizes were observed for improved executive function (Verbal Fluency) and morning vigilance (PVT) following STIM relative to SHAM.

Conclusion: Our preliminary data suggest an automated phase locked acoustic stimulation device significantly enhanced SWA in healthy middle-aged men, with a clear improvement in cognitive function. Data collection and analyses are ongoing.

Support (If Any): The study was supported by the Cooperative Research Centre for Alertness, Safety and Productivity.

0814

WOULD YOU CALL YOURSELF A SHORT OR LONG SLEEPER? PERCEPTIONS OF SLEEP CATEGORY ASSOCIATED WITH REPORTED SLEEP DURATION, INSOMNIA, AND HEALTH

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Introduction: Short and long sleep durations are prevalent and associated with poor health. This study examined whether an individual's self-identified sleep category (e.g., "short" or "long") relates to observed sleep duration. The study also explored whether perceptions of sleep durations are affected by the presence of insomnia and whether self-described category predicts poor health above observed sleep duration.

Methods: Data were from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) Study, a community-based survey of 1,007 adults (22–60 years old). Sleep duration was assessed with the BRFSS item (sleep per 24h period) and the NHANES item (weekday nighttime sleep) for comparison purposes. Insomnia was measured with the Insomnia Severity Index. Respondents were asked whether they considered themselves a "Very-Short-Sleeper," "Short-Sleeper," "Average-Length-Sleeper," "Long-Sleeper," or "Very-Long-Sleeper." Self-described groups were compared to groups derived from reported sleep duration (<7h=short, 7–8=normal, and >8h=long). Linear regression, adjusted for age, sex, race/ethnicity, and education, evaluated sleep duration differences across groups. Multinomial logistic regression, adjusted for covariates and sleep duration, examined whether insomnia predicts self-described group and whether self-described group predicts poor health.

Results: Overlap between derived and self-described category was modest, with only 62% of 7-8hr sleepers identifying as "average-duration." Similarly, overlap for "short" and "long" sleep was 67% and 52%, respectively. This is in comparison to overlap between BRFSS and NHANES of 77%, 88%, and 33% for average-duration, short, and long sleep. Self-identified "very short sleepers" reported 93 fewer minutes of sleep, vs "average-duration sleepers" (p<0.0001). Similarly, "short sleepers" reported 44 minutes less (p<0.0001), "long sleepers" reported 55 more minutes (p<0.0001), and "very long sleepers" reported 101 more minutes (p<0.0001). Insomnia was positively associated with self-identifying as "very short" (B=1.19,p<0.0001), "short" (B=1.37,p<0.0001), "long" (B=1.07,p<0.0001), and "very long" (B=1.26,p<0.0001). Increased likelihood of being in poor health was associated with self-identified "very short" (OR=2.33,p<0.0001), "short" (OR=2.59,p=0.001), and "very long" (OR=3.64,p=0.006) sleep.

Conclusion: Self-described sleep categories are associated with reported sleep duration, but imperfectly overlap with empirically-defined categories. Insomnia may contribute to perceptions of sleep category as abnormal. Self-identified category predicted poor health above observed sleep duration.

Support (If Any): R21ES022931.

0815

SLEEP DURATION IS A PATHWAY LINKING SLEEP TIMING TO OBESITY IN MIDLIFE WOMEN

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Introduction: Women in midlife are susceptible to experiencing poor sleep and are at risk for obesity. Research identifies poor sleep as a

risk factor for obesity in this population. Though sleep duration has been extensively researched in regard to weight outcomes in midlife women, sleep timing is a relatively novel aspect of sleep linked to obesity. However, it is unclear how sleep timing may contribute to weight outcomes in this population. The current study explored the connection between sleep timing and weight, considering sleep duration as a potential mediator in this association.

Methods: The study is an archival analysis of data from the Midlife in the United States-II study (MIDUS-II), Project 4. The sample consisted of 126 women between the ages of 40 to 64 (M = 52.90, SD = 6.94). Measures included actigraphy (i.e., sleep duration, mean sleep timing) and an objective assessment of obesity (i.e., BMI, waist circumference). A mediation model using Hayes' SPSS PROCESS macro was used to assess study aims.

Results: After controlling for selected covariates, sleep timing was not directly associated with BMI (95% CI [-.0106, .0110]) or waist circumference (95% CI [-.0229, .0349]). However, sleep duration was a significant mediator of sleep timing and BMI (95% CI [.0001, .0123]), and sleep timing and waist circumference (95% CI [.0007, .0378]).

Conclusion: Sleep timing was indirectly associated with weight outcomes in the current sample. Specifically, late sleep timing was associated with decreases in sleep duration, which influenced obesity. Delayed sleep timing, therefore, has implications for weight outcomes in this population via sleep duration. This finding highlights the importance of understanding how sleep behavior impacts weight in midlife women. Although sleep timing alone may not impact weight, findings can inform clinical recommendations regarding preventative and interventional approaches to weight management in this population.

Support (If Any): The MIDUS I study (Midlife in the U.S.) was supported by the John D. and Catherine T. MacArthur Foundation Research Network on Successful Midlife Development. The MIDUS II research was supported by a grant from the National Institute on Aging (P01-AG020166) to conduct a longitudinal follow-up of the MIDUS I investigation.

0816

GENDER DIFFERENCES IN OBSTRUCTIVE SLEEP APNEA (OSA) IN PRE-DIABETIC PATIENTS

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Introduction: Little is known about gender differences in OSA rates among pre-diabetic patient populations. The purpose of this study was to determine if there was a clinical difference in OSA rates between males and females who had pre-diabetes in a community medical practice.

Methods: This study consisted of a total of 65 pre-diabetic patients. According to the American Diabetes Association, pre-diabetes is defined as anyone who has a mean HA1c between 5.7%-6.4%. Patients underwent polysomnography to determine the severity of their OSA. OSA was defined as: mild, moderate or severe based on the Apnea Hypopnea Index (AHI). Mild was classified as AHI of greater than 5 but less than 30 apneas per hour. Moderate was greater than 15 but less than 30 apneas per hour. Severe was defined as over 30 apneas. Males and females were split into two groups where the mean levels of AHI and HA1c were examined based on their respective categories of severity. AHI severity was determined based on two HA1c categories of 5.4 - 6.0 and 6.1 - 6.4. Unpaired t-tests were used to determine significance levels.

Results: The percent of females in this study was 57%. The average age of the entire sample was 51 years. The mean HA1c and AHI for males was 5.99 and 33.79 respectively. The mean HA1c and AHI for females was 5.91 and 29.98 respectively (difference of AHI in males v. females=4; p=0.52). Among males, there was a difference of 7 points in AHI between the 5.4–6.0 and 6.1–6.4 HA1c categories (AHI of 31.27 vs. 38.35 respectively). Among females there was an AHI difference of 5 points between the two HA1c categories (AHI of 28.69 vs. 33.49 respectively). The large difference in AHI points between males and females was observed in the 6.1- 6.4 HA1c category (difference=5; p=0.59).

Conclusion: There were clinically important differences in OSA between males and females across the entire sample and among different HA1c severity categories. Larger samples sizes will be needed in future studies to confirm and validate the significance of these findings.

Support (If Any): Funded by Sleep and Wellness Medical Associates.

0817

ADHERENCE TO CPAP TREATMENT IN WOMEN WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Family physicians are under-referring patients with obstructive sleep apnea (OSA) to sleep medicine specialists for diagnosis and treatment, a phenomenon particularly acute in women. Because recruited women have been found to have a surprisingly high OSA diagnosis rate of substantial severity, the present study examines predictors of continuous positive airway treatment (CPAP) adherence in an exclusively female sample - a group rarely selected for evaluation. The objectives were to describe the factors associated with CPAP non-adherence and to examine predictors of treatment adherence.

Methods: Participants were 29 women (mean age = 56.5, sd = 9.8), recruited from two hospital based family medicine clinics. OSA was diagnosed by polysomnography; insomnia-related variables, quality of life and psychological adjustment were assessed by self-report measures.

Results: There were no significant differences between adherent and non-adherent women with respect to severity of OSA. The adherent group had worse nocturnal and daytime functioning than the non-adherent group; this difference reached statistical significance for feeling unrefreshed in the morning, perceived poor sleep quality, feeling sleepy during the day and having difficulty concentrating.. The two most important adherence predictors were: feeling refreshed in the morning and number of nocturnal awakenings.

Conclusion: Our findings suggest that women with moderate to severe OSA may be identified first by complaints related to feeling unrefreshed in the morning, followed by perceived poor sleep quality, sleepiness during the day and difficulty concentrating. These, also, are the women are most likely to accept and adhere to CPAP treatment. Since adherence predictors were basically sleep quality variables, one might speculate that identified CPAP adherent women in family practice settings may be at risk for having their sleep apnea misdiagnosed as insomnia and subsequently be offered inappropriate treatment (e.g. sedatives or hypnotics). Notably, the non adherent women had equally severe OSA, and these are the women, at elevated risk of having their OSA overlooked by their physician.

Support (If Any): CIHR.

0818

SNORING AND BLOOD PRESSURE IN PREGNANT WOMEN

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Introduction: Sleep disturbances are among the most frequent complaint and a major health problem among pregnant women. Although previous studies have drawn increasing attention to the association between sleep and blood pressure in pregnant women, none of them have included daytime sleep and have modeled snoring and objective sleep quantity as well as sleep quality simultaneously. The purpose of our study was to examine the association between snoring, sleep quality and quantity, and blood pressure in third-trimester pregnant women.
Methods: This study was a cross-sectional analysis of two cohorts of healthy pregnant women recruited from a prenatal clinic in a medical center in Northern Taiwan. A total of 322 women reported sociodemographic and health characteristics in a structured interview and wore a wrist actigraph for 7 consecutive days to assess objective sleep patterns. Women's blood pressure was measured by trained personnel while they were rested and were seated using an electronic sphygmomanometer in the clinic.
Results: One hundred and thirty three (41.3%) women reported snoring. Ninety-three women (28.9%) had nighttime sleep < 6 hours, with only 95 (29.5%) women averaging 7 or more hours of nighttime sleep. In the multivariate analyses, snoring remained as a significant predictor of higher diastolic blood pressure ($\beta = 2.07$, $p < 0.05$) and mean arterial pressure levels ($\beta = 2.00$, $p < 0.05$), after adjustment for age, parity, gestational age, body mass index before pregnancy, and sleep quantity and quality by actigraphy.
Conclusion: Snoring is a highly prevalent condition experienced by healthy third-trimester pregnant women. Clinical assessment and screening of snoring are of utmost importance in obstetric practice to potentially prevent or reduce the associated adverse cardiovascular consequences in women during pregnancy.
Support (If Any):

0819

THE EFFECT OF SLEEP DISORDERED BREATHING IN PREGNANCY ON PERINATAL OUTCOMES

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Introduction: Sleep disordered breathing (SDB) is common during pregnancy. Self-reported snoring has been observed in up to 46% of pregnant women. Studies from recent years suggest that SDB during pregnancy may be associated with adverse maternal and fetal outcomes.
Objectives: To examine the effect of maternal SDB on perinatal outcomes and to compare between chronic snorers to pregnancy-onset snorers.
Methods: Women of singleton pregnancy on their third trimester were recruited prospectively and completed a designated questionnaire. The questionnaire included information regarding medical history, snoring during and before the current pregnancy, the Berlin questionnaire and the Epworth sleepiness scale (ESS). Cord blood pH measurements were performed. Data on delivery, gestational age, offspring's gender, birth weight and Apgar scores was retrieved from the medical records.
Results: Three hundred and forty women were recruited. The mean age was 31.7 ± 4.4 years, the mean pre-pregnancy BMI was $21.9 \pm 3.4\,kg/m^2$ and the mean BMI at time of questionnaire was $26.8 \pm 3.7\,kg/m^2$. Thirty-seven percent (124/340) reported of snoring but only 10% had positive Berlin score. Twelve percent of women were chronic snorers and 25% were pregnancy-onset snorers. The mean ESS score was 8.0 ± 4.2. No differences in ESS scores were found between snorers and non-snorers. No differences were found in gestational age, birth weight percentile, apgar scores and cord blood pH between snorers and non-snorers. Snorers had significantly more instrumental deliveries compared to non-snorers (9% vs. 1.5%; p=0.003). Pregnancy-onset snorers had significantly more instrumental deliveries compared to both chronic-snorers and controls (12%, 2.6% and 1.3% respectively; p=0.006).
Conclusion: Instrumental deliveries are more common among women with SDB particularly among pregnancy-onset snoring.
Support (If Any): The research was supported by the Israel Science Foundation (grant # 707/12)

0820

LINKING STRESS TO PARENTING COMPETENCE AMONG TAIWANESE MOTHERS OF PRETERM INFANTS: THE MEDIATING ROLE OF SLEEP

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Introduction: Mothers with a low-birth-weight (LBW, body weight<2,500g) preterm infant hospitalized in the intensive care unit (ICU) are at risk for sleep disturbance, stress, clinically significant emotional distress (e.g., depression), and low parenting confidence. However, less is known about the pathways through which heightened stress contributes to mothers' reduced confidence in parenting. This study aimed to examine the role of sleep disturbancein mediating the association between stress and perceived confidence in feeding among Taiwanese mothers who cared for a LBW infant hospitalized in the ICU.
Methods: Thirty Taiwanese mothers completed a battery of questionnaires at around 1-month postpartum, including 1) sociodemographic information sheet, 2) General Sleep Disturbance Scale assessing the severity of sleep disturbance; 3) Neonatal Unit Parental Stress Scale measuring the level of maternal stress in social/practical, illness/treatments, and parental role/relationships domains; and 4) Lack of Confidence in Feeding Scale measuring mothers' concerns about feeding their infant.
Results: Mothers who experienced heightened stress were likely to demonstrate clinically significant sleep disturbance and lowed confidence in infant feeding. Moreover, greater sleep disturbance in mothers was associated with decreased confidence in feeding infant. A path model with sleep mediating the link of stress to maternal feeding confidence was tested. Results revealed that the negative effect of parental stress related to infant illness/treatments and parental role/relationships (but not social/practical) on feeding confidence was indirectly mediated by poor sleep.
Conclusion: Sleep quality mediates stress and parenting confidence among mothers of LBW preterm infants during early postpartum. As a gateway in regulating the effect of stress on parenting competence, maternal sleep may be a target for intervention. Better quality in sleep is expected to mitigate the negative effect of stress associated with preterm delivery on perceived parenting. More research is needed to explore the underlying biological and psychological mechanisms that regulate stress and sleep and their contributions to parenting.
Support (If Any): This project was supported by a Scholar Research Grant from the Chiang Ching-kuo Foundation for International Scholarly Exchange.

0821

COMORBID INSOMNIA AND SLEEP DISORDERED BREATHING: ASSOCIATION WITH ADVERSE PREGNANCY OUTCOMES

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Introduction: A substantial percentage of pregnant women report disturbed sleep, including increased awakenings, long periods of wake after sleep onset, and poor sleep quality. Sleep disordered breathing (SDB) and insomnia are common and the co-occurrence of these disorders has been described in non-pregnant cohorts with a prevalence of 30%-50%. Independently, each is associated with increased risk for cardiovascular disease in the general adult population, yet when co-morbid, risk for morbidity substantially increases. To date, no study has examined the co-morbid status or impact in pregnant women.

Methods: The prevalence of insomnia and symptoms of SDB were examined in third trimester women. Habitual snoring (snoring ≥3 times/week) was determined by self-report. Insomnia was determined using the Insomnia Symptom Questionnaire (ISQ). Women were classified as SDB-/ISQ- (n=161; 36.7%), SDB-/ISQ+ (n=146; 33.3%), SDB+/ISQ- (n=63; 14.4%), SDB+/ISQ+ (n=69; 15.7%). Logistic regression models were conducted to investigate the relationship between the groups and adverse outcomes after controlling for key variables including age, race, BMI, parity, and smoking status.

Results: Overall 439 women were included with a mean gestational age of 34.1±3.7 weeks. In separate logistic regressions, comorbid SDB/insomnia was independently associated with gestational hypertension (aOR 6.7 95%CI 1.7–23.3, p=0.006) but no association was found for either insomnia alone or SDB alone. Insomnia alone and comorbid SDB/insomnia were both associated with a baby born large-for-gestational age (aOR 3.4 95%CI 1.3–8.6, p=0.01 and aOR 3.0, 95%CI 1.0–9.5, p=0.05 respectively); However, the presence of SDB alone was not. Women with SDB alone and those with comorbid SDB/insomnia were at increased odds of having an unplanned cesarean section (aOR 2.6 95%CI 1.1–5.9, p=0.025 and aOR 2.4, 95%CI 1.0–5.4, p=0.04 respectively).

Conclusion: This is the first study to demonstrate that comorbid insomnia/SDB is associated with key adverse pregnancy outcomes even in the absence of a relationship with SDB alone. Screening of pregnant women with these symptoms could identify those at high risk for adverse outcomes.

Support (If Any): Gene and Tubie Glimore Award for Sleep Research and National Institutes of Health HL089918.

0822

DOES SLEEP QUALITY DURING PREGNANCY INFLUENCE INITIATION AND CONTINUATION OF BREASTFEEDING?

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Introduction: Pregnant and postpartum women experience significant sleep disruption, but the role that perinatal sleep disturbance plays in breastfeeding is not well understood. This analysis examined whether differences in sleep quality during pregnancy predicted initiation and continuation of breastfeeding and the use of formula. We hypothesized that women with higher sleep efficiencies during pregnancy would be more likely to initiate and continue breastfeeding.

Methods: We studied 48 women (mean age 28.2±4.9 years) with a past history of major depression (n=43) or bipolar disorder (n=5) at 33 weeks gestation and postpartum weeks 2, 6, and 16. Sleep onset, sleep offset, and total sleep time (TST) were estimated with wrist actigraphy averaged over each week. Time in bed was defined as the duration between sleep onset and sleep offset, and sleep efficiency was calculated as TST ÷ Time in Bed x 100. We divided the sample into two groups: "lower sleep efficiency" (LSE) and "higher sleep efficiency" (HSE) based on a median split (cutoff was sleep efficiency = 84.9%). Breastfeeding status was obtained through daily diaries and structured interviews performed at the postpartum time points, and we classified new mothers as No-BF, Mixed-BF (breastfeeding with formula supplementation), and Exclusive-BF.

Results: The percentages of women who did any breastfeeding were: Week 2=72.3%, Week 6=62.5%, Week 16= 50%. The LSE group was less likely than the HSE group to initiate breastfeeding (percent No-BF in LSE=45.8% vs. percent No-BF in HSE=16.7% Chi Square (df=1) = 4.752, p=.029). 62.5% of the Exclusive-BF group and 52% of the Mixed-BF groups were in the HSE group, compared to only 14% of the No-BF group (Chi Square (df=2) = 4.611, p=.10).

Conclusion: In our sample of women a history of depression or bipolar disorder, preserved sleep efficiency during pregnancy was associated with initiation and continuation of breastfeeding. Breastfeeding is an important aspect of maternal and infant physical and mental health. Future work should examine how sleep impacts this complex behavior and whether interventions to improve sleep during pregnancy can increase breastfeeding.

Support (If Any): MH086689 (KMS).

0823

GAMMA-HYDROXYBUTYRATE LEVELS IN BREAST MILK OF WOMEN WITH NARCOLEPSY AND CATAPLEXY (NT1) TREATED WITH SODIUM OXYBATE

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Introduction: Women with NT1 face difficult decisions about medication use during the perinatal period, a time when expectant/new mothers experience shortened, fragmented sleep and optimizing symptom relief is essential. The short half-life of Xyrem (sodium oxybate, SO) suggests that postpartum women may be able to take SO and breastfeed safely. Based on gamma-hydroxybutyrate (GHB) half-life and one case report, current literature suggests waiting 4–5 hours after taking SO to breastfeed. Our goal was to determine concentration of GHB in milk of postpartum women taking SO for treatment of NT1.

Methods: Two women with NT1 treated with SO before pregnancy, who elected to discontinue treatment during pregnancy, collected milk samples for analysis of GHB concentration after resuming SO postpartum. One woman collected 15 samples across 2 nights (doses: 3.0gm and 4.5gm twice per night) five months after the birth of her first child; the other collected 13 samples across 2 nights (doses: 2.25gm and 3.0gm twice per night) nine months after the births of her first two children. GHB concentration was determined by gas chromatography/mass spectrometry in the Mouse Metabolic Phenotyping Center at CWRU.

Results: Endogenous GHB levels before taking SO ranged from 5.81–7.60μM in milk. GHB levels were 2- to 4-times higher 4 hours after the first SO dose (10.44–23.88μM) and 3–5 times higher 4 hours after the second dose (8 hours after first dose; 14.60–34.01μM). In general, GHB levels returned to endogenous levels 6–10 hours following the second SO dose, however variability was observed between patients and pregnancies. Higher GHB levels in breast milk were observed with higher SO doses for both patients.
Conclusion: SO is transmitted to breast milk. Despite its short half-life, GHB concentrations remained 2- to 5-times higher than endogenous levels 4 hours after both nighttime doses. To avoid excess GHB exposure, mothers who take SO and breastfeed should consider expressing and discarding their morning milk. Future work should examine breast milk GHB levels after chronic SO use and determine whether GHB levels change as milk composition changes across the postpartum period.
Support (If Any): Department of Medicine, Brown University. UH Rainbow Babies & Children's Hospital.

0824

SLEEP IN THE POSTPARTUM: ACTIGRAPHY AND SLEEP DIARY DATA

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Introduction: We investigated maternal and infant sleep during in the post-partum period, and examined the relationships between maternal and infant sleep patterns.
Methods: Participants were 5 primiparous mothers and their infants. Mothers were recruited from the postpartum unit at the Jewish General Hospital. Only mothers who had a singleton, healthy, normal birth weight infant following a vaginal birth, who were living with a partner, were included. At two time periods, when infants were 2 and 6 months old, mothers recorded their own and their infants' sleep patterns over 7 consecutive days, using a sleep diary as well as wearing actigraphs (MicroMini-Motionlogger (25 grams, Ambulatory Monitoring Inc., Ardsley, N.Y.). Mothers wore the actigraph on their wrist while infants wore it on their ankle.
Results: Although there was substantial variability in total sleep time across nights, actigraph and diary data indicate that, over a 24-hour period, infants consistently slept more than their mothers, both at 2 and at 6 months postpartum. Actigraphs indicated a median of 7.91 hours' total sleep time for mothers at 2 months and 8.55 hours of sleep at 6 months postpartum. Infants slept 11.04 hours at 2 months and 11.64 hours at six months. Infants also had more disrupted sleep than their mothers, with a higher frequency of separate sleep periods at both time periods. Total nocturnal sleep time generally improved for both mothers and infants over time but number of 24- hour sleep episodes did not appear to change.
Conclusion: Despite the significant sleep disruption (seen objectively in frequent awakening) that the postpartum period brings, mothers appear to be getting a "normal" amount of sleep over a 24-hour period at both 2 and 6 months postpartum. Although sleep diary and actigraphy data result in different numerical values, the two measures confirm the mothers' resilience over this life transition.
Support (If Any): -

0825

FEMALE REPRODUCTIVE HORMONES AND HOT FLASHES IN PERIMENOPAUSAL SLEEP DISRUPTION

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Introduction: Perimenopausal sleep disruption is caused primarily by nocturnal hot flashes (nHF). However, evidence suggests that this is not the only etiology. Changes in gonadal steroids (estradiol and progesterone) may also underlie perimenopausal sleep disturbance. We evaluated if hormone dynamics have an independent contribution to sleep disturbance during the menopause transition. We hypothesized that sleep fragmentation would be associated with hypo-estrogenism and anovulation, indicated by lack of progesterone, especially when nHF are infrequent.
Methods: Daily sleep and HF diaries and weekly serum estradiol and progesterone were obtained for 2 months in perimenopausal women with untreated mild depressive symptoms and no primary sleep disorder (N=50). Weekly mean number of awakenings, wake-time after sleep-onset (WASO), sleep-onset latency, sleep efficiency and nHF frequency were calculated. Repeated-measures linear regression was used to examine associations of gonadal steroids and nHF with sleep parameters, after adjusting for age, depressive symptoms, and the interaction with nHF.
Results: Forty-five (90%) women reported nHF. Seven (14%) women were hypo-estrogenic and 23 (46%) had 1+ progesterone peak. nHF were adversely associated with all sleep parameters ($p \leq 0.02$). Independent of nHF, women reported more awakenings if they were hypo-estrogenic (mean 2.7 vs. 1.5, $p<0.001$). This association was observed when nHF were infrequent ($p<0.006$) but not when frequent ($p=0.57$). The association between lack of progesterone and more awakenings ($p=0.03$) became non-significant after adjusting for nHF. Gonadal steroids were not associated with other sleep parameters, nor were depressive symptoms associated with sleep disturbance.
Conclusion: While nHF are strongly linked with sleep disruption, awakenings are independently associated with hypo-estrogenism when nHF are infrequent. No other sleep parameters are linked with perimenopausal gonadal steroid changes. These findings suggest that nHF explain the majority of perimenopausal sleep complaints, but that withdrawal of estradiol also contributes to awakenings when nHF are infrequent. These findings suggest that gonadal steroid hormones may play an important role in regulating sleep through neural mechanisms in midlife women.
Support (If Any): Funding source: 5R01MH082922.

0826

GENDER DIFFERENCES IN SLEEP DISORDERS AND SERVICE-ASSOCIATED ILLNESSES BETWEEN ACTIVE DUTY MALE AND FEMALE MILITARY PERSONNEL

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Introduction: Active duty service members (ADSM) are susceptible to disturbed sleep and sleep disorders. Studies to date have focused

on male ADSM; however the differences in sleep disorders and service-associated illnesses between male and female remain unexplored. The purpose of this study is to compare sleep disorders and service-associated illnesses between genders in the active duty population.

Methods: We conducted a retrospective review of ADSM who underwent a sleep medicine evaluation and an in-lab attended polysomnogram (PSG). Initial sleep questionnaires, demographics, PSG variables, and the diagnoses of anxiety, depression, pain and post-traumatic stress disorder were reviewed and compared for each gender.

Results: Our cohort consisted of 209 ADSM with 51.7% males. The average age was 34.3+/-8.51, and BMI was 28.4+/-3.97 kg/m^2. In our cohort, 64.6% of the patients had excessive daytime sleepiness (ESS >10) and 67.9% had and Insomnia Severity Index (ISI) of >15. Male ADSM were more likely to have deployed and have higher BMIs than females. Females had a higher rate of insomnia (71.3% versus 38%, p <0.001), while males had a higher rate of OSA (85.2% versus 49.5%, p <0.001). Pain was the most frequent service-associated illness found in 50.0% of male and 59.4% of female ADSM respectively. However, female ADSM were significantly more likely to have anxiety RR 2.02 (1.36 - 2.98) and depression RR 2.65 (1.67 - 4.18) compared to male ADSM.

Conclusion: The active duty population demonstrates gender specific sleep differences. Similar to civilian populations, females had higher rates of insomnia while males were more likely to have OSA. Overall, female ADSM had increased rates of service-associated illnesses, suggesting that disturbed sleep may be ascribed to these disorders as opposed to a primary sleep diagnosis. This study adds to a growing body of literature about sleep disorders in female service members and highlights the importance of evaluating sleep disturbances in women with comorbid illnesses.

Support (If Any):

0827

ASSOCIATIONS BETWEEN EVERYDAY DISCRIMINATION AND SLEEP AMONG AFRICAN AMERICANS IN THE JACKSON HEART STUDY

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Introduction: African Americans are more likely to experience poor sleep than non-Hispanic whites. Psychosocial stressors such as discrimination may contribute to the higher prevalence of poor sleep among African Americans; however, this association is underexplored.

Methods: We investigated longitudinal associations between discrimination and sleep and explored interactions with sex in the Jackson Heart Study (JHS). At two time points (2000–2004 and 2008–2012), participants (N=3749) completed the Williams Everyday Discrimination Scale, self-reported hours of sleep (sleep duration) and rated their sleep quality (1=poor -5=excellent). We fit a series of mixed-effects logistic and linear regression models to examine the association of discrimination (in quartiles) with categorical sleep duration (≤6 hours, or "short" vs. 7 or 8 hours), continuous sleep duration and sleep quality accounting for survey years, demographics, socioeconomic status, and other potential confounders (body mass index, hypertension, diabetes, physical activity, stress, alcohol, social support, smoking, depressive symptoms).

Results: At baseline, participants' mean age was 55.4 ± 12.8 years and 63.5% were female. The prevalence of short sleep was 54.7% and 55.8% at each time point, respectively. Men reported a lower mean sleep duration and reported more experiences with discrimination. The association between discrimination and sleep did not change overtime. In pooled analyses, participants who reported higher levels of discrimination vs. lower levels, had a 43% higher odds (odds ratio (OR)=1.43 confidence interval (CI)=1.26, 1.63) of short sleep, slept 15.3 minutes (-20.63, -9.89) less on average, and had a lower sleep quality score (-0.25 (-0.31, -0.18)). Perceived stress partially explained the associations. In fully-adjusted models, associations were attenuated but persisted. Sex modified the association between everyday discrimination and sleep duration, P<0.10. Women who reported higher levels of discrimination slept 22.3 minutes (-29.93, -14.70) less on average compared to those who reported lower levels of discrimination; there was no association observed among men.

Conclusion: Everyday discrimination was associated with shorter sleep duration and poorer sleep quality across two time points, and women were more vulnerable to the association with sleep duration. Future research should identify interventions that may buffer the effects of discrimination on sleep among African Americans.

Support (If Any): 3R01HL110068-03 and 5T32HL007901-18

0828

BLACK-WHITE DISPARITIES IN SHORT SLEEP DURATION WITHIN DIFFERENT ENVIRONMENTAL HOUSING TYPES IN THE UNITED STATES

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Introduction: Suboptimal housing may contribute to racial disparities in sleep health because many minority groups disproportionately live in lower-socioeconomic status environments. Few studies, however, have investigated if sleep duration varies by race within different types of living quarters.

Methods: Using nationally representative 2013 and 2014 data from the National Health Interview Survey with a cross-sectional design, we investigated self-reported sleep duration by type of living quarter (house/apartment, mobile home/trailer, non-transient hotel, and dormitory) among Black and White adults in the US. Direct age-standardization was used to estimate the prevalence of short sleep duration (<7 hours) by living quarter among Blacks and Whites. While accounting for age, Poisson regression with robust variance was used to directly estimate separate prevalence ratios for short sleep among Blacks compared to Whites within housing types.

Results: Among 51,605 adults (mean age: 48.3 ± 0.16 years), 85% were non-Hispanic Whites and 15% Blacks. Fifty-two percent were female and 20% had an annual income of <$35,000. Blacks made up 15% of participants living in a house/apartment, 11% trailer, 29% hotel, and 25% dormitory. Compared to their White counterparts, Blacks living in houses/apartments had a 41% (Prevalence Ratio (PR): 1.41 [95% Confidence Interval (CI): 1.35–1.46]) increased prevalence of short sleep, a 21% (PR: 0.79 [95% CI: 0.64–0.99]) lower short sleep prevalence in trailers, and a non-significant increased prevalence in hotels or dormitories. Among individuals living in houses/apartments, short sleep was higher among Blacks compared to Whites either with or without certain health conditions; for example, short sleep was

higher among obese Blacks (44.4% [95% CI: 42.3–46.4%]) compared to obese Whites (33.2% [95% CI: 32.0–34.4%]). Although non-significant, there was a suggestion of poorer sleep among Whites living in trailers compared to Blacks. No sleep duration differences were observed between Blacks and Whites receiving government housing assistance.

Conclusion: Racial differences in sleep duration exist within some housing types. Future research needs to identify racial differences in physical and social features of housing and surrounding neighborhood characteristics that contribute to differences in sleep duration as an upstream approach to develop effective interventions that address downstream health disparities.

Support (If Any): N/A

0829

A LARGE CROSS-SECTIONAL STUDY OF THE ASSOCIATIONS BETWEEN NEIGHBORHOOD AND INDIVIDUAL SOCIOECONOMIC STATUS AND SLEEP AND NAPPING

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Introduction: Socioeconomic conditions at the individual and neighborhood levels have been recognized as important players in shaping people's health behaviors and outcomes. Previous studies have linked individual-level indicators of low socioeconomic status (SES), such as racial and ethical minorities, low education and poverty, with sleep problems. Some studies also suggest that disadvantaged neighborhood environment may also be associated with extreme sleep duration and poor sleep quality. In the NIH-AARP diet and Health study, a large cohort of over 300,000 middle-to-old aged Americans, we examined the relationship between neighborhood and individual SES in relation to the duration of night-time sleep and day-time napping.

Methods: At baseline (1995–1996), participants reported habitual sleep duration and daytime napping. Participants also reported their home addresses, which was linked to the 2000 US Census. Demographic variables at census tract level were used to generate a socioeconomic deprivation index by principle component analysis. Individual-level demographic factors were also reported at baseline and we focused on race/ethnicity and education. Multinomial logistic regression with robust variance estimation was used to estimate the odds ratios of each sleep and napping category in relation to quintiles of neighborhood SES and categories of individual-level SES indicators.

Results: Low SES at both the individual and neighborhood level was associated with short sleep duration (<5 hr) and excessive napping (1+ hr). Compared to Whites, Blacks are almost four times more likely to report <5hr of sleep (OR (95% CI), 3.95 (3.63, 4.28)), and 3.5 times more likely to report 1+ hr of napping (3.61 (3.40, 3.82)). Compared to college grads, people with less than high school education were more likely to be short sleepers (4.16 (3.85, 4.50) and excessive nappers (2.84 (2.69, 3.00). Compared to the highest quintile of neighborhood SES, the lowest quintile was also associated with short sleep (2.90 (2.68, 3.13)) and excessive napping (2.81 (2.69, 2.94). Long sleep (9+ hr) was not associated with SES in our study.

Conclusion: Both neighborhood and individual SES are associated with sleep and napping.

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0830

SLEEP DURATION BY SOCIODEMOGRAPHIC, SOCIOECONOMIC, AND GEOGRAPHICAL STATUS: THE REGARDS STUDY

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Introduction: Short (<6hrs) and long (≥9hrs) sleep duration are associated with poor health outcomes and the prevalence of each varies by race, socioeconomic status, and geographical location. Few studies have investigated the joint and interactive relationships among these factors on sleep duration. The aim of this study was to characterize habitual sleep duration in a population-based U.S. cohort of Black and White men and women age ≥ 45 years by race, socioeconomic status, and geographic location.

Methods: Within the REasons for Geographic And Racial Differences in Stroke study, 19,986 participants reported habitual sleep duration. Weighted, average sleep duration on weekdays and weekends was categorized (<6, 6.0–6.9, 7.0–7.9[reference], 8.0–8.9, ≥9hrs). Multinomial logistic regression models predicting sleep duration from age, sex, race, education (<high school[reference], high school graduate, some college, college graduate), income (<$20K[reference], $20-34K, $35-74K, $75K+), marital status (single[reference], married, divorced, widowed, other), U.S. region (Northeast[reference], Midwest, South, West), and all interaction terms for race x education x region were conducted.

Results: Average sleep duration was 7.0hrs (SD=1.3). Prevalence of short (<6hrs) and long (≥9hrs) sleep duration were present in 11.4% (n=2,260) and 7.0% (n=1,395), respectively. In the adjusted models examining the interaction between race x education x region on sleep duration, only the race x education interaction was significant ($p<0.001$). For Whites, the odds for short and long sleep duration versus 7.0-7.9hrs decreased with increasing education, whereas the odds decreased only for Blacks with a college degree. Blacks had a higher prevalence of short sleep duration than Whites, irrespective of educational attainment. Each 10-year increase in age and being married or widowed was associated with greater odds for long sleep duration. Men had greater odds for short sleep duration than women. Income levels greater than $20K were associated with less odds for short and long sleep duration. There was no association with region.

Conclusion: Greater education was associated with more favorable sleep duration overall, but the relationship was weaker for Blacks. These findings highlight the importance of race and education as key interactive modifiers of sleep duration.

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0831

HABITUAL WEEKDAY SLEEP DURATION ASSOCIATED WITH MULTIPLE DIMENSIONS OF SOCIOECONOMIC STATUS

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Introduction: Sleep duration is a major public health issue and is related to socioeconomic status (SES). Previous studies were limited in conceptualization of SES to education and/or income. This study evaluated sleep relative to many SES indices.

Methods: Data were from the Sleep and Healthy Activity Diet Environment and Socialization(SHADES) study, a sample of N=1,007 adults aged 22–60. Sleep duration was assessed using the NHANES question and categorized as very short(≤4h), short(5-6h), normal(7-8h), or long(≥9h). SES was operationalized as education, income quintile, ability to "afford the basics," low/middle/upper class, parental education, household size, home type, employment, shiftwork, and social status compared to community and entire US. Multinomial logistic regressions assessing the association between sleep duration and SES were performed, adjusting for age and sex. Further analyses adjusted for education and income to discern unique effects.

Results: Increased likelihood of very short sleep was associated with the following: some college, high school, less than high school, income quintiles 3, 4, and 5, difficulty affording basics, lower class, lower parental education (mother or father), higher household size (mediated by number of children), part-time work, homemaker, inability to work, unemployment, shift work, and subjective social status relative to both the community and the US. Increased likelihood of short sleep was associated with the following: some college, high school, income quintile 4, difficulty affording basics, middle or lower class, lower parental education (mother or father), higher household size (mediated by number of children), inability to work, and subjective social status relative to both the community and the US. Increased likelihood of long sleep was associated with the following: "very hard" to afford basics, inability to work, unemployment, shift work, and subjective social status relative to the US. Nearly all relationships persisted after adjusting for education and income.

Conclusion: Sleep duration is strongly related to many dimensions of SES, and this is not simply explained by education/income.

Support (If Any): K23HL110216, 5K23HL125939, and R21ES022931

0832

SLEEP PARTIALLY MEDIATES THE ASSOCIATION BETWEEN FOOD INSECURITY AND OBESITY: ROLES OF SHORT SLEEP DURATION, INSOMNIA, AND SOCIOECONOMIC FACTORS

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Introduction: Food insecurity (inability to afford enough healthy food) is a socioeconomic stressor with profound health consequences, including increased obesity (perhaps through replacing nutritious food with cheap alternatives). The present study examines the direct associations between food insecurity and both sleep duration and an insomnia index. Further we investigated the potentially mediating role of sleep duration and insomnia in the association between food insecurity and obesity.

Methods: Data were collected as part of the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) Study, a diverse, community-based survey of adults aged 22–60 (N=1,007). Food insecurity was assessed as the frequency over the past 12 months of the following: worry that food would run out, food actually running out, and inability to afford balanced meals. Items were scored as "0=never (reference)," "1=sometimes," or "2=often" and summed as a total score (0=6). Sleep duration was assessed using the NHANES question and categorized as very short (≤4h), short (5-6h), normal (7-8h, reference), or long (≥9h). Insomnia was assessed with the Insomnia Severity Index and categorized as none (≤7, reference), mild (8–14), and moderate-severe (≥15). Obesity reflected BMI≥30 based on self-reported height and weight. Multinomial logistic regressions were adjusted for demographic (age, sex, and race/ethnicity) and socioeconomic factors (education, income, and shiftwork).

Results: Each individual food-insecurity item was associated with both short and very short sleep duration, as well as both mild and moderate-severe insomnia, even after adjustment for demographic and socioeconomic factors. In the full model, total food-insecurity score was associated with both very short (OR=1.23/pt,p=0.002) and short (OR=1.15/pt,p=0.001) sleep duration, as well as both mild (OR=1.28/pt,p<0.0001) and moderate-severe (OR=1.38/pt,p<0.0001) insomnia. Insomnia accounted for 16% of the relationship between food insecurity and obesity (Sobel p=0.009).

Conclusion: Food insecurity is associated with insufficient sleep and insomnia, which may be part of the pathway to increased obesity among the food insecure. Future sleep research and public health interventions should consider the critical role of financial and nutritional security in achieving regular restorative sleep.

Support (If Any): K23HL110216 and R21ES022931

0833

SLEEP PATTERNS IN GREEN VS CONVENTIONAL MULTIFAMILY LOW-INCOME HOUSING

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Introduction: Environmental exposures may contribute to poor sleep among low-income communities. However, the effect of housing type (green vs. conventional) on sleep is unknown.

Methods: We investigated sleep traits among residents of two public housing developments, and assessed the change in sleep duration among participants that moved to either conventional or green housing. Participants self-completed health questionnaires and underwent home inspections. Sleep duration was self-reported in hours before and after participants moved. We fit an analysis of covariance model testing the change in sleep duration based on change in housing category, accounting for potential confounders (baseline sleep duration, age, sex, race, and body mass index (BMI).

Results: At visit 1, most participants (N=225) lived in conventional housing (58.7%), had a mean age of 47.4±16.1 years, were mostly female (77.3%) and black (57.8%) with a mean BMI of 29.1±7.1kg/m^2. Approximately 45% of the sample reported a short sleep duration (≤6 hours). At baseline, participants living in conventional vs. green housing, had a slightly lower sleep duration, 6.6±1.9 hours

and 6.8 ± 1.6 hours, and reported more days of not receiving enough rest, 13.2 ± 11.2 days and 11.9 ± 10.6 days respectively; however, these differences were not statistically significant. Participants in conventional vs. green housing were more likely to report being "too hot" as a barrier to falling asleep and interrupting sleep during the night, $P<0.01$. Participants in green vs. conventional housing were more likely to report "too bright" as a condition making it difficult to fall asleep, $P=0.04$. Participants who moved from conventional to green housing and those that remained in green housing had an average increase in sleep duration of 51.2 minutes (standard error (SE)=22.1) and 31.0 minutes (SE=13.1), respectively, compared to individuals who remained in conventional housing, $P\leq0.02$ for all. Associations persisted after adjusting for covariates.

Conclusion: Individuals in green vs. conventional housing reported less barriers to initiating and maintaining sleep; and individuals who moved into green housing experienced significantly improved sleep duration. Our results suggest that housing interventions may be important to improving sleep, particularly among lower income populations.

Support (If Any): MALHH0229-10 and 5T32HL007901-18.

0834

DIFFERENCES IN SHORT AND LONG SLEEP DURATION BY MARITAL STATUS AMONG BLACK AND WHITE MEN AND WOMEN IN THE UNITED STATES

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Introduction: Research findings suggest that marriage is associated with better sleep. Few studies have investigated racial/ethnic differences in the sleep-marital status relationship.

Methods: Using nationally representative 2013 and 2014 cross-sectional data from the U.S. National Health Interview Survey, we investigated race and sex differences in self-reported sleep duration by marital status. Direct age-standardization was used to estimate the prevalence of short (<7 hours) and long (≥9 hours) sleep duration by marital status among US-born Black and White men and women ≥25 years old. Accounting for socioeconomic status, health status, sadness and other potential confounders, Poisson regression with robust variance was used to directly estimate prevalence ratios for short and long sleep among Black men and women compared to their White counterparts within marital status groups.

Results: Among 44,445 adults (mean age: 48.3 ± 0.16 years), 15% were Black and 52% were female. Fifty-two percent of participants were married, 7% living with a partner, 19% separated/widowed/divorced, and 22% never married. Compared to their White counterparts, married Black men ((41.5% [95% CI: 38.1–44.9%]) vs. (29.8% [95% CI: 28.7–31.0%])) and women ((41.6% [95% CI: 37.6–45.5%]) vs. (27.0% [95% CI: 25.7–28.3%])) had a higher short sleep prevalence; never-married participants had a similar pattern. In fully-adjusted models, short sleep was 38% (Prevalence Ratio (PR): 1.38 [95% CI: 1.25–1.52]) more prevalent among married Black men and 46% (PR: 1.46 [95% CI: 1.27–1.67]) among those never married. There were no significant racial differences among those living with their partner or those separated/widowed/divorced. Short sleep was 56% (PR: 1.56 [95% CI: 1.41–1.73]) more prevalent among married Black women, 16% (PR: 1.16 [95% CI: 1.06–1.26]) among those separated/widowed/divorced, 38% (PR: 1.38 [95% CI: 1.07–1.78]) living with partner, and 46% (PR: 1.46 [95% CI: 1.36–1.72]) never married. Long sleep duration was significantly lower among never married Black men and women and married Black men; otherwise, there were no significant race-sex group differences.

Conclusion: Racial and sex differences in short sleep duration exist by marital status. Future research needs to identify the structural and interpersonal processes that contribute to these differences in the sleep-marital status relationship.

Support (If Any): N/A

0835

ASSOCIATION BETWEEN BEDROOM SOUND LEVELS AND SLEEP CHARACTERISTICS IN A BIRACIAL SAMPLE

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Introduction: Deficient sleep has been linked to a variety of negative health outcomes and deficient sleep is more common in African Americans than whites. Thus, identifying factors that account for sleep differences has important health implications. The goal of this study was to determine if sound levels were associated with sleep and whether the levels differed between African Americans and whites.

Methods: Participants wore a wrist actigraph for 7–10 days to estimate habitual sleep duration and fragmentation. Participants also underwent one night of unattended in-home polysomnography (PSG). On the same night as the PSG, a sound pressure meter was placed in the bedroom to measure average sound level. Participants with AHI>=15 were excluded.

Results: The sample included 40 white and 48 African American participants, 60% of the sample were women and ages ranged from 18–76 years. Compared to the whites, African Americans had less slow-wave sleep (SWS; 56.6 +- 32.5 vs 79.5 +- 33.5 min, p=002), less REM (79.3 +- 38.3 vs 116.0 +-46.7 min, p=.0001), slightly shorter habitual sleep duration (6.3 +-1.0 vs 6.7 +- 0.9 h, p=.14), slightly higher sleep fragmentation (20.6 +- 1.3 vs 18.3 +- 7.4%, p=.15), and slightly higher average sound levels (47.8 +- 9.8 vs 44.1 +- 9.6 decibels, p=.08). In multivariate regression models adjusting for age, sex, race, AHI and education, higher average sound level was associated with less REM sleep (beta= -1.1, p=.012) but was not significantly associated with SWS or actigraphy measures.

Conclusion: Sound levels measured inside the bedroom were associated with REM sleep but not slow-wave sleep or habitual sleep. Sounds levels were slightly higher in the bedrooms of African Americans. Sound levels do not explain the differences in slow-wave sleep or habitual sleep between the races in this sample, but may be associated with racial differences in REM.

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0836

BORN IN THE USA OR BORN IN MEXICO? IMPLICATIONS FOR SLEEP DURATION, SLEEP QUALITY, SLEEP DISORDERS SYMPTOMS AT THE US-MEXICO BORDER

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Introduction: Previous studies have shown that at the population level, being born in Mexico is associated with fewer sleep disturbances. However, previous studies generally did not use standardized/validated instruments and were not able to account for acculturation. The present study examined these relationships in a small city at the US-Mexico border.

Methods: Data were collected from N=100 adults (age 18–60, 53% female) of Mexican descent from the city of Nogales, AZ, on the US-Mexico border. Questionnaires were in English or Spanish. Participants were asked if they were born in the USA or Mexico. Sleep was assessed with the Pittsburgh Sleep Quality Index (PSQI; sleep quality score and sleep duration single-item), and Insomnia Severity Index (items for difficulty falling asleep, difficulty staying asleep, early morning awakenings, categorized as none, mild, moderate, and severe). Regression analyses (linear for continuous variables and multinomial for symptoms) adjusted for age, sex, and education level. Post-hoc analyses examined acculturation (measured with the Acculturation Rating Scale for Mexican-Americans, Mexican and Anglo Orientation Scales) as a mediator.
Results: 66% of the sample was born in Mexico. Being born in the USA was associated with 56 fewer minutes of nighttime sleep ($p<0.05$), 1.65 more points on the PSQI ($p<0.05$), greater likelihood of severe difficulty falling asleep (RR=8.30, $p<0.05$) and severe difficulty staying asleep (RR=11.18, $p<0.05$). When Mexican acculturation score was entered in these models, all relationships were maintained and were relatively unchanged ($p<0.05$). When Anglo acculturation was entered into models, all relationships became non-significant, including sleep duration (B=-41.4,p=0.12), PSQI (B=0.76,p=0.38), and severe difficulty falling (RR=5.12,p=0.13) and staying (RR=5.38,p=0.19) asleep.
Conclusion: Among individuals of Mexican-descent, being born in the USA (vs Mexico) is associated with about 1 hour less sleep per night, worse sleep quality, more insomnia symptoms, and more mild sleep apnea symptoms. These relationships are not explained by Mexican acculturation but they are explained by Anglo acculturation.
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0837

ACCULTURATION ASSOCIATED WITH SLEEP DURATION, INSOMNIA, AND SLEEP QUALITY AT THE US-MEXICO BORDER

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Introduction: Sleep disparities exist among Hispanics/Latinos, though little work has characterized individuals at the US-Mexico border, particularly as it relates to acculturation/assimilation. Acculturation refers to the extent that an individual identifies with and engages in the attitudes/practices of a certain culture. At the border, there are issues of cultural exchange, leading to differential degrees of Mexican and Anglo ("White") acculturation. This study examined the association of acculturation to sleep problems among those of Mexican descent at the US-Mexico border.
Methods: Data were collected from N=100 adults (age 18–60, 53% female) of Mexican descent in the city of Nogales, AZ (66% not born in the US, 33% 1st-generation). Surveys were presented in English or Spanish. Acculturation was assessed with the Acculturation Scale for Mexican-Americans (ARSMA-II), which has separate scales for Mexican and Anglo acculturation (subscale range 0–4), and a combined "Assimilation" score ([Anglo]-[Mexican]). Insomnia was assessed with the Insomnia Severity Index (ISI), Sleepiness with the Epworth Sleepiness Scale (ESS), Sleep Quality with the Pittsburgh Sleep Quality Index (PSQI), and Sleep duration and sleep medication use with PSQI items. Covariates includes age, sex, and education. Regression analyses examined Difference scores associated with ISI, PSQI, and ESS scores, as well as sleep duration and sleep medication use. Post-hoc analyses examined Mexican and Anglo scales separately.
Results: Mean Mexican acculturation score was 2.90(SD=0.75) and mean Anglo score was 1.94(SD=0.94); mean "Assimilation" score was -0.95(SD=1.23). No associations were found between acculturation and ESS. "Assimilation" was associated with higher ISI (B=0.89;95%CI[0.22,1.57];p=0.010) and PSQI (B=0.82pts;95%CI[0.28,1.36];p=0.004). Higher "Assimilation" was also associated with shorter sleep duration (B=-0.49hrs;95%CI[-0.76,-0.21];p=0.001) and increased sleep medication use (OR=1.62;95%CI[1.02,2.56];p=0.04). In all cases, post-hoc analyses demonstrated that these effects were fully mediated by Anglo acculturation score and not related to Mexican score.
Conclusion: Among individuals of Mexican descent at the US-Mexico border, a greater degree of Anglo acculturation is associated with poor sleep, insomnia, shorter sleep duration, and increased sleep medication use. These results support the idea that sleep disparities across groups may depend on acculturation, which should be considered in risk screening and interventions.
Support (If Any): K23HL110216 and the University of Arizona Health Sciences

0838

ACCULTURATION AND SLEEP PATTERNS IN U.S. HISPANIC/LATINOS: THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS (HCHS/SOL) SUEÑO ANCILLARY STUDY

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Introduction: Higher acculturation to the U.S. culture is associated with worse self reported sleep but the relationship with objective sleep patterns has not been well characterized. We sought to describe how actigraphically measured sleep varies by acculturation level among a diverse population of U.S. Hispanics/Latino adults.
Methods: Participants aged 18–64 years (N=2,189) were recruited from the community based HCHS/SOL cohort at four sites for an ancillary study focused on sleep that included 1 week of wrist actigraphy. Mean nightly sleep duration, sleep efficiency, inter-daily stability, and sleep midpoint were calculated. Acculturation status was assessed by the Short Acculturation Scale for Hispanics language (SASH-L) and social (SASH-S) subscales. SASH scores were dichotomized at the median. All analyses accounted for study design and sampling weights. Analyses were adjusted for age and sex standardized to the 2010 U.S. Census.
Results: A total of 2,120 individuals (mean ± SD age 40.7 ± 0.4 years, 48% male, 26% born in the U.S.) were included in this analysis. Compared to those with a lower level of acculturation, individuals with greater acculturation on SASH-L had shorter sleep duration (6.63 ± 0.05

vs. 6.78±0.04 hrs, p=0.02), lower sleep efficiency (87.8±0.2% vs 88.7±0.2%, p=0.01), lower inter-daily stability (0.74±0.01 vs. 0.77±0.01, p<0.01), and later sleep midpoint (4:08 a.m. ± 5 min vs. 3:54 a.m. ± 4 min, p=0.02). Differences by SASH-S were similar but of smaller magnitude.

Conclusion: Greater acculturation is associated with shorter sleep duration, more sleep fragmentation, larger daily variability, and later sleep timing. Sleep may be one pathway through which acculturation affects cardiovascular disease risks and outcomes. Further research is needed to understand the mechanisms by which acculturation impacts sleep.

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0839

RELATIONSHIP BETWEEN STRESS AND SLEEP QUALITY IN AFRICAN IMMIGRANTS: THE AFRICANS IN AMERICA STUDY

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Introduction: The relationship between stress and sleep quality has not been evaluated in African immigrants (AI) living in the United States. Using allostatic load score (ALS) to assess the physiologic response to stress, we postulated that changes in sleep patterns would be associated with a high ALS, and could possibly play a causal role in the physiologic changes associated with the stressful process of immigration.

Methods: Twenty-nine African immigrants (age 39±10 (mean±SD), range 25–62 y, male 72% (21 of 29), BMI 27.6±4.4, range 19.9–42.4 kg/M^2) born in Africa and currently in the Washington, DC metropolitan area, who self-identified as healthy, were recruited. ALS was calculated using 10 variables from three domains: cardiovascular (systolic & diastolic BP, cholesterol, triglyceride, homocysteine), metabolic (A1C, albumin, BMI, eGFR), and immunologic (hsCRP). Sleep patterns before and after immigration and the Pittsburgh Sleep Quality Index (PSQI) were collected. High ALS was defined as ALS≥3.

Results: Thirty-eight percent (11/29) of the AI were in the high ALS group. Compared to the low ALS group (18/29), the high ALS group had scores suggesting a trend toward both reduced sleep (PSQI Duration scores = 1.27±1.01 vs. 0.78±1.06, P=0.23) and reduced sleep quality (Global PSQI scores 1.09±0.83 vs. 0.78±0.81, P=0.33). In addition, while both groups averaged lower amounts of sleep in the US vs Africa, the high ALS group exhibited a trend toward greater reduction in the hours of sleep in the US vs. Africa (1.22±1.72 vs. 0.50±1.10, P=0.21).

Conclusion: This pilot study suggests that African immigrants who are experiencing physiologic changes of stress, as demonstrated by high ALS, also may exhibit poor sleep quality and reduced sleep duration. A larger sample size is necessary to determine whether these patterns can be confirmed.

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0840

SLEEP PATTERNS OF AFRICAN IMMIGRANTS IN THE UNITED STATES

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Introduction: Reduced sleep quality and duration is associated with increased risk of cardiovascular disease, diabetes, obesity, stroke, cancer and reduced quality of life. We sought to systematically investigate the sleep patterns of African immigrants relocating to the United States.

Methods: Immigrants age 18–65 years of age, born in Africa and residing in the US, who did not have established diabetes or cardiovascular disease were recruited. Sleep patterns before and after immigration and the Pittsburgh Sleep Quality Index (PSQI) were collected. Preliminary data on the first 30 patients collected were analyzed.

Results: Eighty percent of participants reported sleep duration of less than 7 hours, 40% less than 6 hours, and 13% reported less than 5 hours. 46% reported decreased sleep duration after immigration, in contrast to 15% who reported increases sleep in the US. Gender, age, marital status, and education level did not correlate with sleep duration. Poor sleep quality (PSQI >5) was present in 9 of 30 individuals. 76% (23 of 30) experienced bathroom awakenings, 26% three or more times a week. Bad dream awakenings were reported in 8 of 30 individuals. 5 of 30 reported daytime sleepiness weekly or more often and 3 of 30 reported nocturnal respiratory symptoms. Sleep medication was only used by one participant. Both older age and older age of immigration were associated with worse sleep quality (p=0.01 and p<0.01 respectively).

Conclusion: Short sleep duration is common among African immigrants. Sleep duration commonly decreases upon immigration. Poor sleep quality, nocturia and awakenings with bad dreams were common in our preliminary sample of African immigrants. These problems may be attributable to adapting to a different culture and further study is warranted.

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0841

EXPLORING SLEEP QUALITY, DURATION, AND DROWSINESS AMONG TRANSPORTATION SHIFT WORKERS: EVIDENCE FROM A HIGH RISK POPULATION

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Introduction: Fifteen million adults in the U.S. work shift schedules (characterized by work outside the conventional daytime), including on-call, night, and rotating shifts. Shift work is associated with health risks, including Type II Diabetes, hypertension, cardiovascular disease, and obstructive sleep apnea (OSA). Recent media coverage of drowsy driving incidents in transportation workers (bus and train operators) suggest current efforts to promote awareness and treatment for OSA are ineffective. In the current study, we examined sleep among transportation workers and identified avenues for programs to improve sleep health in this high-risk population.

Methods: We analyzed data from surveys of employees who work in transportation (truck, snow plough, construction operators) on shift work schedules in the rural Northeast (N = 239). Participants filled out pen-and-paper surveys assessing sleep characteristics including

total sleep time, sleep quality, sleep habits (using the Sleep Hygiene Index) daytime sleepiness using the Epworth Sleepiness Scale; sleep apnea risk (according to the Apnea Risk Evaluation System, ARES); and demographic/clinical factors.

Results: Among the survey respondents, 42.7% (n=27) reported hypertension, 16.4% (n=18) reported sleep apnea, and 14.5% (n=16) reported diabetes. Overall, 40.5% (n=105) reported short sleep (<6hrs), while 52.1% reported sleep between 6 and 9hrs, and 0.8% reported long sleep (>9hrs). Among respondents, 24.7% (n=64) reported "very bad" or "fairly bad" sleep quality. Responses to sleep hygiene identified prevalent, but modifiable sleep habits; 55.6% (n=144) "think, plan, or worry in bed," and 48.6% (n=126) "use alcohol, tobacco, or caffeine within 4hrs of bedtime." In response to "frequency of snoring", 64.1% (n=166) of participants report "sometimes," "frequently," or "almost always" snoring. Finally, a majority of participants, 54.5% (n=60) were at "moderate" to "high" risk for OSA (>=4 on the ARES).

Conclusion: Although sleep health is critical for vigilance and safe driving, individuals in transportation working on shift schedules have poor sleep quality, insufficient sleep, and are at risk for OSA. Future research should use tailored interventions to reduce modifiable barriers (e.g., caffeine close to bedtime) among transportation shift workers to improve sleep health and implement initiatives to improve OSA screening and treatment.

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0842

THE TRAJECTORIES OF SLEEP DURATION FROM ADOLESCENCE TO ADULTHOOD

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Introduction: The extent of sleep problems has been described in children and adults but little is known about the trajectories of sleep from childhood to adulthood. This information could provide insight into the progression of sleep problems and identify critical periods for interventions. We examined the trajectories of sleep duration from 10 to 25 years old in a representative sample and described individual and family characteristics associated with the trajectories.

Methods: We followed 3118 adolescents (age 10–17 at baseline) from the Panel Study of Income Dynamics surveyed up to 6 times over 16 years (1997–2013). Participants reported on their sleep duration at each follow-up. We used latent class growth modelling to identify trajectories of sleep duration and regressed individual and family characteristics on the probability of belonging to each trajectory using multinomial logistic regressions, controlling for birth year. We included baseline information on gender, race, behavioral problems, and subjective well-being; household income; and age, education, marital and working status, and self-rated health of the primary parent.

Results: We uncovered three sleep trajectories: persistent long sleep (8.7% of the sample), average sleep (72.5%), and declining short sleep (18.8%). Adolescents from lower income households or with a parent in poorer health were more likely to follow a pattern of persistent long sleep (relative risk ratio (RRR) and 95% confidence interval: 1.4, 1.0–2.0 and 1.4, 1.0–2.0, respectively) or declining short sleep (RRR 1.9, 1.0–3.6 and 1.8, 1.1–3.0, respectively) than average sleep. Further, adolescents with low parental education were more likely to have persistent long sleep (RRR 2.2, 1.2–3.7), while adolescents who were Black (RRR 1.6, 1.1–2.4), had lower subjective well-being (RRR 1.2, 1.0–1.5), or greater behavioural problems (RRR 1.02, 1.00–1.05) were more likely to have declining short sleep.

Conclusion: Results indicate that sleep duration changed from adolescence to adulthood through distinct trajectories and that these patterns related to individual and family characteristics during adolescence. Findings suggest that inadequate sleep in adults may be a continuum from early life and indicate a potential for early intervention when promoting healthy sleep. Additional research is needed to develop intervention strategies.

Support (If Any): CIHR

0843

PREDICTING SLEEP ACROSS THE LIFESPAN: A POSITIVITY RATIO APPROACH

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Introduction: Poor sleep has been linked to behavioral and emotional changes, impairments in cognitive functioning, and daytime dysfunction. Positive affective experiences may serve as a potential factor in promoting healthier sleep. Prior research has linked sleep to changes in both positive and negative affect across the lifespan, but the prediction of sleep from affect has not been extensively studied. Accordingly, we examined the association between affect and sleep across the adult lifespan, using a novel gauge of affect, the positivity ratio. The positivity ratio is a measure of how much positive affect an individual has in relation to his or her negative affect. We also explored age as a potential moderator between the positivity ratio and sleep outcomes.

Methods: The study was an archival analysis of Midlife in the United States study (MIDUS-II) data. Participants (N = 1,172, 34–83 years old) completed the MIDUS-II PANAS, from which positivity ratio scores were derived. Sleep was assessed through the Pittsburgh Sleep Quality Index, actigraphy, and daily global sleep diaries. Hierarchical linear regressions were performed to predict sleep from affect. The moderation was tested using Hayes' SPSS PROCESS macro.

Results: Higher positivity ratios significantly predicted better self-reported daily sleep quality (β = -.187, p = .001) and higher Global Sleep Scores (β = -.937, p < .001), but not objective sleep measures. Even with negative affect present in the positivity ratio, higher positivity ratios predicted better sleep, indicating that positive affect may serve a protective function. Positivity ratios increased with age (β = .017, p < .001) and predicted better global sleep and sleep quality across adulthood.

Conclusion: These findings extend existing research on sleep and affect by providing an examination of how affect, positive and negative concomitantly considered, predicts sleep. This study provides evidence for the positivity ratio and subjectively-rated sleep quality association, extending prior literature linking the positivity ratio to subsequent health outcomes. Given that the positivity ratio is an equal predictor of sleep across the lifespan, clinicians should examine emotional regulation in addition to cognitive and behavioral components in sleep interventions.

Support (If Any): N/A

0844

AGE-RELATED EFFECTS ON SLEEP LOSS IN WAKING EEG CONNECTIVITY

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Introduction: Research report robust change in functional connectivity (FC) during waking resting state after sleep loss. Studies indicate that older participants show smaller or similar effects to acute sleep loss on vigilance and cognition as compared to the young. However, age-related effects of sleep loss on FC have not been reported. The present study compared waking EEG connectivity before and after sleep deprivation in young and elderly adults.
Methods: Thirteen young (9W;20-28y.o.,mean=24.3±2.7) and 12 elderly (6W;60–70 y.o.,mean=64.1±3.4) healthy subjects were sleep deprived for 26 hours. Two waking EEGs were recorded; the first after 10 minutes of wakefulness and the second after 24 hours of wakefulness. In both age groups, imaginary coherence (Fisher transformed) differences between the two experimental conditions were assessed with a standardized Z-stat. A non-parametric test on the max-stat and a permutation resampling allowed to account for multiple comparisons (between pairs of electrodes) in a FDR like thresholding for significance($p<.05$). These analyses were performed in the anterior-posterior axis (Frontal, Central, Parietal, Occipital) for delta, theta, alpha, and beta bands.
Results: In the elderly, sleep loss induced an increase of imaginary coherence as compared to rested wakefulness in delta between central and parietal derivations, in alpha and theta between frontal, parietal and occipital derivations, and in beta between most derivations. In the young, sleep loss induced an increase in coherence in delta between parietal and occipital derivations and in beta between frontal and parietal derivations. When comparing the two age groups, young subjects showed significantly stronger increase in coherence after sleep loss in delta(P3-O1,P4-O1). However, older individuals showed stronger increase in coherence in theta(F3-F4,F3-P3) and beta(F4-O2).
Conclusion: Sleep loss increased EEG FC. Stronger impact of sleep loss in delta for the young subjects supports the idea that they are more sensitive to the accumulation of wakefulness than older individuals. Interestingly, older subjects show stronger effects of the deprivation in theta and beta. This may reflect an adaptive mechanism to sustain performance level. Future analyses will evaluate how changes in FC under sleep loss are linked to performance detriment.
Support (If Any): NSERC, FRQ-NT, CIHR & FRQ-S.

0845

INTERPRETING IN-HOME SLEEP BIOMARKERS BASED ON POLYSOMNOGRAPHY REFERENCE VALUES

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Introduction: Abnormal sleep patterns have been associated with increased risk for cardiovascular disease, diabetes, and neuro-degeneration. This study investigates whether references values obtained from polysomnography (PSG) can be usefully compared to sleep architecture and sleep continuity biomarkers obtained with limited-montage recordings.
Methods: This retrospective analysis was conducted with frontopolar recordings made in-home with Sleep Profiler™ (Advanced Brain Monitoring). Studies were auto-staged, expert edited, and the two-nights averaged. A normative cohort was selected from records of those who did not have insomnia, daytime sleepiness, depression or anxiety (ISI<=12, Epworth, PHQ9 and GAD7<=10), not taking prescription sleep aids or anti-depressants or diagnosed with OSA. Subjects were stratified into two groups; Young<55 years (nine males, five females, median=27 years) and Older>69 years (14 males, 15 females, median=75 years). Records from a cohort of insomnia patients were also stratified into Young (four males, 11 females, median=44 years) and Older (ten males, eight females, median=73 years) groups. Reference values were obtained from the Health Heart Study using the percentiles to estimate the age-stratified distributions. Systemic differences were recognized when the PSG distributions were significantly different from both the normative and insomnia cohorts using the Welch's t-test ($p<0.05$).
Results: Frontopolar staging exhibited a systemic bias toward reduced stage N3 in the Older but not the Young group (Older: reference=18.0%, normative=5.2%, insomnia=7.3%; Young: reference=19.4%, normative=19.5%, insomnia=17.1%). A similar age-related pattern was observed in the percent time REM (Older: reference=20.7%, normative=16.9%, insomnia=17.1%). A systemic increase in stage N1 and awakenings was observed in both age groups (*N1*-Young: reference=4.1%, normative=6.5%, insomnia=8.3%; Older: reference=4.8%, normative=12.2%, insomnia=11.5%; *Awakenings/h*-Young: reference=3.3, normative=5.7, insomnia=6.5; Older: reference=3.4, normative=7.0, insomnia=7.5). The magnitude of the N1 discrepancies impacted the sleep efficiencies in the Older group (reference=81.8%, normative=74.7%, insomnia=76.2%).
Conclusion: Discrepancies in the N3 sleep detected in the elderly may be explained by the application of different scoring rules (Rechtschaffen/Kales vs. AASM-emulated auto-scoring) applied to age and site-specific attenuation in slow wave sleep. Staging N1 and REM from frontopolar recordings likely contributed to age-specific systemic differences. All other sleep biomarker measures were equivalent.
Support (If Any): This study was supported by the NIH (P01-AG003991; K76-AG054863).

0846

AGING AND SLEEP DISORDERS EFFECTS ON SLEEP STAGE TRANSITION STATISTICS

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Introduction: Sleep recordings are scored first and evaluated further using simple statistics. The summarizing report presents latencies to stages and percentages of stages. Arousals may be reported as well. However transitions between sleep stages characterize normal and disturbed sleep as well. Transitions between sleep stages had been analyzed in the past but are not evaluated in large data sets.

Methods: A new method to quantify transitions between sleep stages was developed. Probability values were calculated for symbolic sequences for sleep stage changes. Up to three consecutive changes in sleep stage (e.g. N1-N2-N3) were considered and their probabilities determined. This allowed us to quantify the frequent swinging between neighboring stages (e.g. N1-N2-N1). A graphical presentation of probabilities gives rapid insight about changes. The method was applied to 196 healthy subjects of different age and 98 subjects with sleep disorders from the Siesta database.
Results: One step transitions (e.g. W-N1, N1-N2) were evaluated first, followed by two step transitions. Four groups were formed and compared: young healthy, old healthy, young with sleep disorder, old with sleep disorder. There was a considerable increase of one step transitions from healthy young to old. The transitions in sleep disorders young were even more than in healthy elderly. There was no big difference between sleep disorders young and elderly. Still age effects were observed in patients with sleep disorders too, to a lower extent.
Conclusion: The new statistical evaluation of transitions may help to group the hypnogram of an individual into a group of subjects. lt may help to characterize changes in sleep structure typical for some disorders (Narcolepsy) and track pharmacological effects.
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0847

EFFECTS OF SLEEP DISORDER AND PHYSICAL ACTIVITY ON COGNITIVE FUNCTION IN OLDER ADULTS

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Introduction: Sleep disorders have been shown to increase the risk of reduced cognitive function in older adults. Daily physical activity is very useful for maintaining cognitive function and preventing dementia. We investigated the relationships between physical activity, sleep disorders, and cognitive performance in older adults.
Methods: The study included 55 adults aged 60 years and over (age, 70.8±4.3 years). None of the participants reported recent reductions in memory or cognitive performance, and showed any impairment in basic or instrumental activities of daily living. All subjects wore accelerometry-based activity monitors on their waists to evaluate amount of exercise. Sleep apnea screenings were conducted using the portable monitor. The apnea-hypopnea index (AHI) and lowest oxygen saturation value were measured. Sleep complaints were assessed using the Pittsburg Sleep Quality Index (PSQI). Excessive daytime sleepiness was evaluated by Epworth sleepiness scale (ESS).We evaluated cognitive function with Wisconsin Card Sorting Test (WCST).
Results: The category achievement in the WCST was significantly correlated with age, PSQI, AHI, lowest oxygen saturation, and amount of exercise. Multiple regression analysis revealed that AHI and amount of exercise were significant contributing factors for category achievement in the WCST. There was, however, no significant correlation between category achievement in the WCST and ESS score.
Conclusion: Our findings suggest that habitual physical activity and improvement of sleep disorder are important for maintaining executive function in older adults.
Support (If Any):

0848

CLINICAL, POLYSOMNOGRAPHIC AND NEUROPHYSIOLOGICAL CORRELATES OF SLEEP-DEPENDENT MEMORY WITH AGING

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Introduction: Sleep plays an important role in overnight learning with memory consolidation linked to distinct neurophysiological processes. In both healthy aging and dementia the beneficial effect of sleep on memory appears to weaken, and sleep disturbance is predictive of more rapid cognitive decline. Changes in sleep architecture, altered sleep neurophysiology, sleep-disordered breathing and brain degeneration may underlie the decline in sleep-dependent memory consolidation (SDMC) with aging. This pilot study examined clinical, polysomnography and quantitative sleep EEG correlates of SDMC in older adults.
Methods: We studied 32 participants (16 male, age 62±13, ESS 7±3, AHI 22±25,) who attended the sleep laboratory for overnight polysomnography. The sample was comprised of three groups: 7 had a diagnosis of mild cognitive impairment (MCI), 18 had obstructive sleep apnoea (OSA), 6 were healthy controls. A 32 word-pair task was administered 1–2 hours before bed. Following an 8-h sleep opportunity participant's declarative memory consolidation was assessed 1-h after waking during a morning recall phase. Power spectral analysis was performed on all-night EEG data (F3-M2, C4-M1) and slow wave activity (SWA, absolute delta EEG power) in NREM sleep was calculated. Spindle density (events p/min) in stage N2 sleep was also derived using an automated spindle event detection algorithm. Associations between clinical diagnostic variables (presence of MCI and OSA, AHI, oxygen desaturation index, arousals) and key neurophysiological features linked to SDMC and memory scores were examined.
Results: Presence of MCI was not associated with percent retention recall, rho = .077, p= .691, nor was presence of OSA, rho = -.117, p = .545. Greater percent retention recall was significantly correlated with increased sleep spindle density at frontal and central regions (F3,spindle density p/min,rho=.438, p=.026). In a sub-group analysis, greater SWA in NREM was significantly related to higher percent retention recall (F3,rho=.629,p=.009) in the OSA group.
Conclusion: Spindle characteristics were the most strongly associated component of SDMC in this sample of older adults exhibiting cognitive decline and sleep disturbance. These preliminary results highlight the potential of sleep intervention programs to target memory deficits observed in aging and dementia.
Support (If Any): Australian NHMRC-ARC Dementia Research Development Fellowship Grant 110776.

0849

SLEEP SATISFACTION AND DYSFUNCTIONAL BELIEFS AND ATTITUDES ABOUT SLEEP IN OLDER ADULTS

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Introduction: A central tenant of Cognitive Behavioral Therapy for Insomnia (CBT-I) is that individuals' thoughts and beliefs about sleep are integral to their sleep quality. Previous research has examined sleep satisfaction in older adults, but little research has focused on how Dysfunctional Beliefs and Attitudes about Sleep (DBAS) may influence sleep satisfaction. In this study of older adults, we hypothesized that participants who endorsed more DBAS would also report less sleep satisfaction.
Methods: 162 older adults (98 females; mean age 66.4, range 60–79) completed questionnaires, which assessed demographic information, included the Dysfunctional Beliefs and Attitudes about Sleep 16 (DBAS-16), and a question about sleep satisfaction. Prior to the screening interview, participants were excluded for being < 60 or > 80 years old, sleep duration not between 6–7.25 hours or 8–9.25, time in bed spent not trying to fall asleep > 30 minutes at night or in the morning, more than 90-minutes napping per day, shift-work, recent travel across multiple time zones, irregular sleep schedule, smoking, and several chronic medical conditions. A multivariable logistic regression was employed to test the relationship between DBAS and sleep satisfaction, controlling for age, sex, sleep duration, and socioeconomic status.
Results: In this sample, 13 of the 162 participants reported having unsatisfactory sleep. Participants who had a higher DBAS score also had a greater odds of reporting less satisfactory sleep (OR=2.11, 95% confidence interval = 1.32–3.38).
Conclusion: As hypothesized, these results suggest that sleep-related dysfunctional beliefs may be associated with a greater odds of older adults reporting unsatisfactory sleep. These findings have therapeutic implications, where sleep satisfaction in older adults could possibly be improved by targeting dysfunctional beliefs about sleep. Future research, which targets these maladaptive beliefs could also help establish causality in this relationship, if it is found that improving these also increases sleep satisfaction.
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0850

GENERAL AND DOMAIN-SPECIFIC SELF-EFFICACY AND SLEEP IN OLDER ADULTS

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Introduction: Although self-efficacy has been linked to sleep outcomes in young adult samples, the relationship between sleep and self-efficacy has not yet been extensively explored in a sample of older adults. Moreover, domain-specific self-efficacy is often a better predictor of health outcomes than general self-efficacy, but the utility of different measures of self-efficacy has not been directly examined in the context of sleep. This study examined the relationship between three measures of self-efficacy and self-reported sleep outcomes to determine how these variables are related in a sample of community-dwelling older adults.
Methods: Data were obtained from the baseline measures of the Active Adult Mentoring Project (AAMP), which contained a sample of 82 community-dwelling older adults aged 50 to 87 years (mean age = 63.37, *SD* = 8.58; 82.9% female). Correlations were examined between three measures of self-efficacy (general self-efficacy, domain-specific sleep self-efficacy, and domain-specific exercise self-efficacy) and three subjective measures of sleep (sleep quality, sleep efficiency, and total wake time).
Results: General self-efficacy is not significantly related to sleep quality (r=.22, p=.06), sleep efficiency (r=.13, p=.26), or total wake time (r=-.16, p=.15). Sleep self-efficacy was associated with sleep quality (r=.46, p<.001), sleep efficiency (r=.49, p<.001), and total wake time (r=-.53, p<.001). To a lesser extent, exercise self-efficacy was also associated with sleep quality (r=.32, p<.01), sleep efficiency (r=.33, p<.01), and total wake time (r=-.23, p<.05).
Conclusion: Self-efficacy plays a role in older adults' sleep, but general self-efficacy is too broad a measure to capture that relationship. Both exercise self-efficacy and sleep self-efficacy measure perceived control over one's physical processes, which may explain why both are related to sleep. Overall, sleep-self efficacy explains the most variance in sleep quality, sleep efficiency, and total wake time and therefore emerges as the best measure to use for research on self-efficacy and sleep in older adults.
Support (If Any): This work was supported by the National Institute on Aging (1R36AG029664-01, PI: Aiken-Morgan; T32AG020499, PI: Marsiske; F31AG032802, PI: Dzierzewski; 1K23AG049955, PI: Dzierzewski) and University of Florida (Age Network research award, PI: McCrae).

0851

FREQUENCY, DURATION AND PREDICTORS OF UNPLANNED AND LONG-DURATION NAPS AMONG A SAMPLE OF MEDICARE BENEFICIARIES

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Introduction: Napping is a highly prevalent but poorly understood form of sleep in older adults. Research suggests that naps are associated with older age, being male, and multiple comorbidities such as pain and depression but studies typically do not distinguish between planned and spontaneous naps. Additionally, little attention has been paid to nap duration. This study describes napping in older adults by sociodemographic and clinical characteristics, with particular attention paid to naps that are unplanned or >60 minutes.
Methods: Retrospective cohort of Medicare beneficiaries ≥65 enrolled in the fourth year of National Health and Aging Trends Study (NHATS) who reported napping (n=1,016). Survey weighting was used for all analyses and to determine population estimates. Logistic regressions were used to examine the relationships between sociodemographic and clinical characteristics and napping behaviors.
Results: Older adults who reported regularly napping, 58.7% reported that some or all naps were unplanned and that 18.5% regularly take naps > hour. Older age, non-white race, non-married status, poorer self-reported health, and shorter nighttime sleep duration were significantly associated with unplanned napping. For example, individuals 75–84 years of age had 2.1 times higher odds of unplanned naps compared to those aged 65–74. Male sex, poorer self-reported health, and a greater number of chronic conditions were associated with higher odds of naps > hour. Those with

the worst self-reported health were 2.76 times more likely to take long naps than those reporting the best health. Neither pain nor depression were significantly associated with either unplanned or long naps.
Conclusion: This study indicates that ~4.3 million older adults in the U.S. regularly fall asleep during the day without meaning to, and that 1.37 million older adults routinely take naps lasting longer than an hour. Furthermore, this research indicates different constellations of risk factors for unplanned napping and long duration napping. Additional research examining the impact of unplanned and long-duration napping is warranted.
Support (If Any): NCMRR K01HD076183 (DJF) and AHRQ K01HS022907 (NEL)

0852

SLEEP DISTURBANCES AND FEAR OF FALLING IN OLDEST ADULTS LIVING IN RETIREMENT COMMUNITY CAMPUS SETTINGS

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Introduction: As the US population ages, aging related health is becoming increasingly relevant. In particular, 1/3 of US older adults over the age of 65 experience a fall each year. Evidence demonstrates the psychological and physical implications of falling, including morbidity and early nursing home placement, as well as increased risk of future falls. Previous studies have confirmed that disturbed sleep, in both men and women, is associated with increased falls risk. Less is known about the relationship between sleep disturbances and fear of falling, a strong predictor of falls risk.
Methods: Residents over the age of 65 (N=307, mean age 84), were recruited from 11 retirement communities in San Diego to participate in a multilevel physical activity intervention (MIPARC) or an attention control. Evaluation of the RCT included collection of participant surveys. Fear of falls was assessed using the 16-item FES-I scale where participants rated their concern for falling (1=Not at all concerned; 5=Very concerned) when performing various tasks. FES-I sum scores greater than 23 indicates a higher concern of falling. Sleep disturbances were assessed using the PROMIS 6-item sleep disturbance scale. The within person relationship between change in self-reported sleep disturbance scale and change in fear of falling was examined from baseline to 12 months with adjusted hierarchical linear models.
Results: Study participants reported a mean fear of falls score of 25.95 at baseline, and a mean score of 27.18 at 12 months. Change in participants' sleep disturbance score was significantly related to an increase in participants' fear of falling (0.11, p=0.045) over the course of the 12-month intervention, when adjusting for participant age, gender, and study condition.
Conclusion: It may be worthwhile for future sleep research to include the assessment of fear of falling as an intermediate target for sleep studies in older adults that are not long enough to assess falls incidence.
Support (If Any): NHLBI #R01HL098425

0853

SLEEP DURATION, FALLS, AND INJURIES AMONG US ADULTS AGED ≥45 YEARS--2014

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Introduction: Short sleep duration has been linked to an increased risk of injury from drowsy driving or occupational accidents. However, little research has investigated the relationship between sleep duration and injuries resulting from falls.
Methods: We used data from 291,613 respondents to the 2014 Behavioral Risk Factor Surveillance System survey who were aged ≥45 years. Multivariable logistic regression models were developed to assess the associations between self-reported sleep duration, falls in the previous 12 months, and falls resulting in injury, controlling for sociodemographics and other variables previously associated with increased risk for falls (overall health, use of special equipment for health problems, history of arthritis, history of stroke, obesity, and excessive alcohol use).
Results: Among adults aged ≥45 years, the distribution of usual sleep duration in a 24-hour period was 11.3% (≤5h), 22.0% (6h), 29.6% (7h), 28.4% (8h), 4.5% (9h), and 3.7% (≥10 h), while 27.3% reported ≥1 fall in the previous 12 months. Among those who reported ≥1 fall, 40.2% stated that at least one of those falls resulted in an injury. There was a U-shaped relationship between sleep duration and experiencing falls, as well as sleep duration and suffering an injury due to a fall. Specifically, compared to adults who slept 7 hours, adults who slept ≤5h, 6h, 9h, or ≥10h were more likely to have fallen ≥1 time (adjusted prevalence ratio (PR) [95% confidence interval]: 1.26 [1.21–1.31], 1.08 [1.05–1.12], 1.06 [1.002–1.11], 1.18 [1.12–1.25], respectively.) Among adults who reported ≥1 fall, compared to adults who slept 7 hours, adults who slept ≤5h, 6h, or ≥10h were more likely to have been injured by a fall (1.26 [1.2–1.33], 1.07 [1.02–1.13], 1.15 [1.06–1.23], respectively.)
Conclusion: Increasing the proportion of the population getting the recommended amount of sleep through public awareness programs and physician-counseling may reduce injuries from falls.
Support (If Any):

0854

LIGHT AS A COUNTERMEASURE TO THE RISK OF FALLING DURING NOCTURNAL AWAKENINGS

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Introduction: The risk of falling increases with age and can result in injury, nursing home placement or even death. Nocturnal awakenings associated with ambulation may contribute to this increase. To counterbalance the risk of falling when walking at night, most people turn on a light (to improve visual cuing); this light, however, can increase alertness, leading to difficulties in returning to sleep. We previously showed that exposure to light in healthy older adults did not, in fact, improve balance. We examine here whether such light could improve balance in older adults with pre-existing deficits in balance.
Methods: In this pilot study, three older individuals (60, 72, and 78 y) who had self-reported balance problems at night underwent two overnight stays in the laboratory. Participants arrived in the evening and two hours after habitual sleep time, they were awakened for 13 min into either a dim light condition (DL, <0.5 lux) or a room light condition (RL, 200 lux). Before each night and during this awakening, their balance (standing and mobile, using a Zeno walkway), visual acuity (low contrast chart) and sleepiness (Stanford Sleepiness Scale) were tested.
Results: As expected, visual acuity was worse during the midsleep awakening into DL (18 correctly identified letters) as compared to RL (30 letters). Our measure of standing balance (center of pressure path length) indicated that balance was notably worse in DL (1.11 cm) than in RL (0.856 cm). While variance in stride length (measure of mobile

balance) was worse following midsleep awakening, it was not different in the two lighting conditions. We also observed greater sleepiness during the midsleep awakening, but no difference between the two lighting conditions.
Conclusion: In a small pilot study, older adults with pre-existing balance problems increased their visual acuity and their standing balance under the RL condition, as compared to a DL condition, without increasing their alertness during nocturnal awakenings. As we did not observe improvement in balance in healthy older adults without balance problems, it may be that light-induced changes in balance at night may be limited to those in whom a deficit exists.
Support (If Any): None

0855

PHYSICAL ACTIVITY AND SLEEP HEALTH: AN ASSOCIATION BETWEEN INTENSITY NOT VOLUME

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Introduction: Physical activity (PA) has been associated with several dimensions of sleep, including sleep satisfaction and daytime alertness. However, the association between PA and sleep health, a multidimensional construct that characterizes sleep among all individuals, has not been explored. This analysis examined the relationship between different measures of physical activity and a composite measure of sleep health.
Methods: 115 adults (66% Female, 60.2±9.1 yr, body mass index [BMI]: 29.7±6.7 $kg \cdot m^{-2}$) were included in the analysis. Participants reported their daily time in light- (LPA), moderate-, and vigorous-intensity physical activity (MVPA) via diary and wore a pedometer (Omron HJ-720ITC) to measure total daily steps for 5–14 days (mean: 9.8 days). Sleep health was measured using the RU_SATED questionnaire, which quantifies regularity, satisfaction, timing, efficiency, and duration of sleep and daytime alertness. Sleep health scores ranged from 0–12, with higher scores reflecting greater sleep health. Multiple linear regression analyses were used to examine the relationship between physical activity measures and sleep health, with analyses adjusted for age, race, gender, BMI, depression history, socioeconomic status, and existing cardiovascular disease.
Results: The mean sleep health score was 9.6±2.4. Participants averaged 62.4±66.0 min of LPA, 44.7±47.6 min of MVPA, and 5689.9±3086.0 steps per day. Self-reported LPA and MVPA were significantly correlated (r=.33, P<.01), but pedometer-assessed daily steps were not correlated with either LPA or MVPA. MVPA was significantly associated with sleep health (β=.31, P<.01). In contrast, self-reported LPA and daily pedometer steps were not related to sleep health (β=.07 [P=.46], β=.06 [P=.58], respectively).
Conclusion: In older adults, higher intensity activity (i.e., MVPA), but not lower intensity activity (LPA) or total volume of activity (pedometer steps), was associated with greater sleep health. Although we cannot infer directionality from these results, physical activity intensity may have a greater effect on sleep health than volume of activity.
Support (If Any): NIH grants R01HL104607 (PI: Hall) and K23HL118318 (PI: Kline).

0856

HEALTHCARE PROVIDERS MISSING A GOLDEN OPPORTUNITY TO DISCUSS SLEEP QUALITY WITH OLDER ADULTS

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Introduction: Sleep is essential to one's health, well-being and functioning. Older adults experience impaired sleep as a result of multi-morbidities, age-related changes, or pharmacologic management. Primary and health care providers have an appropriate skillset to provide non-pharmacological interventions to assist older adults presenting with impaired sleep. Literature regarding consultations between older patients and health providers regarding sleep and the management of sleep impairments during and following hospitalization is limited. The purpose of this study is to examine what consultations and collaborations older adults have with health professionals regarding their sleep quality and the management of any sleep impairments during and following hospitalization.
Methods: A mixed methods prospective longitudinal cohort study was completed with 311 hospitalized older adults (65 years and over) returning to community-dwelling post-discharge. Self-reported sleep quality was obtained via the Pittsburgh Sleep Quality Index. Open-ended questions regarding patient-provider discussions of the assessment, treatment, and mangement of sleep impairments were also examined. Participants were surveyed during their hospital admission, and at three- and six-months post-hospitalization.
Results: Less than 20% of participants discussed sleep at any time point with any health care provider they engaged with and discussions were predominantly initiated by the participants themselves. Pharmacological-based approaches were opted for more frequently at each time point than non-pharmacological approaches.
Conclusion: Primary and healthcare providers have considerable scope to collaborate with older adults to address underlying factors that contribute to sleep impairments and provide them with evidence-based interventions that could assist them to reduce, minimize or prevent sleep issues. Utilizing a client-centered approach for older adults presenting with sleep problems is recommended.
Support (If Any): Project funding was provided by national not-for-profit mental health organization, BeyondBlue. AFL was supported by an Australian Postgraduate Award from Monash University. TH was supported by a National Health and Medical Research Council Early Career Fellowship.

0857

PILOT STUDY OF SLEEP CHARACTERISTICS IN HOSPITALIZED OLDER ADULTS

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Introduction: Sleep disturbance in older adults is associated with age-related health outcomes. However, little is known about sleep characteristics and their consequences during hospitalization

among older adults. We initiated a pilot study among inpatients in an acute-care hospital to describe objective and subjective sleep characteristics. The goal is to evaluate associations between sleep disruption and hospital-related outcomes such as length of stay, discharge to long-term care, delirium and re-admissions. These data may also be utilized to inform potential future interventions to improve sleep and quality of care for older adults in the hospital setting.

Methods: The study setting is an 81-bed community acute-care hospital, in rural Tracy, California. Initial inclusion criteria were age 60+ years and expected duration of stay 2+ days (later relaxed to 1+ day). Exclusion criteria include severe cognitive impairment (MoCA score lt 18) and examiner determination of patient's inability to complete the study. Sleep data are collected using 24-hour actigraphy, sleep diaries, and self-reported pre-hospitalization sleep habits derived from the Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS). Additional data are obtained from electronic health records and chart abstraction.

Results: Thus far, 44 (of a projected 100) patients have been enrolled with a mean age of 69 years. Approximately 55% are female, and 73% scored mild-moderate cognitive impairment at study entry (MoCA score 18–26). Self-reported sleep disturbance was common in the month prior to admission: 83% reported PSQI scores gt 5, 25% night-time sleep duration lt 5 hours, and 30% reported using sleep medications 3+ times per week. Daily napping and excessive daytime sleepiness were reported by 58% and 20% of participants, respectively.

Conclusion: Characterizing sleep and related outcomes among hospitalized older adults is a critical first step towards improving quality of care, and potentially reducing adverse health outcomes in this vulnerable population. Our preliminary data suggest substantial self-reported sleep disturbance and use of sleep medications prior to hospitalization. We expected to complete recruitment by May, 2017, and additional results including objective sleep data are forthcoming.

Support (If Any): Supported by the Tracy Hospital Foundation, Sutter Tracy Community Hospital.

0858

SLOW WAVE ACTIVITY AND MEMORY CONSOLIDATION IN CHILDREN WITH INCREASING SEVERITY OF SLEEP DISORDERED BREATHING

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Introduction: It is unclear why children with primary snoring (PS), the mildest form of sleep disordered breathing (SDB), exhibit equivalent cognitive and behavioral deficits as children with severe obstructive sleep apnea (OSA). This study examined sleep-dependent learning to determine if learning potential was intact in children with PS and whether slow wave activity (SWA) dissipation, a marker of sleep disturbance, would predict memory consolidation in children with increasing severities of SDB.
Methods: Children (5-10y) with clinically diagnosed PS (N=17; obstructive apnea hypopnea index (OAHI) ≤1 event/h), moderate-severe OSA (N=14; OAHI > 5 events/h), and non-snoring population Controls (N=18) completed one night ambulatory polysomnography (PSG) with a sleep-dependent learning protocol conducted pre- and post-PSG. General intellectual ability and parent-reported behavior were assessed one week prior to the PSG. Group differences in IQ, behavior, sleep-dependent learning performance and dissipation of slow wave activity were assessed. Associations between OAHI, SWA and sleep-related memory consolidation were analyzed.
Results: There was a 10-point difference in IQ outcomes between moderate-severe OSA and Controls. Both SDB groups had significantly worse parent-reported behavior and performed worse at acquisition of learning in the narrative memory task than Controls, with recall performance remaining consistent pre- and post-sleep. There were no group differences in acquisition, pre- or post-sleep performance in verbal learning or picture recognition or in dissipation of SWA. SWA was not associated with post-sleep recall performance. Increasing OAHI was significantly correlated with poorer recall of learned narrative (r_s = -0.39, p<0.01) and picture recognition (r_s = -0.40, p<0.01).
Conclusion: Contrary to our hypotheses, learning potential and sleep disturbance as assessed through SWA was equivalent between SDB groups. SWA was not associated with memory consolidation. However, as the number of obstructive events was associated with reduced memory performance, the question of why children with primary snoring experience equivalent deficits remains a mystery and requires further investigation.
Support (If Any): Sleep Research Society Foundation (007-JP-14)

0859

ADOLESCENTS WITH TREATMENT RESISTANT DEPRESSION: COULD SLEEP DISORDERED BREATHING BE INVOLVED?

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Introduction: Sleep disordered breathing (SDB) is frequently associated with depression in adults. SDB causes sleep fragmentation and hypoxemia, and alters serotonergic transmission, all of which may link SDB to depression. Despite improvement in depression with treatment of SDB, SDB is widely underdiagnosed. Since the adolescent brain is less developed than the adult brain, adolescents may be more vulnerable to SDB effects. The aim of this study was to investigate the sleep of adolescents with treatment resistant depression (TRD) and evaluate whether SDB could be involved.
Methods: Polysomnography was recorded in 20 outpatient adolescents (15–18 y.o.) with major depression who did not respond to at least two 6-week trials of antidepressants, i.e. TRD, and 20 healthy controls matched for sex and age. The TRD group had no psychiatric comorbidities aside from anxiety disorders. Depressive symptom severity was rated on the Beck Depression Inventory (BDI-II).
Results: The TRD group had a slightly, but non-significantly, higher respiratory disturbance index (RDI) than the control group (U = 117, p = 0.692). The rate of individuals with an RDI ≥ 15 was significantly higher in the TRD (35%) than in the control (1%) group (Chi2 = 6, p = 0.015). Within the TRD group, higher RDI correlated with higher BDI-II scores (r = 0.50, p = 0.025). This correlation remained significant after controlling for BMI (r = 0.59, p = 0.007).
Conclusion: These results suggest over one third of adolescents with TRD meet diagnostic criteria for SDB. More frequent respiratory events were associated with more severe depressive symptoms. Consequently, in a considerable subgroup of adolescent patients, SDB may play a role in persistent depressive symptoms and treatment resistance. Screening adolescent TRD patients for SDB may be fruitful, since SDB is readily treatable. Such treatment could improve clinical outcomes early in the course of mood disorders.
Support (If Any): This study received no financial support

0860

REGIONAL BRAIN TISSUE INTEGRITY IN CHILDREN WITH SLEEP DISORDERED BREATHING WITH SLEEP DISORDERED BREATHING

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Introduction: Children with sleep-disordered breathing (SDB) exhibit behavioural, cognitive, and autonomic deficits, suggestive of neural injury. The objective of this study was to assess whether neural tissue alterations underlie such deficits, and whether the tissue changes resulted from acute or chronic injury.
Methods: We examined brain tissue integrity with non-invasive diffusion tensor imaging (DTI; two series)-based mean diffusivity (MD) procedures, using a 3.0-Tesla MRI scanner in 18 children with SDB (mean age ± SE, 12.3 ± 0.7 years; 11 male) and 20 non-snoring control children (12.2 ± 0.6 years; 10 male). We also assessed physiological, cognitive and behavioural functions following overnight polysomnography (PSG). Sleep variables, derived from overnight PSG, physiological, cognitive and behavioural scores were compared between groups using Student's t-tests. We calculated MD maps from each series, and both maps were realigned and averaged, normalized, smoothed, and compared between groups using ANCOVA (covariates; age and gender).

Results: No significant differences in age or gender emerged between groups. The obstructive apnoea hypopnoea index (0.3 ± 0.1 events/h vs 7.5 ± 1.9 events/h, p<0.001), body mass index (BMI z-score 0.23 ± 0.17 vs 1.36 ± 0.28, p<0.001) and systolic blood pressure (112.6 ± 2.6 mmHg vs 120.4 ± 1.8 mmHg, p<0.05) were all higher in the SDB group. Sleep variables were similar between groups. Verbal, performance and total IQ, assessed on the Stanford Binet, were 6–8 points lower in the SDB group. Children with SDB exhibited higher scores on externalizing and total problems measured on the Child Behavior Check List (p<0.05), and on the BRIEF, indicating worse problem behaviours. The SDB group had significantly reduced MD values, indicating acute tissue changes, in multiple sites, including the hippocampus, insula, thalamus, temporal and occipital cortices and cerebellum. Significantly increased MD values, suggesting chronic tissue damage, emerged in the frontal and prefrontal cortices.
Conclusion: Both acute and chronic tissue damage occurs in areas that regulate autonomic, cognitive, and mood functions, which were deficient in these paediatric SDB cases. Both short-term and long-lasting pathological processes are operating in the condition.
Support (If Any): The Heart Foundation of Australia (G12M6564) and the Monash University Strategic Fund.

0861

CHARACTERIZING TREATMENT EMERGENT CENTRAL SLEEP APNEA IN CHILDREN

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Introduction: Treatment emergent central sleep apnea (TECSA) is a sleep disorder in which central apnea occurs once positive airway pressure has been applied to resolve obstructive apneas. TECSA has not been characterized in children. The purpose of this study is to determine the prevalence of TECSA in children and identify characteristics of children who develop TECSA.
Methods: This retrospective study included children aged 0–18 started on long-term non-invasive ventilation who had both diagnostic and treatment polysomnography. The criteria for TECSA included: obstructive apnea-hypopnea Index (OAHI) ≥5 during the diagnostic study; improvement in OAHI on the treatment study; central apnea index (CAI) remaining the same or worsening from diagnostic to treatment study; and central apnea Index (CAI) ≥5 and accounting for ≥50% of the apnea-hypopnea index (AHI) during the treatment study. Each child with TECSA was matched to three children of similar age and sleep study date to construct a non-TECSA comparison group. Data collection included clinical characteristics in addition to the diagnostic, first and subsequent treatment studies.
Results: Out of our population of 146 children, 13 were identified as having TECSA for a prevalence of 8.9%. During diagnostic studies, TECSA children had significantly higher OAHI and AHI than non-TECSA children (OAHI: 29.5 ± 25.1 events/h vs 16.0 ± 15.0 events/h, p<0.05; AHI: 33.4 ± 24.7 events/h vs 19.6 ± 17.3 events/h, p<0.05). During titration studies, CAI and AHI were significantly higher in TECSA children than matched controls (CAI: 22.6 ± 32.1 events/h vs 2.0 ± 3.7 events/h, p<0.001; AHI: 29.6 ± 10.0 events/h vs 7.7 ± 9.4 events/h,p<0.001). The mean airway pressure for treatment did not differ between TECSA and non-TECSA children (6.9 ± 1.8 mmHg vs 6.5 ± 1.8 mmHg, p=ns). Six TECSA children had follow-up treatment studies; in 4 children (67%) criteria for TECSA was not met at follow-up.
Conclusion: The prevalence of TECSA in children is similar to what is reported in adults. Higher obstructive indices during diagnostic sleep studies may provide an early indicator for TECSA risk. TECSA may be a transient phenomenon as the majority of TECSA children did not meet the criteria for the disorder at follow-up. A prospective study would be helpful to further explore this finding.
Support (If Any): None

0862

POLYSOMNOGRAPHIC CHARACTERISICS OF PEDIATRIC DOWNS SYNDROME PATIENTS BEFORE AND AFTER HYPOGLOSSAL NERVE STIMULATOR IMPANT

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Introduction: Obstructive sleep apnea (OSA) affects 50–60% of patients with Down syndrome. OSA persists in 50% of patients after adenotonsillectomy and these patients often do not tolerate CPAP. The hypoglossal nerve stimulator is proposed as an alternative treatment for these patients. There have been no previous reports of the polysomnography (PSG) and device titration characteristics these patients
Methods: Six pediatric patients between ages 11 and 18 years with Down syndrome were enrolled for a safety and efficacy trial with the hypoglossal nerve stimulator. Patients underwent preoperative PSG and post operative PSG with device titration at 1,2,6, and 12 months after implantation. The characteristics of these studies are reviewed.
Results: 6 patients had a preoperative AHI between 10 and 50 (Mean 25.96 +/- 12.94 SD). At final voltage levels., AHI was reduced by 51.8–88.7% with a mean reduction of 22.03 +/- 12.67 SD. Titration to the optimal voltage was achieved in all children using a similar technique to CPAP titration. The similarity to CPAP titration allowed sleep staff to quickly master device titration. Unlike adults, these patients were titrated to a single voltage instead of a range. This restriction required titration adjustment until at least the 3rd post op study in all patients. Final voltage settings were determined by the efficacy of the device at relieving obstruction but limited by arousals and discomfort at higher voltage setting. This threshold was complicated by challenges in the study population's ability to reliably report their sensation threshold. One patient had severe central apnea when the device was activated post op. This central apnea resolved on subsequent titrations.
Conclusion: The hypoglossal nerve stimulator has been safe and effective in this limited, first of its kind, application in pediatric down syndrome patients. The titration technique was rapidly adopted and understood by sleep staff given similarities to CPAP titration. The adult titration technique had to be modified to suit the study population resulting in more in lab effort at titration. The device has been well tolerated and utilized daily by these first six patients
Support (If Any): Inspire provided the devices for this study

0863

THE ASSOCIATION BETWEEN BRONCHIAL ASTHMA AND SLEEP BREATHING DISORDER IN PRIMARY SCHOOL CHILDREN, A LARGE-SCALE CROSS-SECTIONAL STUDY

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Introduction: Sleep disordered breathing (SDB) is associated with the bronchial asthma in the adult population. Their association in the children has not been established. The aim of the study is to elucidate whether or not bronchial asthma and SDB were associated in primary school children.
Methods: A questionnaire for a parents of the whole 24,296 primary school children of Matsuyama city was distributed and analyzed.

The questionnaire asked on information on grade, body size, sleep duration, histories of the hypertrophy of tonsils and/or adenoids, in addition to snoring and the history of bronchial asthma. Snoring were classified with its frequency and categorized into three groups: never, sometimes (1 to 4 days a week) and frequently (5 to 7 days a week). Of 21,456 children, 2,840 were excluded because of the lack of information.

Results: 7.2% of snoring children had a history of asthma, while 5.0% of those who didnot snore. Furthermore, 7.1% of children who snored once a week had ahistory of asthma, and 9.9% of those who did 5~7 days a week had a historyof asthma, suggesting that the prevalence of asthma was dependent onfrequency of snoring. Odds ratio of snoring for a history of asthma was 1.46(95% confidence interval 1.30–1.63) in further adjustment with the schoolgrade, Rohrer index, tonsils/adenoid hypertrophy.

Conclusion: There are several limitations in this study: the diagnosis of bronchial asthma were made based on questionnaire, and thus might not be accurate. In addition, this was a cross-sectional study and thus could not show any causal relations. The strength of the study was, however, that as much as 21,456 children (86% of the whole children of the city) were enrolled for analysis. Although there are pathogenic difficulty in developing SDB between adults and children, our study showed that asthma and snoring were associated.

Support (If Any):

0864

PREVALENCE OF ATOPY IN SCHOOL-AGE CHILDREN WITH THE OBSTRUCTIVE SLEEP APNEA SYNDROME

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Introduction: The obstructive sleep apnea syndrome (OSAS) in children has been associated with allergic diseases and asthma. However, the prevalence of atopy in children with OSAS based on objectives measurements of allergy is unknown. The aim of this study is to report the prevalence of atopy based on objective measurements in a cohort of children with OSAS recruited for research purposes. We hypothesized that children with OSAS would have an increased prevalence of atopy compared to the general pediatric population.

Methods: 71 school-aged children with OSAS who participated in a randomized double-blinded controlled trial aimed at studying intranasal fluticasone as a treatment for OSAS underwent percutaneous skin allergy testing (PST), determination of total immunoglobin E (IgE), nasal nitric oxide (NO) production and exhaled NO concentration as biomarkers of eosinophilic inflammation. Parents completed the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire.

Results: The group's age (mean±SD) was 7.2±2.1 years, obstructive apnea hypopnea index (OAHI) (median[interquartile range]) 5[3.4–9.1] events/hour, BMI z-score 1.0±1.1, and IgE 48.7 [17.6–166] IU/mL. 50.7% were female, 76% were African American, and 12.7% were Hispanic. PST to at least one allergen was positive in 49.3%. Nasal NO production was 265.7±68.4 nL/min and exhaled NO concentration 13.9[11.0–19.3] ppb. There were no correlations between OAHI and IgE, NO production and concentration, respectively. Based on the ISAAC questionnaire, the prevalence of current nasal symptoms was 78.6%, current nasal and ocular symptoms 18.3%, hay fever 18.3%, asthma 29.5%, severe asthma 2.8%, eczema 15.5%, and eczema severe enough to disturb sleep 2.8%.

Conclusion: Children with OSAS have a high prevalence of positive PST yet similar to the general population based on the Third National Health and Nutrition Examination Survey data. IgE, oral and nasal NO are also similar to values reported in normal children. However, the prevalence of asthma, hay fever, and eczema are greater than those described in the general population. We speculate that similar mechanisms may predispose to both atopy and OSAS, or alternatively that atopy predisposes to OSAS.

Support (If Any): R01HL120909, UL1TR000003, REDCap

0865

SLEEP PARAMETERS OF PATIENTS WITH DUCHENNE MUSCULAR DYSTROPHY

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Introduction: Patients with Duchenne Muscular Dystrophy (DMD) have a variety of sleep related breathing disorders (SRBD) due to their muscular weakness including sleep apnea and hypoventilation. To further understand SRBD in DMD, we examined the polysomnographs (PSG) of 17 patients with DMD and studied correlations among PSG indices and sleep parameters.

Methods: We reviewed our sleep center database and identified patients with DMD who underwent PSG in the period from 2005–2016. Data collected included heart rate, respiratory rate, End-tidal CO2 measures (baseline, mean, max, time greater than 50 torr), 02 measures (baseline, low, average, time less than 88%) total sleep time (TST), sleep efficiency, sleep onset latency, percentage of REM and N3 sleep, apnea/hypopnea index (AHI), indices of obstructive apnea, central apnea, central and mixed apnea, respiratory disturbance (RDI), periodic limb movements, and arousals. Other data recorded for each subject included age, BMI, BMI-Z score. Descriptive statistical analysis, including means and standard deviations were calculated. We computed Pearson correlation coefficients to examine the relationships between PSG indices and other parameters using $p<0.05$ for statistical significance.

Results: 13 out of 17 patients had sleep apnea (mean AHI = 9.6). In the 9 patients whose time spent greater than 50 torr was recorded, time spent above 50 torr was positively correlated with BMI (0.84), REM latency (0.82) and the arousal index (0.84), but not AHI (-0.29). A positive correlation was also found between maximum CO2 and arousal index (0.76).

Conclusion: Hypoventilation is a common and independent of overall AHI in patients with DMD. Patients with DMD who have a higher BMI are more likely to have hypoventilation and DMD patients who have hypoventilation are more likely to have fragmented sleep. Reliable CO2 measures may be especially important to identify sleep disorders in patients with DMD.

Support (If Any): None

0866

A SYSTEMATIC REVIEW OF HEALTH OUTCOMES FOR CHILDREN WITH NEUROMUSCULAR DISORDERS USING LONG TERM NON-INVASIVE VENTILATION.

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Introduction: With increasing survival, recognition of the benefits of earlier intervention for respiratory insufficiency, and improvement in the technology used for non-invasive ventilation, the use of long-term non-invasive ventilation in children with neuromuscular

disease has increased dramatically over the last 10 years. To date, while individual studies have looked at the impact of NIV on important outcomes, there has been no summary of these results. The aim of this systematic review is to summarize the published data relevant to health outcomes in children with neuromuscular disease using non-invasive ventilation.

Methods: A scoping review was performed as the first step for identifying all published literature on children using long-term non-invasive ventilation and identified 289 publications. These articles were then screened for inclusion of discrete data on children with neuromuscular disease. Outcomes of interest included survival, healthcare usage, quality of life, respiratory function, sleep quality, neurocognition, or care giver burden. Grey literature sources were excluded.

Results: A total of 35 publications were identified for inclusion in this review. A total 823 children were across these studies. While the majority of children using non-invasive ventilation had spinal muscular atrophy (59%) or Duchenne muscular dystrophy (19%), 20 additional neuromuscular diseases were present in the remaining children. An outcome of interest was studied in 71% of studies with the remaining studies only describing subject characteristics. The most common outcomes studied were change in polysomnography results (34%), healthcare usage (20%), and survival (20%); the remaining studies addressed respiratory function, neurocognition, sleep and quality of life.

Conclusion: The majority of information on non-invasive ventilation use in children with neuromuscular diseases comes from two predominant conditions with use in a large number of additional unique diseases. Outcomes focus on polysomnography results and healthcare usage with less emphasis on outcomes of potential greater relevance to children and their families.

Support (If Any):

0867

SLEEP DISORDERED BREATHING IS HIGHLY PREVALENT AMONG NEWBORNS WITH MYELOMENINGOCELE

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Introduction: Children with myelomeningocele are at risk for sleep-disordered breathing (SDB), possibly due to comorbid hydrocephalus and Chiari II malformations. Yet, objective assessments of their sleep in the newborn period have not been published. The goal of this study was to compare SDB in newborns with and without myelomeningocele, in the absence of obvious additional risk factors for SDB.

Methods: Twenty newborns with myelomeningocele (12 male; mean gestational age 38 ± 2.6 weeks) who had undergone fetal (n=5) or postnatal (n=15) surgical repair were monitored with 12-hour attended polysomnography during the neonatal hospital admission at mean postnatal age of 8 ± 7.8 days. These newborns' sleep measures were compared to those of (postmenstrual) age-matched subjects admitted to the newborn ICU for non-neurologic concerns.

Results: Every newborn with myelomeningocele had SDB. The mean apnea hypopnea index (AHI) (32.4 ± 21.8) for these subjects was significantly higher than that of the comparison group (18.8+11.0) (conditional logistic regression, p=0.035, OR 1.11, 95% CI 1.01–1.23, per 1 point increase in AHI). AHI was highest during active sleep for both myelomeningocele (48.9 ± 26.8) and comparison (29.8 ± 18.9) newborns. The mean oxygen saturation of subjects with myelomeningocele (94.1 ± 3.1) was slightly lower than that of comparison subjects (96.4 ± 2.2) (p = 0.05, OR = 0.68, 95% CI 0.46–0.99). Time spent in specific sleep wake stages was not different between groups.

Conclusion: SDB is ubiquitous among newborn infants with myelomeningocele. As treatment of SDB has long-term benefit for behavior and general health among older children, screening and treating sleep apnea in newborns with myelomeningocele may provide a new, worthwhile opportunity to optimize health at the very start of life.

Support (If Any): This work was supported by a grant from the American Sleep Medicine Foundation and the University of Michigan Barwick Scholar Award.

0868

THE ASSOCIATION BETWEEN OBSTRUCTIVE SLEEP APNEA WITH INSULIN RESISTANCE IN OBESE CHILDREN

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Introduction: Obstructive sleep apnea (OSA) and insulin resistance is highly prevalent in obese children. OSA and obesity are independently associated with insulin resistance (IR) in adults. There is mixed evidence of correlation between OSA and insulin resistance in children. We aim to evaluate the association between OSA and IR in obese children.

Methods: A retrospective study was performed in a tertiary care pediatric obesity clinic. Subjects aged 2–18 years with normal development who underwent overnight polysomnography (PSG), anthropometric measurements, and fasting laboratory tests from 2013 to 2016 were reviewed. Primary outcome measure was homeostatic model assessment of insulin resistance (HOMA-IR). Subjects treated for IR with metformin prior to lab studies were excluded. Subjects with significant OSA (apnea-hypopnea index [AHI] ≥5) were compared with those without significant OSA (AHI<5). Oxygen desaturation index (ODI) was categorized as <4 vs. ≥4 around the median. Linear regression was used to assess the relationship of HOMA-IR with AHI and ODI unadjusted and adjusted with age, gender and BMI. Logistic regression with receiver operating characteristic (ROC) analysis was used to investigate the optimal cutoff of AHI/ ODI on outcome HOMA-IR≥3.

Results: 77 subjects; mean age 11.9 ± 4.2 years, 55.8% female, all obese (BMI% median (Q1, Q3) 99(99.0, 99.8); 45% Caucasian; 41(53%) had AHI<5, 36(47%) had AHI≥5. Prevalance of comorbidities (e.g hypertension, dyslipidemia) were similar. The OSA group had 1.44 greater HOMA-IR units than the non-significant AHI group (p=0.022). Patients with higher ODI had greater HOMA-IR (by1.38 units; p=0.048). However, after adjusting for BMI, age, and gender, AHI≥5 was no longer significant (p=0.76). BMI was the strongest predictor for increased HOMA-IR (p<0.001). ROC curve supported our AHI dichotomy by identifying the optimal AHI cutpoint at 5 with AUC 0.68(95%CI0.55-0.88), sensitivity 0.77, specificity 0.65. ODI cutpoint was 4.6 with AUC 0.72(95%CI 0.60–0.85) sensitivity 0.76, specificity 0.68 for predicting HOMA-IR≥3.

Conclusion: Our findings support the association of OSA and IR in obese children. But this relationship appears to be impacted by BMI. Significant IR could be discriminated by AHI/ODI ≥5 with moderate sensitivity/specificity. Future studies are needed to examine effects of sleep parameters on metabolic function.

Support (If Any):

0869

CRP IS A BETTER PREDICTOR OF CARDIOMETABOLIC RISK THAN APNEA/HYPOPNEA INDEX IN ADOLESCENTS WITH MILD-TO-MODERATE OBSTRUCTIVE SLEEP APNEA

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Introduction: The guidelines for when and how to treat mild-to-moderate obstructive sleep apnea (OSA) in adolescents are often a clinically gray area. We examined the relative contribution of apnea/hypopnea index (AHI) vs. C-reactive protein (CRP) in predicting cardiometabolic risk in a general population sample of adolescents with mild-to-moderate OSA.

Methods: Adolescents from the Penn State Child Cohort underwent a single 9h polysomnography. Those with mild-to-moderate OSA (2≤AHI<15) were included in the study (n=135; ages 12-22y, 66.7% male, BMI percentile 72.6±2.3). A fasting blood draw was taken upon awakening (7:00), and plasma levels of CRP, glucose, insulin, HDL cholesterol, and triglycerides were measured. Blood pressure (BP) was assessed in the evening while seated. Linear regression models examined the relative contribution of CRP and AHI in predicting cardiometabolic health, adjusting for age, sex, and ethnic minority.

Results: In adolescents with mild-to-moderate OSA, CRP was a stronger predictor of diastolic BP (β=0.15, p=0.09), glucose (β=0.22, p=0.01), insulin resistance (homeostatic model assessment [HOMA]; β=0.20, p=0.02), triglycerides (β=0.16, p=0.08), and the continuous metabolic syndrome risk score (cMetS; β=0.29, p=0.001), than AHI (all p>0.16). These associations of CRP with cardiometabolic risk were stronger within mild-to-moderate OSA compared to the full sample of adolescents with AHI<15 (n=364), where only insulin resistance (β=0.16, p=0.004), triglycerides (β=0.14, p=0.01), and cMetS (β=0.23, p<0.001) were predicted by CRP, and not AHI (all p>0.487).

Conclusion: Incorporating a measure of systemic inflammation improves the ability for clinicians to detect cases of mild-to-moderate OSA with true cardiometabolic risk in adolescents. These findings have implications in improving prognosis and treatment options for adolescents with OSA in the mild-to-moderate range.

Support (If Any): NIH R01 HL63772, R01 HL97165, UL1 TR000127, C06 RR16499

0870

ARE THE CARDIOVASCULAR CONSEQUENCES OF OBSTRUCTIVE SLEEP APNOEA COMPOUNDED BY OBESITY IN CHILDREN?

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Introduction: Up to 50% of overweight/obese children have obstructive sleep apnea (OSA) compared to up to 6% of normal weight children. Both obesity and OSA have independent adverse cardiovascular effects, yet, there is limited research into their combined effects in children. This study aimed to compare sleep quality and architecture as well as cardiovascular variables (blood pressure, heart rate, nocturnal dipping) between normal weight and overweight/obese children with and without OSA, and controls.

Methods: Seventy-four children (8–18 years) referred to the Melbourne Children's Sleep Centre, and 24 healthy weight non-snoring community controls were recruited. Children were grouped according to their obstructive apnea hypopnea index (OAHI): OSA (>1 event /h) or primary snoring (PS ≤1 event/h) and whether they were healthy weight or overweight/obese (BMI z-score ≥ 1.04): (1) non-snoring healthy weight control group; (2) healthy weight PS group; (3) healthy weight OSA group; (4) overweight/ obese PS group and (5) overweight/obese OSA group. Office blood pressure was recorded whilst awake and heart rate and pulse transit time (PTT) as an inverse surrogate measure of continuous blood pressure recorded continuously during sleep.

Results: Sleep quality and architecture were similar between groups. Wake systolic blood pressure was significantly higher in the overweight/obese OSA group compared to the control, healthy weight PS and overweight/obese PS groups (P<0.05 for all). During sleep, blood pressure and heart rate were elevated in the overweight/obese OSA group compared to non-snoring controls (p<0.05). More children who were overweight/obese had reduced dipping of blood pressure and heart rate when asleep compared to healthy weight children. BMI z-score predicted heart rate and PTT when asleep and both age and BMI z-score predicted blood pressure when awake.

Conclusion: This study showed that being overweight/obese has independent effects on blood pressure and heart rate in children with OSA. We have previously shown that treatment of OSA reduces blood pressure and suggest that treatment of all severities of OSA in the growing number of overweight/obese children may improve cardiovascular outcomes.

Support (If Any): The Heart Foundation of Australia (G12M6564), Monash University Strategic Fund and The Victorian Government's Research Infrastructure Support Program.

0871

INCREASED RISK OF BEHAVIOR PROBLEMS AND POOR QUALITY OF LIFE IN OVERWEIGHT AND OBESE CHILDREN AND ADOLESCENTS WITH SLEEP DISORDERED BREATHING

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Introduction: Overweight and obesity in childhood is a major risk factor for sleep disordered breathing (SDB). It is well established that SDB and obesity, independently, place children at increased risk of poor functional outcomes, however an understanding of whether obesity comorbid with SDB adds significantly to the risk is unclear. This study aimed to determine whether overweight and obesity increased the detrimental effect on cognition, behavior, mood and quality of life observed in children with sleep disordered breathing.

Methods: Children and adolescents (8-16y) with clinically diagnosed SDB were categorized into two groups: healthy weight (BMI z-score <1.04, N=11) and overweight/obese (BMI z-score ≥ 1.04, N=10). Age-matched healthy weight, non-snoring Controls (N=25) were recruited from the community. All participants underwent overnight laboratory polysomnography (PSG). Cognitive, behavioral, and quality of life assessments were conducted in the home following the PSG. ANCOVA assessed group differences in cognitive outcomes, controlling for socio-economic status. Kruskal-Wallis ANOVA determined group differences in behavior and quality of life. Where group differences were found, hierarchical linear regressions determined the additive effect of weight on outcomes.

Results: Children with SDB had significantly poorer behavior and quality of life than Controls, with overweight/obese children with SDB reported to have the greatest dysfunction. No group differences were found in cognitive outcomes. The obstructive apnea hypopnea index (OAHI) was a significant predictor of withdrawn behavior (R^2=0.42), inattention (R^2=0.43) and aggressive behavior (R^2=0.30). BMI z-score added significantly to aggressive behavior (R^2=0.22) and was an independent predictor of overall Externalizing behaviors (R^2=0.26). OAHI was an independent predictor of school functioning (R^2=0.30). BMI z-score was an independent predictor of social functioning (R^2=0.38) and significantly added to the prediction of physical functioning over OAHI (OAHI R^2=30; BMI Z-score R^2=0.37).
Conclusion: Overweight and obesity comorbid with SDB increases the risk of externalizing behaviors such as aggression, but does not affect the traditional behavioral associates of SDB such as inattention and school functioning. These findings have important implications for screening and treatment of SDB in this population.
Support (If Any): The Heart Foundation of Australia (G12M6564), Monash University Faculty of Medicine, Nursing and Health Sciences Strategic Fund

0872

BODY POSITION EVALUATED DURING SLEEP BY POLYSOMNOGRAPHY IN INFANTS WITH PIERRE ROBIN SEQUENCE

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Introduction: Management of obstructive sleep apnea in infants with Pierre Robin Sequence (PRS) is multifaceted. Conservative management includes prone positioning during sleep which theoretically allows gravity to pull the tongue anteriorly to decrease upper airway obstruction. However, prone sleep positioning conflicts with safe infant sleep data that has indicated supine positioning to be safest for young infants. Although prone positioning is recommended by many centers for infants with PRS world-wide, there is little data to support or argue against this practice.
Methods: Infants with micrognathia and suspected PRS who were referred for a clinically indicated polysomnography (PSG) were recruited from craniofacial clinic and inpatient units. The PSG was divided into periods of supine and prone sleep, moving from their usual sleep position to the other position midway in the study (non-prone to prone in 6/8 subjects). Standard recording channels were used. For each position, data was collected on obstructive apnea-hypopnea index (OAHI), central apnea index (CAI), lowest oxygen desaturation, highest PCO2, sleep efficiency, and arousal index.
Results: Ten infants were recruited and eight studies were completed to date. All infants were term except one, average age at the time of the study was 41.6±37 days, and 8/10 (80%) were female. OAHI and CAI decreased in 6/8 (75%) infants from non-prone to prone position. Sleep efficiency increased in 4/8 (50%) and arousal index decreased in 5/8 (62.5%). The lowest oxygen desaturation and the highest PCO2 on room air were comparable within infants for both body positions.
Conclusion: Preliminary results have demonstrated individual variation in apneic events in response to body position during sleep. Due to the small number of subjects there is currently insufficient evidence to conclude any recommendations on sleep position in infants with Pierre Robin Sequence. We speculate that the decision to use prone positioning as a therapy should be objectively evaluated in individual infants.
Support (If Any): None

0873

OBSTRUCTIVE SLEEP APNEA IN CHILDREN WITH BECKWITH-WIEDEMANN SYNDROME

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Introduction: Beckwith-Wiedemann syndrome (BWS) is a rare pediatric overgrowth and cancer predisposition disorder that results in a spectrum of clinical findings. In children with BWS, macroglossia is particularly prominent in those with hypomethylation of the IC2 region of chromosome 11. Infants and children with BWS can have very severe obstructive sleep apnea (OSA), but the prevalence of OSA in this population is poorly understood, as is the relationship between OSA and the BWS genotype/phenotype. We hypothesized that there would be a high prevalence of OSA in children with BWS, and that OSA would be more severe in children with IC2 mutations due to more significant macroglossia.
Methods: Children with BWS at Children's Hospital of Philadelphia undergo polysomnography as part of their multidisciplinary evaluation. Medical records from children evaluated from 2006 through November 2016 were reviewed for results from polysomnography, genetic testing, and clinical assessment. Wilcoxon signed-rank test was used to compare apnea hypopnea index (AHI) between age groups.
Results: 223 children with BWS were evaluated. Of those, 21 children with BWS who had not previously had treatment for OSA and underwent polysomnography, genetic testing, and clinical assessment were included in the analysis. Median (range) age was 14.7 months (3 days to 6 years) at the time of polysomnography. 11 (52.3%) had an AHI >5/hour. In the cohort, median (range) AHI was 5.5/hour (0 to 80.9/hr). There was a trend toward greater AHI in participants less than 12 months old compared with those 12 months and older (p=0.051). Those with IC2 mutation did not have a greater AHI (p=0.75).
Conclusion: There is a high prevalence of OSA in BWS. Infants with BWS may be at the greatest risk for OSA compared to older children. More research is needed to determine the role of genetic factors and macroglossia in OSA in children with BWS.
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0874

SLEEP DISORDERED BREATHING IN CHILDREN WITH REFRACTORY EPILEPSY TREATED WITH VAGUS NERVE STIMULATOR

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Introduction: Vagus nerve stimulation (VNS) is an effective treatment option for medically refractory epilepsy. The effects of VNS on sleep disordered breathing (SDB) were reported in some case series. However, studies in pediatric population are not well-described. The primary purpose of our study is to describe clinical characteristics, and polysomnographic findings in children with VNS.

Methods: A retrospective review of medical records and polysomnographic results was performed in pediatric patients aged 0–20 years old with refractory epilepsy at CCHMC. Only children with VNS treatment at the time of sleep study were included.
Results: 22 subjects met the criteria for entry into this study. 77.3% of subjects had localization related epilepsy, 13.6% had generalized epilepsy, and 9.1% had features of both generalized and localization related epilepsy. 54.5% were male. The mean age at the time of VNS insertion was 8.4 ± 4.2 years. The mean age at the first PSG after VNS insertion was 10.9 ± 4.6 years. Three patients had obstructive sleep apnea (OSA) prior to VNS insertion. Common presentations at sleep clinics included snoring (81.8%) frequent night awakening (68.2%), parasomnia (68.2%), daytime sleepiness (45.5%) and gasping (45.5%). The mean apnea-hypopnea index (AHI) was 11.5 ± 18.8/hr (median 4.1; range 0 - 69.2) and the mean obstructive index (OI) was 10.9 ± 18.5/hr (median 3.9; range 0 - 67.1). Obstructive sleep apnea (OSA) was diagnosed after VNS insertion in 19 patients (86.4%), 6 of which (27.2%) had severe OSA. One patient (4.5%) had co-existing central sleep apnea on subsequent polysomnography. 8 patients (36.4%) had significant hypoventilation. For management, 31.8% of patients were treated with BiPAP, 9.1% with CPAP, 9.1% with ventilator, 18.2% with upper airway surgery (adenotonsillectomy and/or uvulopalatopharyngoplasty) and 36.4% were treated conservatively.
Conclusion: Sleep disordered breathing, including obstructive sleep apnea and hypoventilation, is common among children with medically refractory epilepsy treated with VNS. The mechanism is currently unknown, but may involve the effect of VNS firing on upper airway muscle tone or central respiratory control. Further studies are needed to assess what factors associated with VNS play a crucial role in the upper airway collapsibility.
Support (If Any): None

0875

CORTISOL IS ELEVATED IN OVERWEIGHT ADOLESCENTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: In adults, a number of studies over the last 15 years suggest that obstructive sleep apnea (OSA) is associated with hypothalamic-pituitary-adrenal (HPA) activation and elevated cortisol levels. The literature regarding cortisol levels in overweight children, adolescents, and adults is mixed. The aim of this study was to explore the relative contributions of OSA and body weight in cortisol levels within a large general population sample of adolescents.
Methods: Adolescents (n=416; 17.0 ± 0.1y, 54.1% male, 22.1% minority) from the Penn State Child Cohort underwent a single 9h polysomnography. Those with OSA (n=44) were defined by an apnea/hypopnea index (AHI) ≥ 5. Height and weight were recorded in the evening for the assessment of body mass index (BMI) percentile; those with BMI ≥ 85th percentile (n=142) were considered overweight. At 19:00 and 7:00 (upon awakening), saliva samples were collected and analyzed for cortisol via ELISA. ANCOVA assessed differences in evening, morning, and average cortisol levels in groups defined by OSA severity and overweight, adjusting for age, sex, and ethnic minority status.
Results: Compared to normal-weight controls, overweight adolescents with OSA had significantly elevated average cortisol (17.0 ± 1.3 ng/mL vs. 13.9 ± 0.4 ng/mL, p=0.017). Neither the presence of OSA within normal-weight adolescents (all p>0.459) nor the presence of overweight within non-apneic controls (all p>0.346) significantly affected cortisol levels. Within overweight adolescents, however, average (17.0 ± 1.3 ng/mL vs. 14.3 ± 0.6 ng/mL, p=0.054) and evening (11.0 ± 1.5 ng/mL vs. 8.0 ± 0.7 ng/mL, p=0.063) cortisol were higher in those with OSA compared to controls.
Conclusion: OSA in overweight adolescents is associated with HPA hyperactivation, which is a well-established risk factor for cardiometabolic disorders. These data suggest that overweight adolescents with OSA are the most severe group, and that salivary cortisol may be a useful biomarker to detect who may require immediate therapeutic intervention.
Support (If Any): NIH R01 HL63772, R01 HL97165, UL1 TR000127, C06 RR16499

0876

AFTER THE REFERRAL: POLYSOMNOGRAPHY COMPLETION RATES IN CHILDREN REFERRED FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Despite guidelines for evidence-based diagnosis of pediatric obstructive sleep apnea (OSA), studies in primary care settings have found low rates of polysomnography (PSG) and other referrals for children at-risk for OSA. For children who are referred, little is known about the rate of PSG completion. The objective of the current study is to identify the rate of completed PSG amongst children referred for suspected OSA.
Methods: We employed a computer decision support system (Child Health Improvement through Computer Automation; CHICA) to prompt primary care providers (PCPs) for all patients ages 1–11 with a positive screen for snoring. We examined the electronic health records for all children referred for PSG through this process in five primary care clinics between August 2015 and July 2016. Clinics are located in Indianapolis, Indiana, and serve ethnically diverse children from families with a lower income (83.4% with Medicaid insurance).
Results: PCPs referred 124 snoring children for PSG. Referred children represented 5.9% of snoring children for whom the PCPs received an electronic medical record prompt to consider OSA. Of those referred, only 54.8% completed the PSG (despite scheduling availability), 25.0% were scheduled but cancelled/missed the appointment, 16.9% were contacted but never scheduled, 2.4% initiated but did not complete the PSG, and one patient (0.9%) was currently scheduled at the time of analysis. OSA was identified in 64.7% of children completing the PSG, with a range of severity: mild (2.0<AHI>4.99) = 50%; moderate (5<AHI>9.99) = 15.9%; and severe (AHI>10) = 34.1%.
Conclusion: Only a small proportion of snoring children were referred for PSG. Amongst those referred, the PSG completion rate was moderate. Many children who ultimately did complete the PSG were found to have OSA. Taken together, these findings suggest that many children with possible OSA remain unidentified, even in a system with automated screening and computer decision support.
Support (If Any): This study was supported by funding from the Indiana University School of Medicine, Section of Pulmonary, Allergy, and Sleep Medicine.

0877

THE COMPARISON BETWEEN NAP AND OVERNIGHT POLYSOMNOGRAPHIC DATA OF PEDIATRIC OBSTRUCTIVE SLEEP APNEA.

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Introduction: The studies on daytime polysomnography (PSG) or Nap-PSG are very scarce. The criteria to diagnose Obstructive sleep apnea (OSA) have been changed from time to time. Furthermore, advancement in technology in this era allows more advance devices to be deployed and merged into part of PSG. These are expected to yield more accuracy when compared with the past.
Methods: Snoring pediatric patients with regular nap schedule were informed and consented. Patients underwent overnight polysomnography and nap polysomnography separately, but within 2 month of each other. Both tests were done with the same recording devices and in the same manner. Patient's sleep behavior was observed by a sleep technician and were categorized into primary snoring, mild OSA, moderate OSA and severe OSA by apnea-hypopnea index (AHI). Sleep parameters between nap-PSG and standard-PSG were compared.
Results: There were twenty nine patients (62.1% male) with median aged and IQR was 5 years old [4.5–6] and median BMI was 15.9 kg/m^2[14.0–19.2], were recruited. The median AHI, arousal index of nap-PSG was 5.5 events/hour [2.0–20.9] and 21.2 events/hour [11.8–34.1], respectively, whereas those of standard-PSG were 6.9 events/hour [4.0–14.8] and 17.8 events/hour [14.8–31.1] respectively. There was no statistical significant between both groups. The best accuracy cut-point for nap-PSG to diagnosis for OSA is 2.5 events/hour, which yield sensitivity and specificity 73.1% and 100% respectively. Scatter plot showed a monotonic relationship between AHI from both tests. Spearman's rank correlation coefficient revealed a moderate positive correlation (P-value = 0.001, correlation coefficient = 0.59). From the treatment standpoint, the AHI cut-point criterion for surgery is usually more than 5 events/hour. We found that using nap-PSG AHI cut-off point more than 20 events/hour also yielded a good positive predictive value to considered surgery, which was 100%.
Conclusion: Nap-PSG has lower percentage of REM stage and higher percentage of N3 stage, which is similar to the early stage of normal nighttime sleep. Nap-PSG showed a promising trend as an alternative diagnostic tool for standard polysomnography. Nap-PSG cut-off more than 20 events/hour yield a good specificity for considering surgery.
Support (If Any): no

0878

SCREENING OF PEDIATRIC SLEEP-DISORDERED BREATHING WITH A CONTACT-FREE UNDER-THE-MATTRESS SENSOR

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Introduction: Contact free measurement of sleep and obstructive sleep apnea (OSA) in children may simplify screening, and allow unobtrusive home testing. In this study, a contact-free system, previously validated for sleep in adults, was tested for its sleep apnea screening capabilities in children.
Methods: Children referred to a sleep study with suspected Sleep-Disordered Breathing (SDB) underwent full polysomnography in a sleep laboratory, and were simultaneously measured with the contact-free system, utilizing a piezo-electric (PE) sensor placed under the mattress. This PE system (EarlySense, Israel), which has been previously validated for sleep staging in adults, measures parameters, including respiration effort, heart rate and movement. In apnea detection, the system identifies periodic patterns of respiration effort associated with apnea. The system's Apnea-Hypopnea-Index (AHI) and sleep/wake detections were compared to polysomnography-based manual scoring of a blinded expert.
Results: Ten children (5 males), ages 1–13 (5.4±3.6), with BMI of 14–21 (17.1±2.1), number of apnea/hypopnea events of 0–21 (9.7±6.0) and AHI of 0–3 (1.5±0.8) were included. The PE system's sleep/wake accuracy was 84.8%, with some overestimation of wake. Wake sensitivity was 85.0% and sleep sensitivity was 84.8%. Bland Altman analysis for the total number of apnea/hypopnea events, showed a standard deviation of 5.39 with bias of -1.65 for the PE system compared with the gold standard. Bland Altman analysis for AHI values, showed a standard deviation of 0.99 with bias of -0.07 for the PE system compared with the gold standard.
Conclusion: This interim analysis shows promising results for the estimation of SDB in children using a contact-free under-the-mattress system. The wake overestimation may be explained by high activity levels of children, especially in younger ages. This overestimation was not present in adults, which had better sleep/wake accuracy of 89.4%, wake sensitivity of 80.8% and sleep sensitivity of 91.2%. Additional children with higher AHI are being recorded to increase and vary the database, and further work is needed to adjust the sleep algorithm for young children. The PE contact-free system may be used in the future for effortless screening of children's sleep for several consecutive nights, in their natural home setting.
Support (If Any): None.

0879

SLEEPING SUPINE MAKES OSA MORE SEVERE AND DECREASES THE SYMPATHOVAGAL BALANCE IN PRESCHOOL-AGED CHILDREN

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Introduction: In both adults and children obstructive sleep apnea (OSA) has significant adverse cardiovascular consequences. In adults sleeping position has a marked effect on OSA severity, however the limited number of studies in children have reported conflicting findings. We aimed to determine the effect of position on OSA severity and the cardiovascular consequences in preschool-aged children.
Methods: This was a retrospective analysis of children aged 3–5 y diagnosed with OSA (n=75) and non-snoring controls (n=25). Sleeping position was classified as supine, semi-supine, left lateral, right lateral, prone and semi-prone using manual analysis of video recordings during one night of attended polysomnography. The proportion of each sleep state spent in each position, OSA severity and cardiovascular parameters (mean heart rate and blood pressure; the blood pressure and heart rate surge at respiratory event termination; heart rate variability) were compared between positions during NREM and REM sleep using mixed model analysis.
Results: Both non-snoring controls and children with OSA spent significantly more sleep time supine than in any other position, with the time spent supine not different between the groups (p=0.16). OSA severity measured using the obstructive apnea hypopnea index, was higher when supine compared with the other sleeping positions during

NREM ($p<0.05$), and higher in the moderate/severe OSA group when supine compared with left and right lateral ($p<0.05$ for both) and prone ($p=0.007$) during REM. Sympathovagal balance was decreased in children with OSA when in the supine and lateral positions ($p<0.05$). Surges in HR tended to be greater in NREM compared to REM and this was statistically significant for the left lateral position ($p<0.01$). Sleeping position had no effect on the mean heart rate or blood pressure.

Conclusion: This study identified that preschool-aged children, whether non-snoring controls or children with OSA, sleep predominately in the supine position, and that OSA was more severe in the supine position. We suggest that positional therapy to avoid the supine sleep position could have significant beneficial effects to reduce OSA severity and the known cardiovascular consequences.

Support (If Any): National Health and Medical Research Council of Australia Project APP491001; Victorian Government's Research Infrastructure Support Program.

0880

THE INFLUENCE OF SLEEP DISORDERED BREATHING SEVERITY ON CEREBRAL OXYGENATION IN CHILDREN

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Introduction: Sleep disordered breathing (SDB) is a common paediatric sleep disorder ranging in severity from primary snoring (PS) to obstructive sleep apnoea (OSA). Children with PS by definition do not experience clinically significant desaturation or sleep fragmentation, whereas OSA is characterized by repetitive hypoxia, hypercarbia and sleep fragmentation. Both hypoxia and sleep disruption are thought to impact neurocognitive development. Near-infrared spectroscopy measures tissue oxygenation index (TOI) which represents cerebral oxygenation. To date there have been few studies examining the effects of SDB on TOI in children and they have not distinguished between severities of OSA. The aim of this study was to determine the effect of SDB severity on TOI in children.

Methods: 139 children aged 3–12 y underwent overnight polysomnography and were classified as having PS (obstructive apnoea hypopnoea index (OAHI) ≤1 event per hour; n=31), mild OSA (>1 OAHI ≤5 events per hour; n=38), moderate/severe OSA (MS) OSA (OAHI >5 events per hour; n=30) or non-snoring controls recruited from the community (n=40). One-way analysis of variance (ANOVA) with Bonferroni post hoc testing was used to compare severity groups in each sleep state. Pearson correlations were performed to assess the relationship between OAHI and TOI during wake, N1, N2, N3, REM and total sleep for the cohort as a whole. Results are presented as mean±SEM.

Results: During wake, TOI was significantly lower in controls (72.5±0.6%) compared to PS (75.0±0.6%) and MS OSA (75.0±0.5%), $p<0.05$ for both. Though not reaching statistical significance, all severities of SDB had elevated TOI compared to controls during the different sleep stages. When the entire cohort was analysed, there was no correlation between OAHI and TOI in any sleep stage.

Conclusion: Our study has demonstrated that children with SDB have elevated cerebral oxygenation compared to healthy non-snoring controls during wake. This may be due to a protective mechanism influenced by other physiological parameters such as elevated blood pressure, which is evident in children with SDB, acting to conserve cerebral oxygenation levels.

Support (If Any): National Health and Medical Research Council of Australia Project APP1063500. Victorian Government's Research Infrastructure Support Program.

0881

CENTRAL ADIPOSITY PREDICTS INCREASED HEART RATE IN CHILDREN AND ADOLESCENTS WITH OBSTRUCTIVE SLEEP APNOEA

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Introduction: Obstructive sleep apnoea (OSA) and obesity in children have adverse cardiovascular effects, including elevated heart rate (HR). Little is known about the additive effects of obesity and OSA on HR in children. Previous studies have identified that anthropomorphic measurements are more sensitive indicators of OSA risk in children than body mass index (BMI), but studies have not investigated the association between these measures and the cardiovascular outcomes of OSA. We aimed to determine whether BMI z-score, the anthropomorphic measures of neck, waist, hip circumferences, the neck/waist (NWR), waist/hip (WHR) and waist/height (WHtR) ratios, and OSA severity were predictive of increased HR, during wake and sleep in children.

Methods: Children (3-18y) undergoing assessment for suspected OSA (n=301) and age-matched non-snoring controls (n=98) underwent overnight polysomnography. They were grouped by age into 3-5y (n=175); >5-9y (n=91); and >9y (n=90). Linear regression identified the determinants of HR during wake and sleep.

Results: The obstructive sleep apnoea index was not a significant predictor of increased wake or sleep HR in any age group. BMI z-score was predictive of sleep HR in the >9y group (STD β, 0.36; $p=0.002$). WHtR was the anthropomorphic measurement that was the best predictor of HR in all of the age groups. WHtR was a significant predictor of increased HR during wake in the 3-5y (0.20, $p<0.01$) and wake and sleep in the >5-9y group (0.34, $p<0.01$; 0.32, $p<0.01$ respectively) and during sleep in the >9y group (0.38, $p=0.001$).

Conclusion: Our results indicate the relationship between the cardiovascular sequalae of OSA and OSA severity and obesity is age-dependent. BMI z-score was predictive of increased HR only in the children over 9y of age. The only anthropometric measure that was predictive of increased HR in all age groups was WHtR, with the strength of the association increasing with age. This suggests that it may be central adiposity that is primarily driving elevated HR in children with OSA rather than OSA severity or obesity as measured by BMI z-score.

Support (If Any): National Health and Medical Research Council of Australia; Heart Foundation of Australia; Victorian Government's Research Infrastructure Support Program

0882

CHANGES IN CEREBRAL OXYGENATION DURING CENTRAL AND OBSTRUCTIVE EVENTS IN CHILDREN WITH SLEEP DISORDERED BREATHING

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Introduction: Sleep disordered breathing (SDB), a common condition in children ranges from primary snoring (PS) to obstructive sleep apnoea (OSA). Children with PS have similar daytime deficits to those with OSA, thought to be due to repetitive hypoxia. However, children with PS do not experience clinically significant desaturations.

We aimed to examine changes in cerebral oxygenation associated with central and obstructive events during sleep in children across a range of SDB severities.
Methods: 172 obstructive and 121 central events were analysed in 18 children (3–10 years), diagnosed with SDB using polysomnography. Children were classified as PS (obstructive apnoea hypopnoea index (OAHI) ≤1 event per hour; n=6), mild OSA (>1 OAHI ≤5 events per hour; n=5), moderate/severe OSA (MS) OSA (OAHI >5 events per hour; n=7). One-way ANOVA with Bonferroni post hoc testing and Student's t-tests compared the maximal (nadir) % change from baseline cerebral tissue oxygenation index (TOI) during NREM and REM between SDB groups.
Results: 82 central and 5 obstructive events were analysed for PS, 39 and 21 for MILD OSA, 51 and 95 for MS OSA. % change in TOI was greater for MILD OSA (-3.6 ± 0.4%) compared with MS OSA (-2.2 ± 0.2%; p<0.01) during obstructive events in NREM sleep. There were no group differences during REM sleep. TOI decreased during sleep for central events in all groups (PS -2.8 ± 0.3%; MILD OSA -3.3 ± 0.4%; MS OSA -2.7 ± 0.3%). As there was no group difference in the % change in TOI during central events, the SDB groups were combined for further analyses. % change in TOI was significantly greater during NREM (-3.4 ± 0.2%) versus REM (-1.9 ± 0.2%; p<0.001).
Conclusion: We have demonstrated that during NREM sleep cerebral oxygenation falls in response to both obstructive and central events. During central events children with PS have a similar fall in TOI to children with OSA, which is of a similar magnitude to the decrease in TOI during obstructive events. This study highlights the impact of central events on cerebral oxygenation in children, particularly in those with PS.
Support (If Any): National Health and Medical Research Council of Australia Project APP1063500. Victorian Government's Research Infrastructure Support Program.

0883

RELATIONSHIP BETWEEN PAIN AND POLYSOMNOGRAPHIC MEASURES IN PEDIATRIC OBSTRUCTIVE SLEEP APNEA PATIENTS

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Introduction: In children with OSA, lower SpO2% nadir is predictive of less need for post-adenotonsillectomy morphine. However, in adults with severe OSA, CPAP increases pain tolerance. Opposing effects of OSA-related sleep fragmentation and hypoxemia on pain perception were hypothesized. We tested a relationship between pain and PSG variables in children evaluated for OSA.
Methods: On PSG evening, parents of 66 children (28 girls, 52 minorities, 2-17y.o., no neurological, endocrine, psychiatric conditions) and 50 children ≥5 y.o. used PedsQL to rate intensity (average of present and past 7 days) and frequency (average of past week and month) of the children's pain experience. On PSG evening and following morning, all children reported pain levels using FACES scale, and for 21 children forearm pressure pain threshold (PPTh) was measured. Each pain measure was regressed on sleep efficiency (SE), awakenings, arousal index (ArI), N1%, AHI, SpO2% nadir, time spent below SpO2 90% (TimeO2<90%) and desaturation index. Sex, age and BMI were used as covariates, wherever significant.
Results: Mean AHI=7.3 ± 10.5. Higher parent-rated pain intensity was associated with greater TimeO2<90% (p=0.02). Higher child-rated pain intensity was associated with greater N1% (p=0.03), while pain frequency, with greater TimeO2<90% (p=0.002) and N1% (p=0.003). Higher evening FACES were associated with higher ArI (p=0.05), while higher morning FACES, with higher AHI (p=0.001) and N1% (p=0.02), lower SE (p=0.005) and ArI (p<0.001). Morning PPTh showed greater pain tolerance with lower SpO2% nadir (p=0.04).
Conclusion: Time spent below SpO2 90% relates to greater pain ratings, while lower SpO2% nadir relates to greater pain tolerance on a psychophysical test, suggesting opposite effects of apnea-related hypoxemia on different pain measures. Sleep disturbance, as captured in sleep efficiency and stage N1% measures, and respiratory event frequency appear to increase pain ratings, although acute and chronic effects of arousals may differ.
Support (If Any): None.

0884

INFLAMMATORY FACTORS PRE AND POST ADENOTONSILLECTOMY IN PEDIATRIC OBSTRUCTIVE-SLEEP-APNEA

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Introduction: Systemic inflammation is commonly advanced as related to pediatric obstructive-sleep-apnea. Increase in high-sensitive CRP has been shown in association with the syndrome, with decrease following adenotonsillectomy. Many inflammatory factors have been identified with complex interaction between factors. We performed a study of interleukines 17 and 23 that control other interleukines on children before and after adenotonsillectomy.
Methods: Children between 6 to 16 years diagnosed with obstructive-sleep-apnea based on clinical evaluation, anatomic evaluation of upper-airway including classification of tonsils and nocturnal polysomnography that were submitted to adenotonsillectomy and prospectively followed with new evaluation 6 months post treatment. Blood samples were obtained at each evaluation and determination of plasma high-sensitivity-CRP, tumor necrosis factor alpha, interleukins 1,6,10,17,and 23.
Results: 31 children, mean age 7.5 ± 0.6 years,36% girls, had changed from pre to post surgery with a mean apnea-hypopnea-index of 15.95 versus 2.9 (p=0.006), a mean oxygen-desaturation-index of 13.7 versus 2.7 (p=0.005). Mean heart rate during sleep changed from 87 to 79 beats/minute (p=0.002).Inflammatory factors also decreased after surgery indicating improvement such as high-sensitivity-CRP (p=0.01),Tumor-necrotic-alpha(p=0.046), interleukines 1 (p=0.019), 17 (p=0.039).But interleukine 6 had no change (p=0.11), as did interleukin 10 (p=0.112) and interleukine 23 (p=0.224). Interleukin 6 was not significantly increased at entry compared to expected normal level and did not change.
Conclusion: Adenotonsillectomy did not bring the total group to complete normal AHI despite clear overall improvement. If the pro-inflammatory interleukine 17, secreted predominantly by the T helper 17 cells,is significantly improved,the abnormal up-regulation of 17 appears to have decreased with surgery. The interleukine 23 was not significantly change despite the clinical improvement. Interleukine 23 is a cytokine with immunomodulatory effect. One of its reported activity is to differentiate naïve T cells into IL-17-producing TH17 cells. Adenotonsillectomy may not eliminate mouth-breathing, and persistence of mild sleep-disordered-breathing may still have a negative effect on inflammatory factors.
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0885

OROFACIAL MORPHOLOGY AND DYSFUNCTIONS IN CHILDREN WITH PERSISTANT SLEEP DISORDERED BREATHING LONG-TERM AFTER ADENOID AND/OR TONSILS REMOVAL

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Introduction: The main etiology for pediatric sleep-disordered-breathing (SDB) is the hypertrophy of adenoids and tonsills, and their surgical removal (T&A) is the first line treatment. Nevertheless, incomplete resolution of SDB after T&A, or a relapse with time are a common finding. Our aim was to screen persistant SDB patients and evaluate the prevalence of craniofacial-orthodontic abnormalities, oral dysfunctions or obesity in this population.

Methods: A 6 questions validated pediatric questionnaire, the Hierarchic Severity Clinical Scale (HSCS) was sent to parents of 2068 children operated between 2002 and 2015 in a tertiary hospital. Patients reporting SDB, and without craniofacial syndrome were invited to complete a clinical examination and an ambulatory sleep study.

Results: 735 parents returned the questionnaire (56.2% males, time from surgery 4.1 ± 3.4 years). Resolution of SDB was found in 512 patients (69.7 %; 369 patients HSCS=0 and143 patients 0<HSCS<2.72 who only snored when sick), persistant mild SDB was found in 165 patients (22.4%) while 58 (7.9 %) had a HSCS>2.72 suggesting persistent obstructive sleep apnea. Mean HSCS were 0,83 ± 1.0 for non-syndromic versus 1,44 ± 1.1 for syndromic children (p<0,01). Among those 223 children with persistant SBD symptoms, 34 were syndromic; 54 non syndromic children were examined (mean HSCS 2.18 ± 1.0) showing convex profiles (38/54), malocclusions (posterior crossbite 11/54, class II malocclusions 18/54), oral dysfunctions (52/54 low tongue posture, 22/54 short lingual frenum, 23/54 oral hypotonia) and nasal cartilage hypotonia (n=8 only Caucasian). Moreover, only 7/54 children were overweight or obese, resulting in 2 phenotypes: a moderate severity group associated with obesity (mean AHI 2,59 ± 1,79), and a mild severity group that combined malocclusions/oral dysfunctions (mean AHI 1,48 ± 1,7).

Conclusion: Persistant SDB after T&A in non-syndromic children seems to be associated with multiple anatomical and functionnal factors.

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0886

LONG-TERM NON-INVASIVE VENTILATION THERAPIES IN CHILDREN: A SCOPING REVIEW

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Introduction: Long-term non-invasive ventilation (NIV) is a common modality of breathing support used for a range of sleep and respiratory disorders. The aim of this scoping review was to provide a summary of the literature relevant to long-term NIV use in children.

Methods: We used systematic methodology to identify 11581 studies with final inclusion of 289. The search was run in nine databases with additional grey literature sources. The search was limited to human studies published between 1990–2016. Inclusion criteria were: children 0–18 years; and NIV use greater than 3 months outside acute settings. Study design or outcomes assessed were not limited.

Results: We identified 76 terms referencing to NIV. Study design characteristics were most often single center (84%), observational (63%), and retrospective (54%). NIV use was reported for 73 medical conditions with obstructive sleep apnea (29%) and spinal muscular atrophy (8%) as the most common conditions. There were significant differences in medical conditions across ages (Pearson Chi-square 112.4, p<0.05). Continuous positive airway pressure (CPAP) was used in 25% of studies, versus 19% bilevel positive airway pressure, 2% auto-PAP, and 42% combination of CPAP and bilevel. Descriptive data, including NIV incidence (61%) and patient characteristics (51%), were most commonly reported. Outcomes from sleep studies were reported in 27% of studies followed by outcomes on respiratory morbidity such as improvement of respiratory symptoms, tracheostomy avoidance or decannulation, or reduction in post-operative complications in 15%. Reduction in other symptoms including sleep, neurocognition, mood, behavior and quality of life were reported in less than 5% of studies. Mortality was an outcome of interest in 6% of studies. Outcomes assessed differed by disease category (Pearson Chi-square 19.6, p<0.05). Adverse events and adherence were reported in 20% and 26% of articles respectively. Authors reported positive conclusions for 73% of studies.

Conclusion: Long-term use of NIV has been documented in a large variety of pediatric patient groups with studies of lower methodological quality. Data was unevenly available across medical conditions.

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0887

POSITIVE AIRWAY PRESSURE ADHERENCE IN CHILDREN: A RETROSPECTIVE REVIEW TO EXAMINE ADHERENCE RATES AT A MULTI-DISCIPLINARY PEDIATRIC SLEEP CENTER

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Introduction: Positive airway pressure (PAP) therapy remains the gold standard and least invasive treatment modality for obstructive sleep apnea in children. Adequate adherence is defined as 80% usage for greater than 4 hours per night in both adults and children. Adult literature reports a wide range of adherence in adults. Currently most studies report PAP adherence rates in adults to range from 40 to 80%. The data in the pediatric population is more limited. Multiple factors play a role in PAP adherence in children. These include parental and patient understanding of PAP therapy, a multi-disciplinary approach to management, and close follow up early in the treatment process.
Methods: We conducted a retrospective review of 256 patients, ages 1–18 years, followed at our center for PAP therapy between 2014–2016. All patients were using CPAP or BIPAP therapy, followed in the Sleep Clinic at Texas Children's Hospital, provided education to PAP therapy, and had been acclimated to PAP in a pediatric sleep laboratory. The data was downloaded to Encore Anywhere at three month intervals and analyzed over a 2 year period. Patients were further subdivided by the durable medical equipment company (DME) that provided routine care. Data was analyzed using standard deviation of the mean, 95% confidence interval, and standard weighted ANOVA.
Results: Overall adherence at any given 3 month interval amongst the selected patients was 46% (95% CI 42–50%). Average usage was 4 hours per night (SD +/- 2.7, 95% CI 3.66–4.34 hr). Adherence reported by the patient's assigned DME company was 52%, 52%, 35%, 35%, and 18% respectively across 5 DME companies (p=0.001).
Conclusion: PAP adherence at our center remains in the range of those reported in the adult literature. Many factors influenced non-adherence including, pressure prescribed, patient education provided by DME company, specific protocols followed by DME, and age of patient. Further analysis is needed to delineate specific factors related to adherence to therapy in children.
Support (If Any): N/A

0888

AUTO-ADJUSTING CPAP: AN OPTION FOR TREATMENT OF OBSTRUCTIVE SLEEP APNEA IN OBESE CHILDREN

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Introduction: Obstructive sleep apnea (OSA) is common in children with obesity. The first line treatment is adenotonsillectomy. Children with obesity are at higher risk of surgical complications and require longer hospital stay. Weight loss is challenging with low success rate. Continuous positive airway pressure (CPAP) is a treatment option for children with OSA. Challenges with CPAP include side effects, low adherence rates, and need for a repeat sleep study while on CPAP (titration). Auto-adjusting CPAP (APAP) devices are commonly used in adults but are not in children. We aim to show that APAP can be an option for treatment of OSA in children with obesity.
Methods: The study is a retrospective chart review of children with obesity who were prescribed APAP for management of OSA from 2/2016 until 5/2017. The patients were seen at the sleep center of the University of California San Francisco. APAP was prescribed and initiated by a durable medical equipment company without prior desensitization. Data collected included: age, body mass index (BMI), apnea hypopnea index (AHI), saturation nadir, subjective report of side effects, objective adherence, residual AHI, titration data, and history of adenotonsillectomy. Data are presented in mean +/- SD except AHI presented in median (range).
Results: Eleven children were included at the time of this abstract. Ages were 14.0+/-3.6. The AHI was 19 (9.8–85.0); the saturation nadir was 83.5 +/-6.2 and BMI 39.2+/-8.7. Six children had BMI in the morbid obesity range. The average hours of APAP use (nights used) was 5.5+/-1.8. Days used ranged from 53% to 100%. Residual AHI was 2.4 (0.6–4.7).
Conclusion: APAP is a treatment option for obese children with OSA and appears to be well tolerated with adequate adherence.
Support (If Any): NONE

0889

IDENTIFYING BARRIERS TO CPAP ADHERENCE IN THE PEDIATRIC POPULATION

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Introduction: Non-invasive ventilation with positive airway pressure (PAP) has been shown to be an effective treatment for obstructive sleep apnea in pediatric patients. However, poor adherence is common and contributes to the cardiovascular, neurocognitive and behavioral morbidities associated with untreated OSA. Identifying perceived barriers to the use of PAP, will allow the opportunity to create specific interventions to address such barriers and improve adherence.
Methods: As part of our CPAP Quality Improvement Program, the adherence barriers to CPAP questionnaire (ABCQ) (Simon 2011) has been administered to patients requiring PAP and their parents at Cincinnati Children's Hospital starting in March 2016. The ABCQ consists of 31 questions related to PAP use on a five-point, Likert-type scale consisting of never, rarely, sometimes, often and very often. The questionnaire can be classified into 5 domains based on the perceived barrier to PAP use: affective, behavioral, cognitive, environmental and physical. Responses considered as the most important barriers to address were answered with "often" or "very often".
Results: To date, 35 questionnaires have been completed by caregivers (c) and 29 by patients (p). Questions within the domains "affective" or "physical" were most frequently given for not using PAP. The most frequent response patients gave was they "can be healthy without it". 31%, versus 11% of caregivers. Thirty percent of caregivers and 25% of patients reported they "don't feel like using" PAP. Twenty-one percent of both patients and caregivers reported "embarrassment" as a barrier. The "hassle of using PAP" was reported in 24% of patients and 17% of caregivers. Other frequently reported barriers included not using it when they "don't feel well" (21% (p), 22% (c)), "makes them feel sick" (17% (p), 18% (c)), and causes a "stuffy nose" (10% (p), 17% (c).

Conclusion: Despite multiple interventions in our CPAP adherence program, the ABCQ has helped identify additional barriers, especially in the affective, behavioral and cognitive domains, to CPAP usage. These barriers may explain why we have had difficulty improving our CPAP adherence. We are currently designing interventions to address these barriers including targeted education and better integration of behavior sleep psychologist.
Support (If Any):

0890

INDIVIDUALIZED THERAPY FOR TREATING OBSTRUCTIVE SLEEP APNEA IN PEDIATRIC CROUZON SYNDROME PATIENTS

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Introduction: Pediatric patients with Crouzon syndrome have great possibilities in suffering from obstructive sleep apnea (OSA), which is mainly due to midfacial hypoplasia and facial deformities. For most patients, a multi-disciplinary and sequential treatment plan is necessary to make for Crouzon syndrome often has different phenotypes of different severity in OSA and facial deformities. Typical patients were selected in this study to illustrate the necessity of individualized therapy for treating OSA.
Methods: In the study, four Crouzon syndrome children of different severity in suffering from OSA and maxillofacial deformities were introduced. Detailed information in individualized treatment options was given including clinical manifestations, radiological findings, polysomnography detectings and treatment combinations. Based on the above findings, different but effective treatment options for these children's OSA problems were adopted, either by surgeries including distraction osteogenesis and craniomaxillofacial surgeries with or without tonsillectomy, or by noninvasive continuous positive airway pressure (CPAP) therapy. Patient 1 was performed with LeFort IIIosteotomy and external distraction osteogenesis. Patient 2 was given LeFort IIIosteotomy and external distractor fixation and concurrent bilateral mandibular body osteotomy and internal distractor fixation for bimaxillary distraction. Patient 3 received LeFort I osteotomy for maxillary advancement with concurrent bilateral tonsillectomy. Differently, patient 4 with mild OSA disturbance adopted initial continuous positive airway pressure (CPAP) with good adherence and body development. Six years later, he began orthodontic treatment for preparing for orthognathic surgery. Recently bimaxillary surgery was performed on him to enlarge upper airway anatomically as well as improve facial profile.
Results: Follow-up studies showed problems of OSA and nocturnal hypoxia of those four patients were all alleviated greatly, as well as maxillofacial deformities. Combined with preoperative and postoperative orthodontics, patient 1 and 4 also got optimal results in better facial profile and dental occlusion.
Conclusion: Thus, given Crouzon patients had great possibliities in suffering from OSA and hypoxia problems, individualized therapy should be made and performed carefully to obtain optimized treatment results based on adequate clinical evaluations and patients' conditions including age, disease severity and esthetic considerations.
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0891

PREDICTING PEDIATRIC OBSTRUCTIVE SLEEP APNEA WITH PARENT-REPORTED SLEEP QUESTIONNAIRES

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Introduction: Pediatric Sleep Questionnaire (PSQ) and Child Sleep Habits Questionnaire (CSHQ) have been PSG-validated. However, short and reliable instruments for pediatric OSA screening are still needed. We used PSQ and CSHQ subscales to predict pediatric OSA.
Methods: Parents of 66 children referred for PSG (28 girls, 52 minorities, 2-17y.o., no neurological, endocrine, psychiatric conditions) filled out PSQ and CSHQ on the PSG evening. Four PSQ scores were computed: 22-item Sleep-Related Breathing Disorder (PSQ-SRBD) and its 3 subparts, 8-item snoring/apnea (PSQ-SNAP), 4-item daytime sleepiness (PSQ-DS), and 6-item hyperactivity (PSQ-Hyp). Two CSHQ scores were computed: 3-item Sleep Disordered Breathing (CSHQ-SDB) and 8-item Daytime Sleepiness (CSHQ-DS). Hierarchical logistic regressions predicted AHI≥1, AHI≥5 and AHI≥10 from age, sex and BMI, followed by either PSQ- or CSHQ-derived scores.
Results: Mean AHI=7.3 ± 10.5; 46 children had AHI≥1, 20 had AHI≥5, and 18 had AHI≥10. AHI at all levels was predicted by age ($p<0.004$) and BMI ($p<0.04$), but not by sex. PSQ-SRBD did not predict AHI; however, PSQ-SNAP did at all levels ($p<0.003$, $p<0.056$, $p<0.015$, respectively), and PSQ-Hyp predicted AHI≥5 ($p<0.014$) and AHI≥10 ($p<0.011$). CSHQ-SDB predicted only AHI≥1 ($p<0.008$). PSQ-DS and CSHQ-DS did not predict AHI at any level. Predicting AHI≥1, PSQ-SNAP and CSHQ-SDB, each separately combined with age and BMI, show similar sensitivity/specificity (91%/38% vs. 87%/42%, respectively). Predicting AHI≥5, PSQ-Hyp addition to PSQ-SNAP results in higher sensitivity but lower specificity (45%/93% without PSQ-Hyp vs. 60%/84%).
Conclusion: These preliminary data suggest that for pediatric OSA screening (i) questions specifically targeting snoring and apnea symptoms are more useful than more general function queries, (ii) 8 is more optimal number of questions than 3, (iii) hyperactivity questions may help identify moderate to severe OSA, and (iv) daytime sleepiness questions do not appear useful.
Support (If Any): None.

0892

NECK CIRCUMFERENCE-HEIGHT RATIO AS A PREDICTOR OF OBSTRUCTIVE SLEEP APNEA IN THAI CHILDREN

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Introduction: Prevalence of obesity in Thai children has been progressively increased. Neck circumference-height ratio (NHR) is a measure to assess fat distribution and important predictor of metabolic syndrome in children. The goal of our study is to determine if NHR predicts OSA in Thai children.
Methods: For this retrospective study, Polysomnographic and anthropometric data from 98 children (69 Male and 29 Female) aged 5–15 years presenting between September 2013 to August 2016 was obtained. Children with genetic syndromes, severe neurological disorders, craniofacial abnormalities, tracheostomy, post adenotonsilectomy, in-hospital polysomnogram(PSG) or sleep efficiency < 80%

were excluded. Data was analyzed using Spearman 's rho correlation, Chi square and ANOVA test.
Results: BMI-Z score, arousal index and REM RDI were statistically correlated with NHR (*r=0.588, p*< 0.001). NHR, BMI-Z score and arousal index were correlated with OSA level statistically (*r=0.266, p*=0.008 and r=0.621, *p*<0.001 respectively). There is no-good cut-off point of NHR from ROC curve to predict OSA (OAHI ≥1.5/hr). The cutoff point 0.22 of NHR was selected from ROC curve with area under the curve at 0.637 to predict moderate to severe OSA (OAHI ≥ 5/hr) at sensitivity of 72.3% and specificity of 51%. NHR at 0.22 is more predictive in children > 8 years of age with sensitivity of 78.3% and specificity of 62%. For NHR≥ 0.22, the odd ratios of OAHI ≥ 5 in all children and children more than 8 years of age were 1.67 and 5.85 respectively.
Conclusion: NHR is a simple tool to predict moderate to severe OSA in Thai children especially in children more than 8 years of age. NHR ≥ 0.22 can be utilized to triage pediatric patients for PSG.
Support (If Any):

0893

INCREASED INFLAMMATION FROM CHILDHOOD TO ADOLESCENCE MEDIATES THE ASSOCIATION BETWEEN WAIST CIRCUMFERENCE AND OBSTRUCTIVE SLEEP APNEA IN BOYS

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Introduction: Cross-sectional studies in adults and children have reported that inflammation is independently associated with obstructive sleep apnea (OSA). Waist circumference, a surrogate marker of visceral adiposity, is associated with both inflammation and OSA severity. The aim of this study was to examine whether, longitudinally, inflammation mediates the association between increasing waist circumference and OSA severity in prepubertal children transitioning to adolescence.
Methods: A subsample of the PSCC (n=51; 9.1 ± 0.2y at baseline, 15.6 ± 0.2y at follow-up; 58.8% girls) with longitudinal sleep and inflammation data was included in this study. At both time points, participants underwent 9h polysomnography, physical exam, and fasting morning blood draw. Plasma C-reactive protein (CRP) was measured via ELISA. Associations between increasing waist circumference (Δwaist), increasing CRP (ΔCRP), and apnea/hypopnea index (AHI) at follow-up were examined via linear regression, adjusting for age, BMI percentile, and ethnic minority.
Results: While body composition was similar between prepubertal boys and girls (p=0.48), sex differences emerged at follow-up, with boys having a higher waist/hip ratio (1.01 ± 0.01 vs. 0.87 ± 0.04, p=0.06) and significantly more visceral fat (75.8 ± 2.6 cm^2 vs. 43.1 ± 2.2 cm^2; p<0.001), as measured by DXA scan. In boys, but not girls (p=0.81), Δwaist was associated with ΔCRP (β=0.52, p=0.03). Furthermore, ΔCRP predicted follow-up AHI in boys (β=0.95, p<0.001) but not girls (β=0.13, p=0.53). The association between Δwaist and follow-up AHI was significant in both boys (β=0.47, p=0.05) and girls (β=0.44, p=0.02); when ΔCRP was added to the models, Δwaist was no longer a significant predictor in boys (β=-0.01, p=0.91), suggesting mediation.
Conclusion: Increases in inflammation from childhood to adolescence explain, to a large degree, the association between increasing waist circumference and OSA severity, as well as sex differences in OSA prevalence in this age. These findings suggest that inflammation derived from visceral adipose tissue precedes development of the disorder, suggesting a potential causal mechanism.
Support (If Any): NIH R01 HL63772, R01 HL97165, UL1 TR000127, C06 RR16499

0894

COMPARISON OF OVERNIGHT OXIMETRY DOWNLOAD WITH POLYSOMNOGRAPHY IN CHILDREN

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Introduction: The diagnosis of obstructive sleep apnoea (OSA) in children is challenging given the high prevalence (2–3%), the significant associated morbidity and the resource intensity of the Polysomnography (PSG) which remains the gold standard. The limited availability of PSG often results in a delay in diagnosis and management of significant OSA. The aim of this study is to evaluate the reliability of the overnight oximetry download as a screening tool for the diagnosis of OSA in children.
Methods: A retrospective analysis of all children with clinical suspicion of OSA who underwent an overnight oximetry download and a subsequent PSG in a tertiary Paediatric Hospital from January 2014 to April 2016. The oximetry was reported based on McGill Scoring System and the diagnosis of OSA was based on mixed obstructive apnoea hypopnoea index (MOAHI).
Results: During the study period, 110 patients had overnight oximetry download as well as PSG. Sixty-one children (56%) had normal, 30 (27%) had mildly abnormal and 19 (17%) had moderately/severely abnormal oximetry. Sixty-four percent of children with normal oximetry did not have OSA on PSG. Of the children with severely abnormal oximetry, 100% had severe OSA on PSG. The overall sensitivity and specificity of oximetry for identification of OSA were 63% and 78% respectively. The overall positive and negative predictive values (PPV and NPV) were 78% and 64%, respectively. The sensitivity and specificity of moderate/severe abnormal oximetry for diagnosis of moderate/severe OSA were 59% and 100%, respectively. PPV and NPV of moderate/severe abnormal oximetry were 100% and 78%, respectively.
Conclusion: Children with moderate/severe abnormal oximetry do not need a PSG to diagnose OSA. They can be treated based on the oximetry result. However, a normal oximetry does not rule out OSA in children and they still require a PSG.
Support (If Any): Nil

0895

THE EFFECT OF LOOP GAIN ON EFFICACY OF SUPPLEMENTAL OXYGEN FOR TREATMENT OF INFANTS WITH OBSTRUCTIVE SLEEP APNEA (OSA)

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Introduction: Recent work from our group has demonstrated that the use of supplemental oxygen (suppO2) in infants with OSA results in fewer respiratory events and improved oxygenation without adversely affecting alveolar ventilation. However, a common observation in our study was that suppO2 was effective in some, but not all, infants. Based on data for adult patients with OSA, the administration of suppO2 seems most effective in those with a hypersensitive ventilatory control

system (i.e. high loop gain). Accordingly, we hypothesized that infants who respond well to suppO2 have a higher measured loop gain than those who respond poorly.
Methods: We conducted a retrospective analysis of 10 infants with OSA treated with suppO2 from 2007–2013. Subjects underwent a room air, diagnostic sleep study (RA-PSG) followed by a study for suppO2 titration (O2-PSG) on a separate night. The five subjects who best responded to suppO2, defined as those that showed the largest percent reduction in obstructive apnea hypopnea index (O-AHI) and those five with the worst response to suppO2 were identified. Loop gain was estimated from spontaneous breathing using 3 minute windows of sleep containing at least one respiratory event. Square root transformed nasal pressure airflow was used to provide a surrogate of ventilation. A standard model of ventilatory control (gain, time-constant, delay) that best matched ventilation data during periods of unobstructed breathing was used to estimate loop gain at the natural 'resonant' frequency (LGn) by a scorer blinded to responder condition.
Results: SuppO2 significantly reduced the O-AHI in responders (22.2 ± 10.0 events.hr^{-1} vs. 2.1 ± 1.0 events.hr^{-1}: $p<0.05$) whereas it remained unchanged in the non-responders (18.3 ± 14.1 events.hr^{-1} vs. 20.3 ± 18.1 events.hr^{-1}: p=NS). Compared to non-responders, responders displayed an elevated LGn (0.48 ± 0.07 vs. 0.36 ± 0.06: $p<0.05$).
Conclusion: Our preliminary evidence suggests that infants with OSA who respond to suppO2 therapy have a higher loop gain compared to non-responders. These data suggest that similar to adults with OSA, ventilatory instability is an important mechanism causing OSA in some infants.
Support (If Any):

0896

DO NOT WAIT FOR CHILD OBESITY: OVERWEIGHT LEADS TO SLEEP DISORDERED BREATHING AND WEIGHT LOSS TO ITS REMISSION IN PRE-PUBERTAL CHILDREN TRANSITIONING TO ADOLESCENCE

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Introduction: Identifying the factors that predict the incidence, persistence, and remission of sleep disordered breathing (SDB) in the transition from childhood to adolescence is essential for its prevention. We investigated the role of body weight on the natural history of SDB in pre-pubertal children transitioning to adolescence.
Methods: Data from the Penn State Child Cohort, a randomly-selected sample of 421 children (5-12y) followed-up as adolescents (12-23y) was used. Incidence, persistence and remission of SDB, including primary snoring and obstructive sleep apnea (OSA), was ascertained by in-lab, 9-hour polysomnography (PSG). Body mass index (BMI) percentile and its change from baseline to follow-up (ΔBMI) was ascertained during the physical examination.
Results: Overweight children had 2.6-fold odds (95%CI 1.02–6.52) of developing OSA in adolescence and obese children had 3.4-fold odds (95%CI 1.55–7.23) of persisting with SDB in adolescence. In contrast, weight loss was significantly associated with remitting from SDB, particularly among children with normal tonsil or adenoid size (-12.0 ± 5.2 ΔBMI percentiles) but not among those with enlarged tonsils and/or adenopathy in childhood (-1.0 ± 4.3 ΔBMI percentiles). Only 4.4% of the remitted SDB cases had a history of adeno/tonsillectomy.
Conclusion: These data support a causal role for overweight, obesity and weight loss in the development, chronicity and remission, respectively, of SDB in the transition from childhood to adolescence. Thus, weight loss should be pursued already in overweight children in order to prevent SDB. Importantly, neither weight loss nor adeno/tonsillectomy were predictive of the remission of SDB in a large proportion of children with a history of enlarged tonsils and/or adenopathy. These data support that the remission of SDB in these children is related to normal developmental trajectories of the upper airway and, thus, frequent watchful waiting may be indicated.
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0897

SLEEP-DISORDERED BREATHING, SLEEP ARCHITECTURE AND CARDIOMETABOLIC RISKS: EFFECTS OF WEIGHT LOSS INDUCED BY LONG-TERM EXERCISE TRAINING AND MODIFIED FOOD HABITS IN OBESE YOUTH

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Introduction: The relationships between sleep-disordered breathing (SDB) and cardiometabolic comorbidities in pediatric population are currently of major interest. It is well accepted that lifestyle modification based on an increased physical activity and healthy diet is useful as therapeutic treatment to manage obesity and its cardiometabolic risks (CMR). However, it remains unknown whether a weight reduction, achieved by both long-term exercise training and modified dietary habits improves sleep architecture, decreases SDB and CMR. The aim of this study was therefore to assess in obese adolescents; i/ the association between SDB and CMR, ii/ the effects of a 9-month lifestyle intervention (physical activity and balanced diet) on these parameters and sleep architecture.
Methods: Twenty-nine subjects (14.6 ± 1.3 yrs., BMI z-score= 4.7 ± 0.9) were studied. Before and after the lifestyle intervention, several assessments were performed: i/ standard overnight ambulatory polysomnography during which total sleep time (TST), %REM, %NREM stages, apnea-hypopnea index (AHI) and respiratory-disturbance index (RDI) have been recorded, ii/ MetScore, a CMR predictor, calculated from the average of the z-score of fasting insulin, glucose, triglycerides, HDL-Cholesterol, waist-circumference and blood pressures, 3/ CRP concentration, 4/ fat mass.
Results: The subjects were divided in 2 groups: G1:AHI<2 (33.3%) and G2:AHI≥2 (66.7%). At baseline, MetScore was higher in G2 (0.25) than G1 (-0.26). AHI and RDI were correlated with MetScore ($r=0.46$ and $r=0.50$, $p<0.05$ respectively). Furthermore, CRP was associated with MetScore ($r=0.44$, $p<0.05$). At the end of the intervention, AHI and RDI were not decreased in G2 despite a decline of BMI z-score and fat mass. Conversely, MetScore and CRP were lower (-0.65, $p<0.001$ and -4mg/l, $p<0.05$). In both group, TST was longer (G1:479min, G2:489min) than recorded during baseline night (G1:455min, G2:450min) with an increase of %REM and a decrease of %N3.
Conclusion: This study showed a strong relation between SDB and CMR in adolescents with severe obesity. A combination of supervised aerobic exercises and a balanced diet lead to weight, CMR and systemic inflammation reduction without changes in SDB. Further investigations will be necessary to understand the association between changes in sleep architecture and weight loss.
Support (If Any): "Le Don Du Souffle" (Besançon, France)

0898

INFANT SLEEP STUDIES: FACTORS AFFECTING ADEQUATE TOTAL SLEEP TIME FOR OPTIMAL INTERPRETATION

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Introduction: In infants undergoing evaluation for apnea with polysomnograms (PSG), a total sleep time (TST) of at least 240 minutes has been reported as necessary for optimal interpretation and for reliability of apnea rate estimation. We reviewed infant PSGs done in our pediatric center to determine the factors affecting TST.
Methods: 242 PSGs were performed in infants less than 6 months chronological age from March 2013 to December 2015. Potential variables affecting optimal TST including location and time of study, chronological age of infant, underlying medical or craniofacial conditions, and the presence or absence of oronasal tubes, including nasogastric, orogastric and impedance catheters were reviewed.
Results: Of the 242 studies, 150 studies (62%) had TST ≥240 minutes. PSGs done in the sleep laboratory (N=107) compared to other locations (NICU, PICU and inpatient floor, N=135); those done in older infants (3–6 months (N=96) versus 0–3 months (N=146)); those done at night (N=108) compared to daytime (N=134) were more likely to have adequate TST (all p<0.001). Inadequate TST of <240 minutes (N=92) was associated with sleep disordered breathing (SDB) (p=0.004), underlying medical or surgical anomalies (p=0.005), presence of oronasal tubes (P=0.002), concomitant impedance catheters (p=0.005) and the diagnosis of gastro-esophageal reflux disease (59% of infants with abnormal Impedance test had TST <240 minutes). Short term and one year follow up of infants with TST <240 minutes, showed rare unexpected clinical issues (N=2).
Conclusion: Infant PSGs done in 3–6 month old infants, in the sleep lab, at night, with no oronasal tubes had higher TST, compared to those with SDB or underlying pathologies. Identification and correction of modifiable factors may improve TST in the NICU and institutional protocols to optimize study quality could be implemented. In our sample, an absolute TST <240 minutes did not affect ability to diagnose SDB in these infants.
Support (If Any):

0899

INVOLVING COMMUNITY PARTNERS IN PARENT-BASED SLEEP EDUCATION

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Introduction: Behavioral sleep education for children with sleep disturbance is currently provided largely within academic medical centers, which often include long waiting lists for this service. Our study aims to determine the feasibility of providing sleep education training to parents of children with autism spectrum disorders in diverse community practices in relation to more traditional university-based settings.
Methods: We included three Tennessee pediatric practices in this study, along with community therapists. The following elements comprised our study: (1) Recruitment and consent of participating families, and instruction in study procedures; (2) Collection of baseline data; (3) Therapist training and fidelity; (4) Delivery of sleep education to families; and (5) Collection of intervention data. Our sleep education curriculum was delivered in one 60–90 minute session with 2 follow-up sessions and covered appropriate sleep habits, including construction of an individualized bedtime routine and optimization of parent-child interactions. Paired t-tests were used to compare data pre- and post- intervention. We used on-line surveys through Research Electronic Data Capture (REDCap) to reduce family burden.
Results: All of our therapists reached fidelity on mock sessions and actual parent education sessions. To date, 21 families have participated with 16 completing baseline and intervention data. Children had a mean (standard deviation) age of 7.0 (2.9) years. Improvements were noted in the following Children's Sleep Habits Questionnaire (CSHQ) total and subscales: total (p = 0.003), sleep onset delay (p=0.000), bedtime resistance (p=0.001), sleep duration (p=0.000), night wakings (p=0.048), and parasomnias (p=0.030). The Family Inventory of Sleep Habits (FISH) also improved (p=0.002).
Conclusion: This study shows that sleep education typically housed within specialized medical settings can be extended to community practitioners with minimal background in sleep, allowing families to receive behavioral sleep education in familiar locations as part of their ongoing care and with potentially shorter wait times. Partnering with community practitioners to deliver such education to families provides an opportunity to broaden access to sleep therapeutics in the community, while forging collaborations between sleep medicine physicians, primary care providers, and community therapists.
Support (If Any): American Sleep Medicine Foundation 2016 Strategic Research Award and Meharry-Vanderbilt Community Engagement Research Core

0900

NATURAL HISTORY OF INSOMNIA SYMPTOMS AND INCIDENCE OF PSYCHIATRIC DISORDERS: ROLE OF CHILDHOOD-ONSET, ADOLESCENCE-ONSET AND FULL REMISSION

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Introduction: Adolescence is a critical developmental period during which many psychiatric disorders have their first onset. We examined the potential relationship between the natural history of insomnia symptoms and the incidence of psychiatric disorders using a longitudinal design during the transition from childhood to adolescence.
Methods: Data from the Penn State Child Cohort, a longitudinal study of 421 children (5-12y) followed-up as adolescents (12-23y) was used. Insomnia symptoms were defined by the presence of difficulties falling and/or staying asleep using parent/self-reports on the Pediatric Behavior Scale and Pediatric Sleep Questionnaire. Psychiatric disorders were ascertained by parent/self-report during clinical history and physical examination. Logistic regression analysis predicting incident psychiatric disorders adjusted for sex, race, age, eveningness, body mass, apnea/hypopnea, and periodic limb movement indices.
Results: Compared to controls (11.9%), adolescents with incident insomnia symptoms at follow-up had a significantly higher (25%) incidence of psychiatric disorders (OR=2.4, 95%CI=1.17–5.05) and this incidence was even higher (38.6%) in adolescents with persistent insomnia symptoms since childhood (OR=4.5, 95%CI=2.05–9.72). In contrast, adolescents who fully remitted from their childhood insomnia symptoms had an incidence of psychiatric disorders (11.5%) similar to that of controls (OR=0.90, 95%CI=0.24–3.43) and significantly lower than childhood-onset insomnia (OR=0.11,

95%CI=0.02–0.61). Child/Adult Behavior Checklist analyses confirmed that internalizing and externalizing behaviors were increased in those with childhood-onset and adolescent-onset insomnia symptoms, while internalizing behaviors improved with full remission of insomnia symptoms.
Conclusion: Insomnia symptoms in the transition from childhood to adolescence are associated with increased incidence of psychiatric disorders, with the greatest incidence found in childhood-onset insomnia. Importantly, full remission of childhood insomnia symptoms confers a reduced incidence of psychiatric disorders comparable to never experiencing insomnia symptoms. This transitional period may be critical for the treatment of insomnia symptoms and associated internalizing behaviors to prevent developing psychiatric disorders, particularly mood and anxiety disorders.
Support (If Any): National Institutes of Health R01 HL63772, R01 HL97165, UL1 TR000127, C06 RR16499

0901

A SYSTEMATIC REVIEW TO EXPLORE THE FEASIBILITY OF A SLEEP INTERVENTION FOR INSOMNIA IN CHILDREN WITH NEURODEVELOPMENTAL DISORDERS: A TRANSDIAGNOSTIC APPROACH

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Introduction: Children with neurodevelopmental disorders (NDD) are at high risk for sleep problems, especially insomnia. Insomnia can result in excessive daytime sleepiness, impairments in daytime functioning, and contribute to increased NDD symptoms. Many children do not receive what is believed to be the first line treatment - behavioural intervention. One important barrier is that it is currently not known whether behavioural interventions developed for typically developing children work for children with NDD, and if interventions need to be modified for each diagnostic group. This systematic review aimed to establish commonalities in sleep problems experienced across NDD populations, and evaluate the effectiveness of behavioural sleep treatments for children with NDD.
Methods: Nine databases were searched. The search strategy focused on four semantic groups: children; sleep; intervention terminologies; and NDD, specifically Attention-Deficit/Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), Cerebral Palsy (CP), and Fetal Alcohol Spectrum Disorder (FASD). Eligible studies needed to include both children with a NDD and a pre-post measure of a sleep variable, employed a behavioural intervention, and be written in English or French.
Results: A total of 8763 citations were identified, which was reduced to 4602 following the removal of duplicates. A further 4414 citations were removed following title and abstract screening. Full-text articles were retrieved for 188 studies, 146 were excluded, leaving 42 studies. The majority of studies were conducted with ASD and ADHD populations. Common sleep problems were evident across the NDD populations; those most frequently reported included bedtime resistance, night-waking, early morning awakening, and co-sleeping. The most common interventions used were implementation of healthy sleep practices, reinforcement, graduated extinction, and faded bedtime, all of which are standard treatments in typically developing children with insomnia. All studies reported at least one behavioural treatment component as effective.
Conclusion: Behavioural sleep interventions can be effective in NDD populations. Commonalities across NDD populations for both sleep problems reported and behavioural interventions implemented suggest the feasibility of developing a transdiagnostic behavioural sleep intervention suitable for children with a range of NDD.
Support (If Any): This research is funded by NeuroDevNet, a Centre of Excellence of Canada.

0902

THE INTERPLAY BETWEEN MOOD AND COGNITION IN ADOLESCENTS' INSOMNIA

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Introduction: Numerous studies have indicated that insomnia is a risk factor for internalizing problems. However, there is little understanding of the mechanisms underlying this association in adolescents. Cognitive models view internalizing problems as resulting from an interaction between cognitive distortions that predispose individuals to a higher likelihood of psychopathology, and negative mood. Experimental laboratory-based studies and clinical observations have found that sleep deprivation results in cognitive distortions and in increased negative mood. In adolescents, lower subjective sleep quality and quantity are cross-sectionally associated with negative mood, and longitudinally with increased risk of mood problems. In addition, experimentally restricting sleep in adolescents worsened mood. However, few studies have explored the interplay between negative mood, cognitive bias, and insomnia as they relate to internalizing symptoms in adolescents. *The objective of this study* was to examine the hypothesis that insomnia moderates the associations between affective and cognitive mechanisms that underlie internalizing problems.
Methods: Thirty five adolescents (mean age 14.9 + 1.5 years) participated in the study. Negative mood and cognitive errors were assessed using self-report measures validated for youth. Insomnia was assessed using the Pittsburgh Sleep Quality Index Scale. Internalizing problems were assessed using the Child Behavior Checklist (CBCL).
Results: Regression analysis was used to examine the moderating role of insomnia status on the associations between negative mood and cognitive errors. CBCL internalizing score served as the independent variable; effects of gender and chronotype were controlled for, as these variables are known to impact internalizing problems. Analyses revealed an interaction effect of insomnia status by negative mood such that, for youth with insomnia but not for youth without insomnia, negative mood was associated with higher internalizing scores. No interaction effect was found for cognitive errors.
Conclusion: Negative affect was associated with high levels of internalizing symptoms in adolescents with insomnia but not in adolescents without insomnia. This supports the hypothesis that disrupted sleep moderates the association between mood and internalizing problems in adolescents. Understanding how sleep, cognition and mood interact in adolescents with internalizing problems is important as it may contribute to the development therapeutic strategies that target this interaction.
Support (If Any):

0903

A RANDOMIZED TRIAL OF A SELF ADMINISTERED PARENTING INTERVENTION FOR INFANT AND TODDLER INSOMNIA

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Introduction: There are an insufficient number of sleep clinicians to provide face-to-face services to the millions of American families struggling with pediatric insomnia. We evaluated a commercially available DVD that had not yet been tested through a randomized controlled study.
Methods: From November 2012 to September 2015, 239 families were enrolled and randomly assigned to one of three study arms: a DVD intervention condition (the Sleep Easy Solution), a Website comparison condition (http://www.johnsonsbaby.com/sleep), and a Wait List comparison condition. Neither the DVD nor the website was developed by the investigative team. Furthermore, the creators of the DVD and the website played no role in study design, implementation, interpretation, or funding. One parent from each family was asked to complete the Extended Brief Infant Questionnaire at baseline (prior to randomization) and one-month follow-up.
Results: The overall 1-month follow-up survey completion rate was 76.6%, with no significant differences across the three study conditions (81.3%, 68.3%, and 80.5% for DVD, Website, and Wait List respectively, p = .09). A trichotomous variable - Do you consider your child's sleep a problem? (not a problem at all, a small problem, a very serious problem) - was the primary outcome measure. DVD was superior to Wait List in terms of the primary outcome (p = .03). Similarly, regarding secondary outcomes, DVD was superior to Wait List in terms of longer continuous sleep periods (p = .003), more favorable perceptions of the child's overall sleep (p = .001), and higher parental confidence in managing the child's sleep (p = .001). DVD was not superior to Website on the primary outcome (p = .37). In addition, Website was not superior to Wait List on the primary outcome (p = .21).
Conclusion: The favorable results of the DVD intervention suggest that this is a promising self-administered treatment for pediatric insomnia.
Support (If Any): This study was funded through an intramural grant from the Research Institute at Nationwide Children's Hospital.

0904

ACTIGRAPHIC VALUES IN CHILDREN AND ADOLESCENTS: WHAT IS NORMAL?

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Introduction: Actigraphy is widely used in pediatric sleep research and clinics. Yet no normative values have been established to help researchers and clinicians identify normal vs. poor quality sleep. The purpose of this study is to provide normative values for activity during sleep and percent scored sleep for children and adolescents ages 8–18 years.
Methods: Participants were healthy community-dwelling children and adolescents (n=618) drawn from studies in the United States and Australia (52% female, mean age 13.5±2.5 years). All participants wore an Ambulatory-Monitoring Inc. (AMI, Ardsley, NY) actigraph on their non-dominant wrist for at least 5 nights and completed sleep diaries. Data were recorded in 1-minute epochs and zero-crossing mode, and were scored using the Sadeh algorithm. Sleep onset was identified as the first of 3 consecutive minutes scored as sleep after diary reported bedtime; sleep offset was the last of 5 consecutive minutes of sleep before diary reported wake time. Percent sleep was scored as the percent of sleep minutes in the sleep period (sleep onset to sleep offset).
Results: All participants had a minimum of 3 scorable nights of data, with 94% having at least 5 scorable nights. Mean activity count during non-sleep period hours was 215.4 (SD=23.4, range 129.7 to 268.0), and mean activity count during the sleep period ranged from 0 to 46, with activity counts increasing over the night (mean hour 1=8.5 [SD=5.1] to mean hour 9=14.5 [6.8]). Average percent sleep was 92% (SD=4.4). For both activity during sleep and percent sleep, statistically significant differences were found with boys more active than girls, and older youth (14–18 years) more active than younger youth (8–13 years) ($p<.001$); however, the meaningfulness of these activity count differences (all <3) is questionable.
Conclusion: This study is the first to examine actigraphic values in a large sample of healthy community dwelling children and adolescents. These normative data can be referenced for researchers and clinicians using actigraphy.
Support (If Any): NIH grants MH045945, MH076969, MH077662, HD047928, HL119441 and Australian Research Council grant DP0881261

0905

DEVELOPMENT OF THE PROMIS® SLEEP HEALTH MEASURES FOR CHILDREN AND ADOLESCENTS

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Introduction: There is no standard pediatric self-report measure of sleep health. Furthermore, existing measures have not been informed by stakeholders or developed using rigorous measurement science. The Patient Reported Outcomes Measurement Information System (PROMIS®) has produced over 100 person-centered measures that evaluate physical, mental, and social health in adults and children. Two PROMIS sleep-related measures (Sleep Disturbance and Sleep-Related Impairment) have been developed and psychometrically evaluated for adults. The purpose of this study was to develop and evaluate pediatric sleep health measures using PROMIS methodology.
Methods: Concepts for self-report questions (items) were identified with input from sleep experts, clinicians, parents, youth, and systematic literature review. Items were iteratively revised based on cognitive interviews with 35 children and 21 parents, and then administered to 1104 children aged 8–17 and 1477 parents of children aged 5–17. Items were subjected to classic psychometric analysis and item response theory-based calibration.
Results: The initial item pool contained 112 items. Items were removed (52), revised (19), or added (1) based on cognitive interviews. Sixty-one items were field tested, with an additional 25 items removed based on psychometric properties. Two item banks measuring distinct sleep health dimensions were identified. Sleep Disturbance (SD, 12 items) captures difficulties with sleep initiation, sleep maintenance,

and sleep quality. Sleep-Related Impairment (SRI, 13 items) assesses the impact of poor sleep on daytime functioning. SD and SRI item banks discriminate among children with a wide range of sleep health experiences. Items were selected for 8- and 4-item short forms to ensure adequate measurement precision across the full range of severity. An index of Sleep Practices (11 items) was also developed, with items focusing on sleep routines, technology use around sleep, and sleep timing.

Conclusion: The PROMIS pediatric SD and SRI item banks are brief and psychometrically robust measures of patient-reported sleep experiences. These measures are meaningful and well-understood by children and parents, and provide efficient and precise measures of sleep in children across development, and in both general and clinical populations. The final measures are undergoing clinical validation in youth with sleep disorders, autism, asthma, and atopic dermatitis.

Support (If Any): PCORI SC-14-1403-12211.

0906

LIGHT FLASHES DURING SLEEP WITH ADJUNCT COGNITIVE BEHAVIORAL THERAPY INCREASES SLEEP IN TEENS

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Introduction: Biological and psychosocial pressures across the teenage years contribute to delayed bedtimes and insufficient sleep. In two separate randomized controlled trials, we determined whether a novel set of interventions using both light exposure during sleep and cognitive behavioral therapy (CBT) would increase total sleep time in teens by allowing them to go to sleep earlier than usual.

Methods: *Study 1:* Teens were assigned to receive either three weeks of Light (3 millisecond light flashes every 20 second during the final three hours of sleep) or Sham therapy and asked to try to go to sleep earlier. *Study 2:* Teens received four brief motivation-focused CBT sessions in addition to a modified Light (3 millisecond light flashes every 20 seconds during the final two hours of sleep) or Sham therapy. Outcome measures included diary-based sleep times, momentary ratings of evening sleepiness, and subjective measures of sleepiness and sleep quality.

Results: *Study 1:* Mixed effects models revealed that light therapy alone was inadequate in changing the timing of sleep. *Study 2:* Mixed effects models showed that Light+CBT successfully moved sleep onset 50.1±27.5 minutes earlier, increased nightly total sleep time by 43.3±35.0 minutes, and improved sleep quality 0.50±0.61 points. While Sham+CBT had similar effects, compliance with bed timing was three-fold greater in the Light+CBT. At the end of the intervention, teens in the Light+CBT group reported increased evening sleepiness relative to teens in the Sham+CBT group.

Conclusion: Light exposure during sleep, in combination with a brief, motivation-focused CBT intervention consistently moved bed times earlier and increased total sleep in teens. This type of passive light intervention in teens may lead to novel therapeutic applications.

Support (If Any): This study was supported by the National Institute of Child Health and Human Development R21 HD073095-01 (JMZ); Lucille Packard Foundation for Children's Health, UL1TR001085, Stanford Child Health Research Institute fellowship (KAK).

0907

INCREASED CASES OF CHILDHOOD NARCOLEPSY AFTER THE 2009 H1N1 PANDEMICS: PRELIMINARY DATA FROM THE PEDIATRIC WORKING GROUP OF THE SLEEP RESEARCH NETWORK

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Introduction: Several studies have shown increased cases of narcolepsy in children and adolescents after the 2009 H1N1 pandemic in Europe and China. There are no reported data in the United States.

Methods: The Pediatric Working Group of the Sleep Research Network (PED-SRN) has conducted a retrospective review with prospective follow-up on Pediatric Narcolepsy since 2010. This multi-center collaborative project consists of 20 pediatric sleep centers across the United States. One of our main objectives is to evaluate the monthly and yearly incidence of childhood narcolepsy in the United States, and correlate the incidence with historical influenza data. Subjects aged 0–18 years at the time of diagnosis of narcolepsy from 2000–2015 were included. Secondary narcolepsy cases were excluded. Data were obtained from medical records with an additional interview. The study was approved by the IRB from each site. Informed consent was obtained for the prospective arm.

Results: 652 subjects were enrolled, and 648 completed records were included in the analysis. The mean age at the onset of excessive daytime sleepiness (EDS) was 9.7±3.7 years. 331 subjects were males (50.8%). 305 subjects were Caucasian (47.1%) and 265 subjects were African American (40.9%). Cataplexy was noted in 444 subjects (68.5%). The duration of EDS before a narcolepsy diagnosis was 20.2±25.2 months. HLA-DQB1*0602 was found in 91.6% of all subjects, and in 96.5% of narcolepsy with cataplexy. Evidence of streptococcal infection within one year prior to narcolepsy diagnosis was found in 73 subjects (11.7%). Increased yearly cases of childhood narcolepsy was noted following the 2009 H1N1 pandemics. The increased cases were 2 folds in 2010, 2011, 2012 and 2013 compared to the baseline (2009 or prior years). A seasonal pattern of narcolepsy onset was noted in cases after 2009 with the peak incidence in May and June.

Conclusion: There is a significant increase in the number of childhood narcolepsy cases with seasonal pattern after the 2009 H1N1 pandemics in the United States. The magnitude of increase is not as high as in many European countries, but is comparable to a report in China.

Support (If Any): IIR JazzPharmaceuticals and SRN

0908

SCHOOL START TIMES AFTER 8:30 AM PREDICT THIRTY MINUTES LONGER SLEEP DURATION IN TEENS FROM A NATIONAL URBAN COHORT

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Introduction: Adolescents have a physiological circadian drive and social pressures to stay up later. Thus, when school schedules require early wake time, morning REM-rich sleep is often truncated. Given the importance of sleep for teen health, mood, and school performance, the American Academy of Pediatrics recommends middle and high schools begin after 8:30 AM. Many studies investigating the association between school start time and sleep duration rely on global survey questions about sleep habits prone to measurement error. This study investigated the extent to which school start times were associated with shorter sleep duration using 1-week sleep diaries.

Methods: Data came from 534 adolescents (M_{age}=15.4, SE_{age}=0.5, *Range*=14.6–17.6) who participated during a school week in a substudy of Fragile Families & Child Wellbeing Study, conducted across 20 cities in a diverse sample of predominantly low-income families. Sleep duration was calculated from daily diary reports of bedtime and wake time and school start time on days when the teen attended school (n=1915 school-days). Covariate data (sex, age, race, and household income) were obtained by field interviewers from teens and primary caregivers. Multi-level analyses of sleep on nights before attending school examined the association of school start times with sleep duration. Ongoing analyses will test the association of school start times with actigraphically-assessed sleep measures.

Results: Compared to adolescents with earlier (before 8:30 AM) school start times, those with later (after 8:30 AM) school start times had longer sleep duration (mean 8.1 hours ± 11.4 minutes compared to 7.5 hours ± 8 minutes), on average, 32.7 minutes more per day (p<0.0001), after adjusting for sex, age, race, and household income.

Conclusion: These national data confirm that later school start times are associated with longer adolescent sleep duration using repeated measures of sleep that have higher validity than one-time global measurement.

Support (If Any): R01HD073352 (L. Hale, PI)

0909

NEONATAL SLEEP-WAKE ANALYSES PREDICT 18-MONTH NEURODEVELOPMENTAL OUTCOMES

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Introduction: Objective measures of neonatal brain functional integrity are lacking. Sleep patterns reflect concurrent neurological function and can be measured objectively with polysomnography, while patterns of brain oxygen metabolism during sleep-wake stages may be detected by cerebral near-infrared spectroscopy (NIRS). We evaluated the predictive value of quantitative neonatal sleep parameters for 18-month neurodevelopmental outcomes.

Methods: Newborns with suspected seizures underwent a 12-hour bedside polysomnogram with concurrent cerebral NIRS. For each infant, the distribution of sleep-wake stages and electroencephalogram delta power were calculated. Fractional tissue oxygen extraction (FTOE), derived from NIRS, was calculated across sleep-wake stages. Neurological examination (Thompson) scores were assigned on the day of the polysomnogram. Surviving infants completed Bayley Scales of Infant Development (BSID), 3rd edition, at age 18–22 months. Robust regression techniques were used to evaluate associations between sleep measures, FTOE, and BSID scores.

Results: Twenty-nine infants completed the BSID (gestational age 39.6 ± 1.4 weeks). Increased time in quiet sleep predicted lower 18-month cognitive (adjusted r^2=0.22, p=0.006) and motor (adjusted r^2=0.27, p=0.004) scores. Higher 0.5-2Hz EEG power predicted better language (adjusted r^2=0.25, p=0.005) and motor (adjusted r^2=0.53, p<0.0001) scores. Associations remained significant after adjusting for Thompson score and for exposure to phenobarbital (which may affect sleep and is a proxy for seizure diagnosis). There was no association between the absolute FTOE value during specific sleep-wake stages and BSID scores. However, attenuated difference in FTOE between wakefulness and quiet sleep was associated with lower cognitive (adjusted r^2=0.14, p=0.05), language (adjusted r^2=0.21, p=0.025), and motor (adjusted r^2=0.32, p=0.005) scores in univariate and adjusted analyses.

Conclusion: These novel, longitudinal data suggest that inefficient neonatal sleep - increased time in quiet sleep, lower electroencephalogram delta power during that stage, and muted changes in FTOE across sleep-wake stages - is an informative and independent predictor of adverse long-term outcome for newborns with neurological dysfunction.

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0910

TO BED OR NOT TO BED? CRIB IS THE ANSWER!

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Introduction: Where a young child sleeps can significantly impact the quality and quantity of sleep. Although most children transition to a bed from a crib sometime between the ages of 2 and 3 years, most practitioners often recommend waiting until closer to 3 years. However, little is known about how this change impacts toddler sleep. Thus, this study examined whether sleeping independently in a crib or a bed at different ages was associated with sleep outcomes in a large sample of North American toddlers.

Methods: Caregivers (81.3% mothers) of 1,245 toddlers ages 18–35 months (*M* age 25.65 months; 51.4% male) reported on child sleep patterns and problems using Johnson's® Bedtime® Baby Sleep App, which is a free, publicly-available smartphone application. Three age groups were considered: 18–23.9 months, 24–29.9 months, and 30–35.9 months.

Results: Rates of crib-versus bed-sleeping differed significantly by age (x^2 = 167.54, p<.001), with 64.2% of those 18–23 months, 37.4% of 24–30 months, and 18.5% of 30–35 months sleeping in a crib. ANCOVA (covarying for gender) was used to examine the effects of sleep space (crib versus bed) by child age group on sleep patterns and problems. Across all ages, toddlers who slept in a crib had earlier bedtimes, shorter sleep onset latencies, better sleep consolidation and caregiver-perceived sleep quality, and fewer caregiver-perceived sleep problems (all p values <.05) than toddlers who slept in a bed. Older toddlers had fewer night awakenings (p<.05); no other main effects for

age emerged, and the sleep space by age interaction was non-significant across models.
Conclusion: Sleeping in a crib instead of a bed is associated with enhanced toddler sleep quantity and quality. Consistent with practice recommendations, results suggest that deferring the crib-to-bed transition until age 3 can benefit child sleep
Support (If Any): Johnson & Johnson Consumer Inc., Skillman, NJ, USA.

0911
CHRONOTYPE AND TYPE 2 DIABETES RISK IN PREADOLESCENTS
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Introduction: An individual's chronotype, or preference in the timing of sleep or food intake, may have metabolic implications. Late chronotype has been associated with higher body mass index (BMI) and hemoglobin A1c (HbA1c) in adults and greater BMI, portion sizes, and lower HDL cholesterol levels in adolescents. Our objective is to examine the associations between chronotype and risk factors for insulin resistance and type 2 diabetes in preadolescents ages 10–13 years. We hypothesize that late chronotype associates with greater insulin resistance and higher glucose levels.
Methods: Twenty-four (13 normal-weight [NW, BMI 5-85th percentile], 11 obese [OB, BMI greater than 95th percentile]) preadolescents (age 11.7 +/-0.8 yrs, Tanner stages 1–5) underwent anthropometric measurements and fasting blood draw; glucose, insulin, C-peptide, HbA1c, and lipid levels were measured. Obese participants underwent a 3-hour oral glucose tolerance test (OGTT). Mid-sleep time on free days (MSF), a measure of chronotype, was assessed via actigraphy over 1 week and secondarily through administration of the Children's ChronoType Questionnaire (CCTQ) and Morningness-Eveningness Scale for Children (MESC).
Results: Sleep parameters did not differ significantly between NW and OB children. As expected, OB versus NW participants had significantly higher fasting plasma insulin levels (23.6 +/-14.8 vs. 5.6 +/-2.6 uI/mL, p=0.002) and HOMA-IR levels (5.3 +/-3.5 vs. 1.2 +/-0.6, p=0.003). MSF by actigraphy was positively associated with fasting plasma glucose (r=0.67, p=0.048) in summer or "free day" subjects only. HbA1c was positively associated with CCTQ score (r=0.25, p=0.012) and lower MESC score (r=-0.23, p=0.017) in all subjects. On regression analysis, CCTQ score predicted a higher HbA1c independently of BMI and pubertal stage, indicating an independent association between later chronotype and higher glucose levels.
Conclusion: These preliminary findings suggest that a late chronotype in preadolescents may have a deleterious impact on glucose homeostasis independent of obesity and pubertal stage and that advancing bedtimes may reduce glucose levels and lower risk of type 2 diabetes in preadolescents. Our preliminary findings call for expansion of our pilot study to a larger cohort.
Support (If Any): This study is supported by the Endocrine Fellows Foundation and the University of Chicago Institute of Translational Medicine.

0912
THE INFLUENCE OF PARENTAL SHIFT WORK ON THEIR CHILD'S DIET
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Introduction: Shift-workers are less likely to eat meals with their families, and tend to consume foods that are unfavorable to health. There is a paucity of information regarding the impact of parental working time arrangements on the make-up of their child's diet. Therefore, the aim of this study was to assess the diets of shift-workers' children versus day-workers' children.
Methods: Children and parents/guardians completed a battery of questionnaires on one occasion assessing demographics and the child's diet using a food frequency questionnaire. Dietary core foods and non-core foods were determined per the Australian dietary guidelines. All children were 8-12years old and free of any clinically diagnosed sleep, behavioural or dietary problems.
Results: N=54 (10.7 ± 1.1years; male: 54%) children had a parent who identified as working shifts. The remaining 222 children did not (10.6 ± 1.3years; male: 48%). There was no difference between children whose parents worked shifts and those who did not for both percent energy (%E) from core food (foods were as core or non-core) (61.0 ± 12.7%VS 62.2 ± 14.0%; p=0.547) and %E from non-core food (39.0 ± 13.0% VS 37.8 ± 14.0%; p=0.560). Amongst the shift-working parents there was a difference in child's diet by sex, dependent on whether it was the mother or father participating in shift-work. For boys, there was no difference between mothers and fathers working shifts for both %E from core food (mother shift-worker: 58.5 ± 11.0%; father shift-worker 56.8 ± 13.4%, p=0.74) and %E from non-core food (mother shift-worker: 41.5 ± 11.0%; father shift-worker 43.1 ± 13.4%, p=0.76). For girls, there was a significant difference in both %E of core foods (mother shift-worker: 69.5 ± 13.4%; father shift-worker 60.5 ± 7.4%, p=0.044), and non-core foods (mother shift-worker: 31.0 ± 13.4%; father shift-worker 39.5 ± 7.4%, p=0.044). This suggests that girls' diet consists of less core foods and more non-core foods if they have a father that works shifts vs a mother that works shifts.
Conclusion: These results suggest that diets in children, specifically females, are influenced by the gender of the parent working shift-work and there needs to be further research.
Support (If Any):

0913
EXPLORING SLEEP DISTURBANCE AMONG FAMILY CAREGIVERS OF CHILDREN WITH MEDICAL COMPLEXITY
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Introduction: Family caregivers of children with complex care needs that depend on medical technology (e.g. home ventilation) are relied upon to provide skillful, vigilant homecare 24-hours/day. This responsibility has been linked to chronic sleep disturbance, placing family caregivers at risk of poor health outcomes. To inform testing of a sleep promoting intervention, the following questions have guided this research: What factors influence sleep among family caregivers? How do family caregivers appraise the utility of sleep-promoting interventions? To what degree do family caregivers perceive sleep and related health outcomes as problematic?
Methods: A multi-site cross-sectional observational design using mixed data sources is underway. Participants include family caregivers with a child dependent on medical technology at night, > 3 months homecare experience and no diagnosed sleep disorders. Interviews have been completed for qualitative content analysis. Quantitative measures administered include: Q- sort using images/text depicting

sleep-promoting interventions; Scale of the Problem to measure participant's appraisal of their sleep/health on a unipolar Likert scale ranging from 0 to 4.
Results: Nine participants have completed study procedures with further sample diversification planned. Emerging qualitative themes include: 1) caregiver (vigilance/worries, mood/emotions, sleep habits, parenting preferences), 2) child (age/development, equipment use, sleep quality, care needs), 3) family (financial/household stressors, other child-care, employment demands), 4) environment (lights/noises, personal technologies, housing, sleep location); and, 5) homecare (presence of night nursing, provider competence, family-centred service, resource constraints). To date, participants rank mindfulness/yoga (7/9), brief daily-exercise (6/9) and enhanced use of respite (6/9) their 'top choices' among evidence-based interventions. Moreover, family caregivers appraise their sleep quality (3.2/4), daily stress (3.2/4), sleep quantity (3.0/4) and fatigue (3.0/4) to be problematic.
Conclusion: Findings suggest multiple factors contribute to poor quality and inadequate quantity of sleep among family caregivers when a child is medically complex. Family caregivers assign value to addressing sleep problems and support testing of evidence-based sleep promoting interventions with demonstrated effectiveness in other caregiver (older-adult) populations.
Support (If Any): Funding for the study is gratefully acknowledged from the SickKids Foundation and Holland Bloorview Research Institute.

0914

SLEEP PATTERNS IN URBAN CHILDREN WITH ASTHMA AND HEALTHY CONTROLS

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Introduction: Urban stressors and nocturnal asthma challenge healthy sleep outcomes. We sought: 1) to describe variability in sleep patterns in ethnically diverse urban children with and without asthma, and 2) to examine associations between sleep pattern variability and sleep hygiene and neighborhood risk.
Methods: 379 children 7–9 years old (249 asthma, 130 healthy controls) and their caregivers completed a fall/winter monitoring period. Sleep was assessed through actigraphy, and sleep hygiene via the Children's Sleep Hygiene Scale. A neighborhood risk index was created via geocoding.
Results: Mean sleep duration across the sample was 9.3 hours (*SD*=0.6). Compared to recommendations for this age group (10.5–11 hours nightly), our sample had shorter sleep duration (*M*=9 hours), *t*=-28.7, *p*<.001. On average, non-Latino whites slept longer (*M*=9.5 hours) than African Americans (*M*=9.2) and Latinos (*M*=9.2), *F*=10.1, p<.001. Average sleep duration was similar in children with (*M*=9.3) and without asthma (*M*=9.3). Asthma participants had lower sleep efficiency (*M*=84%) than controls (*M*=88%), *F*=6.2, *p*<.05; and more night wakenings (*M*=5.1 and 4.4, respectively), *F*=3.8, *p*<.05. There were no asthma/control group differences in *variability* of sleep start time, sleep duration or the midpoint of sleep. In the entire sample, non-minorities had less variability in *sleep start time* (*M*=52 mins) than minorities (*M*=1:05), *F*=13.8, *p*<.001, *sleep duration* (*M*=54.7 min) than minorities (*M*=61 min), *F*=7.8, *p*<.01, and in the *midpoint of sleep* (*M*=40 mins) than minorities (*M*=54 min), *F*=15.4, *p*<.001.Poorer *sleep hygiene* was associated with more variability in sleep duration (*r*=-.16, *p*<.01) and sleep midpoint times (*r*=-.11, *p*<.05). More *neighborhood risk* was associated with variability in sleep start time (*r*=.18, *p*<.01), sleep duration (*r*=.12, *p*<.05) and sleep midpoint (*r*=.19, *p*<.001).
Conclusion: Tailored sleep hygiene interventions are needed to enhance sleep and may help improve daytime functioning. Integrated interventions addressing both nocturnal asthma and sleep hygiene are also needed.
Support (If Any): R01 HD057220, Eunice Kennedy Shriver National Institute of Child Health and Development (D. Koinis Mitchell, PI)

0915

SELF-REPORTED SLEEP BEHAVIORS AND SLEEP DISTURBANCES IN ADOLESCENTS WITH AND WITHOUT ASTHMA

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Introduction: Asthma impacts approximately 10% of adolescents. Youth with asthma are at risk for increased sleep disturbance, even when their asthma is well-controlled. However, only a small number of studies have examined sleep behaviors in addition to sleep disturbances in adolescents with asthma. The purpose of this study was to examine self-reported sleep behaviors and sleep disturbances in adolescents with and without asthma.
Methods: Participants were 58 adolescents with asthma (50% female, mean age=14.5, range 12–18) and 58 adolescents without asthma (50% female, mean age=14.5, range 13–18). Participants completed the Children's Report of Sleep Patterns (CRSP), which provides information about self-reported napping frequency, sleep quality, as well as sleep location (e.g., falling asleep with a parent present or in a siblings room), and generates scores for Bedtime Fears/Worries, Insomnia, and Daytime Sleepiness.
Results: Adolescents with asthma reported less independent sleeping compared to adolescents without asthma, *t(*113)=3.17, *p*=.002. While no difference was found between adolescents with or without asthma in terms of insomnia symptoms, *t(*114)=.08, *p*=.94, adolescents with asthma did report more frequent worries and fears at bedtime compared to adolescents without asthma, *t*(114)=9.26, *p*<.001. Adolescents with asthma reported increased daytime sleepiness compared to those without asthma, *t(*114)=1.88, *p*=.06, which was also reflected in the increased napping frequency reported by adolescents with asthma, with 51.7% taking naps sometimes or every day, compared to only 17.2% of adolescents without asthma χ^2 (2)=16.34, *p* <.001. Notably, adolescents with and without asthma did not differ on self-reported sleep quality χ^2 (1)=1.55, *p*=.21.
Conclusion: The results from this study highlight increased daytime sleepiness and more frequent napping in adolescents with asthma. In addition, in this study adolescents with asthma had more fears and worries at bedtime, as well as less independent sleeping. More research is needed to determine the contribution of asthma to both nighttime worries and daytime sleepiness.
Support (If Any): NIH grant R01 HL119441

0916

ASSESSING SLEEP PROBLEMS WITHIN THE CONTEXT OF EARLY BEHAVIORAL INTERVENTION FOR AUTISM SPECTRUM DISORDER

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Introduction: Children with Autism Spectrum Disorder (ASD) may face several developmental obstacles, including sleep problems. While parent-reported sleep concerns are often expressed within early ASD treatment programs, little research exists to help behavioral clinicians navigate these concerns and to provide needed resources for children

and their families. Specifically, it is unclear whether asking basic questions about child sleep, such as "Do you think your child has a sleep problem?" would be beneficial as an initial screening step in early behavioral treatment plans.
Methods: This study included 40 children with ASD (M_{age} = 5.5) who attended a center-based early behavioral intervention program five days per week. Child sleep problems were evaluated using 1) an informal parent interview (does your child have a sleep problem?), 2) The Children's Sleep Habits Questionnaire (CSHQ), and 3) actigraphy. Using actigraphy, we determined whether each child's sleep duration estimates fell within the National Sleep Foundation's (NSF) guidelines.
Results: Sleep concerns were common in our sample, with 51% of parents reporting their child had a sleep problem and 78% of parents endorsing concerns above the clinical cutoff on the CSHQ. Additionally, 88% of children slept fewer hours than recommended by the NSF, and 33% of children fell within the 'not recommended' range for their age. While basic parent perceptions of sleep problems were significantly related to clinically severe symptoms on the CSHQ ($p < .05$), they were not associated with child sleep duration ($p = .73$).
Conclusion: The current study suggests that parent-reports of sleep problems may not be sufficient in screening whether children are receiving adequate sleep. This could be due to differing parent perceptions of what constitutes a sleep problem, or a lack of awareness regarding healthy sleep guidelines. These preliminary data may provide helpful information for behavioral clinicians to screen sleep problems and incorporate sleep education as part of a child's early ASD treatment plan.
Support (If Any): 1) Interdisciplinary Research Award, Purdue University Center for Families 2) Gadamski Foundation, collaborative Autism Research Grant

0917

ARE SLEEP DIFFICULTIES ASSOCIATED WITH GASTROINTESTINAL DISORDERS IN CHILDREN WITH AUTISM?

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Introduction: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impaired social functioning and restricted repetitive behaviors, interests and activities. Insomnia and gastrointestinal disorders (GID) are among the most frequently reported comorbidities in ASD and they deteriorate the clinical picture. Here we report on sleep in ASD children with and without treatments for GID.
Methods: We reviewed the medical charts of 262 patients from a specialized sleep clinic for children with mental health disorders. Four groups matched for age, sex and body mass index were extracted: 16 ASD children treated for GID (ASD+GID: 6.3 ± 0.9 years), 16 untreated ASD children (ASD: 6.25 ± 0.87 years), 16 non-ASD children treated for GID (nonASD+GID: 7.08 ± 0.99 years) and 13 healthy controls (CN: 7.08 ± 0.99 years). All completed two clinical sleep scales: the Children's Sleep Habits Questionnaire (CSHQ) and the OWL-SI (a 9-item inventory adapted from the CSHQ (Jaworski M et al., Sleep 2016, 39 (suppl.): A328). A standard sleep questionnaire, including sleep latency, number of awakenings and total sleep time was also filled by all.
Results: ASD children not treated for GID were reported more frequently to sleep poorly on the OWL-SI than ASD children who were treated (p=.05). This effect was due to an increased index of nocturnal hyperarousal (p=.05). The CSHQ did not reveal significant differences between these 2 groups. No differences were found between the nonASD+GID and the CN groups on these 2 scales but the nonASD+GID children reported waking up more often at night than CN children on the standard sleep questionnaire ($p<0.01$).
Conclusion: These results suggest that poor sleep and GID potentiate each other in children and point toward the need for assessment of GID in children with poor sleep, including those with ASD.
Support (If Any): *Fondation Les Petits Trésors de l'Hôpital Rivière-des-Prairies* and the COPSE program for undergraduate students, Université de Montréal.

0918

SLEEP AND NEUROENDOCRINE PROFILES IN 3- AND 9-MONTH OLD INFANTS WITH A FAMILY HISTORY OF AUTISM

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Introduction: Circadian abnormalities have been associated with Autism Spectrum Disorder (ASD) based on separate reports of sleep and hormone irregularities. Limited information is known about the etiology and emergence of those co-occurring conditions. Since ASD is only diagnosed reliably after 2–3 years of age, we are examining the developmental trajectory of sleep and hormone rhythms in infants at greater risk for ASD because they have an older sibling with the disorder.
Methods: Sleep and hormones are being rigorously characterized at 3, 9 and 12 months in infants from families with and without a history of ASD. Data include: The Children's Sleep Habits Questionnaire (modified); 7 days of actigraphy and sleep diary; and salivary melatonin and cortisol across one day (at 0800, 0900, 1000, 1800 and 2100).
Results: To date, there are no significant differences in total sleep time between low- and high-risk infants at either 3 or 9 months. Bedtimes do not differ between groups at 3-months but are relatively earlier in low- versus high-risk infants at 9 months ($p<0.05$). High-risk 9-month old infants were also more likely to fall asleep in a bed other than their own ($p<0.01$). Preliminary cosinor analyses yield significant 24-hour rhythms at 3 months for melatonin in 4/10 low-risk and 1/3 high-risk infants, and for cortisol in 1/9 low-risk and 0/2 high-risk infants.
Conclusion: Thus far, there are no group differences in infant sleep at 3 months but possible deviations at 9 months of age. The emergence of circadian rhythms is already observed in hormone profiles at 3-months in some infants; however, increased sample sizes are necessary. Better understanding of sleep and circadian dysfunction often co-occurring with ASD may help guide treatment strategies and minimize the negative impact of these disturbances on both the children and their families.
Support (If Any): This research was supported by the Congressionally Directed Medical Research Program, Autism Research Program, AR130253.

0919

SLEEP DISTURBANCES MODIFY THE IMPACT OF WORKING MEMORY DEFICITS ON LEARNING PROBLEMS IN ADOLESCENTS WITH HIGH-FUNCTIONING AUTISM SPECTRUM DISORDER

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Introduction: Sleep disturbances are highly prevalent in persons diagnosed with autism spectrum disorder (ASD). Less is known,

however, about the relationship between sleep disturbances and cognitive functioning on learning difficulties in this population, with no studies to date reporting specifically on this association in adolescents with high-functioning ASD (HF-ASD).
Methods: Adolescents diagnosed with HF-ASD (N=96) at Penn State Hershey Psychiatry Outpatient Clinic were evaluated to determine the relationship between parent-reported sleep disturbances (defined as a clinically elevated T score ≥65 on the Pediatric Behavior Scale [PBS] sleep problems subscale) and objective measures of working memory (as measured by the WISC Working Memory Index) on parent-reported learning problems (as measured by T scores on the PBS school problems subscale [i.e., learning difficulties, disorganized schoolwork, low grades]). Linear regression analysis tested main effects and interaction effects between working memory and sleep disturbances on learning problems.
Results: A significant interaction ($p<.05$) indicated that the relationship between working memory deficits and learning problems was modified by sleep disturbances. Stratified analyses showed that working memory deficits were significantly associated with greater learning problems among HF-ASD adolescents with clinically significant sleep disturbances (β=-0.480, p=0.001), even after adjusting for age, gender, race, socio-economic status, and medication use (β=-0.427, p=0.003), while not among HF-ASD adolescents without clinically significant sleep disturbances (β=-0.032, p=0.828).
Conclusion: Sleep disturbances are a useful clinical marker of more severe learning problems related to working memory deficits in adolescents with HF-ASD. These data also indicate that absence of sleep disturbances is related to less contribution of working memory to learning problems, thus, future studies should test whether improving sleep in adolescents with HF-ASD may reduce the impact of working memory deficits on learning problems.
Support (If Any):

0920

NONREM SLEEP EEG SLOW WAVES IN CHILDREN WITH AUTISM

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Introduction: Autism is a developmental disorder with a neurobiological etiology. Studies of the autistic brain point toward atypically organized brain networks which may lead to a lower capacity to synchronize the EEG during sleep. We compared the intrisic characteristics and topography of nonREM sleep EEG slow waves (SW) in autistic and neurotypical children.
Methods: The sleep of 13 autistic boys (mean age = 10.23, SEM= 0.57) and 13 neurotypical boys (mean age = 10.23, SEM = 0.57) was recorded in a laboratory for 2 consecutive nights. None of the participants were medicated, intellectually disabled, nor complained of poor sleep. SW (0.3–3.99Hz, >75μV) were detected for the whole night with an automatic algorithm on artefact free sections of nonREM sleep in frontal, central, parietal and occipital derivations. Three-way Anovas with one independent factor (2 groups) and 2 repeated measures (4 derivations X 4 nonREM periods) were performed to compare SW density (number per minute of NREM sleep), SW slope (velocity between SW negative and positive peaks), SW amplitude (μV), and SW duration (sec).
Results: Significant interactions between Groups and Derivations were found for SW density ($p<0.01$), slope ($p<0.05$), amplitude ($p<0.05$) and duration ($p<0.01$) showing lower topographical (inter-derivations) differences in autistic than in neurotypical children. No interaction between Groups and nonREM periods were found, indicating that these differences were stable across the night.
Conclusion: SW characteristics are more evenly distributed along the anteroposterior axis in autistic than in neurotypical children. These differences are not modulated by the dissipation of homeostatic sleep pressure across the night and probably reflect atypical cortical organization in autism.
Support (If Any): Canadian Institutes of Health Research and Kids Brain Health Network Canada

0921

REM SLEEP ASSOCIATIONS WITH INTERNALIZING PROBLEMS IN CHILDREN WITH AUTISM SPECTRUM DISORDER (ASD)

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Introduction: Sleep difficulties and mood disorders are common co-morbidities in children with Autism Spectrum Disorder (ASD). Some polysomnography (PSG) research has shown that children with ASD have less REM sleep compared to typically developing controls (TD). Furthermore, associations between REM sleep and emotional state have been reported in the literature. We hypothesize that REM is associated with internalizing behaviors (i.e. withdrawn, depressed) in children with ASD. We aim to compare REM sleep amount and REM sleep theta and gamma activity between children with ASD and TD and determine associations with daytime reporting of internalizing behaviors.
Methods: 12 ASD and 17 TD participants, all drug naïve and ages 9–18 years, had an overnight home PSG with 7-channel EEG. Power spectral bands in the 4–7 Hz and 30–50 Hz ranges were calculated using Fast Fourier Transformation from F3/F4 leads during REM sleep. The Child Behavior Checklist (CBCL) was used to collect parental reports about participants' internalizing behaviors.
Results: ASD participants had reduced REM sleep compared to controls (ASD =18.1%, TD=23%, p=0.049) and internalizing scores correlated with both REM sleep amount (r= 0.89, $p<0.005$) and REM theta activity (r=0.84, p=0.009) in the ASD group only. ASD participants demonstrated a trend towards a negative correlation between REM gamma frequency and internalizing behaviors (r=-.68, p=0.065). Results retained significance after adjusting for age.
Conclusion: In ASD participants, reductions in REM sleep and REM theta power are associated with reduced internalizing behavior but conversely, reductions in REM gamma power suggested more problematic internalizing behavior. It is unclear if co-morbid psychopathology can induce neurophysiological changes in the sleep architecture or if these changes can contribute to daytime dysfunction in children with ASD. Given our robust findings with REM sleep, future treatment trials suppressing REM sleep to improve mood co-morbidities among children with ASD may elucidate a causal direction.
Support (If Any): Study Sponsored by Autism Speaks, Inc.

0922

PILOT DATA: SLEEP DYSFUNCTION IN SURVIVORS OF CEREBELLAR TUMORS TREATED WITH AND WITHOUT RADIATION

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Introduction: As survival rates for children with brain tumors rise, there is an increasing focus on studying contributors to long-term morbidity, including sleep dysfunction. Although the cerebellum is the most common site for pediatric brain tumors, sleep research in survivors of these tumors is scarce, particularly in relation to the role of radiation treatment. In the present study, we evaluated sleep characteristics in a small cohort of cerebellar tumor survivors treated with and without cranial radiation therapy.
Methods: Participants included 17 (M = 22.9 ± 6.7 years) long-term survivors of pediatric cerebellar tumors (11 with medulloblastoma treated with surgery, radiation, and chemotherapy, and 6 with juvenile pilocytic astrocytoma treated with surgery alone) as well as 8 healthy controls (M = 26.6 ± 10.7 years). All participants completed sleep questionnaires, including the Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale, and Berlin Questionnaire, in addition to neuropsychiatric evaluations. A subset of the survivors also completed a 10-day period of wrist actigraphy. Multiple regression analysis was conducted to evaluate the relationships between survivorship group and each outcome variable.
Results: On the PSQI, 11 (65%) of survivors had abnormal sleep (total score ≥ 5) and 8 (47%) endorsed insomnia symptoms (sleep efficiency < 85%). The survivor group also had significantly lower sleep efficiency than the control group ($\beta = 0.12$, $p < 0.05$) after adjusting for age. Age at diagnosis, neurologic complications, cognitive function, and radiation exposure did not predict sleep efficiency.
Conclusion: Survivors of pediatric cerebellar tumors in this small cohort have a high prevalence of sleep dysfunction and experience lower sleep efficiency relative to healthy controls. Interestingly, exposure to radiation was not a predictor of sleep dysfunction. These findings suggest that there is substantial sleep morbidity in cerebellar tumor survivors, even in those treated without radiation. Future research should evaluate for predictors of sleep outcomes in a larger sample of survivors in both radiation and non-radiation exposed populations.
Support (If Any): Center for Neurosciences Research, Emory Department of Pediatrics, Children's Healthcare of Atlanta

0923

PROVIDING THE BEST BEDROOM ENVIRONMENT FOR CHILDREN WITH CEREBRAL PALSY

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Introduction: Between 23–46% of children with cerebral palsy have sleep problems. Often these sleep problems go undiagnosed and undertreated. Interventions, if offered, are most often pharmacological. However, medication side effects are a significant concern and there is a clear need to build the evidence-base for non-pharmacological sleep interventions for these children. A recent review of the evidence-base for environmental modifications to promote sleep showed promising results warranting further study. The study aims were to determine 1) if providing parents with manualized sleep education and problem solving strategies focused on the environment increased parental knowledge, and 2) if increased knowledge then translated into parental actions to decrease sleep negative features in the bedroom.
Methods: This pilot study recruited child/parent participants through community agencies. Baseline and 6 week follow-up data collection included the Parental Sleep Environment Knowledge Questionnaire (PSEKQ), Parental Interactive Bedtime Behavior Scale, Child Sleep Habit Questionnaire, Parent Knowledge of Healthy Sleep and sleep actigraphy. Parents received the Children's Best Bedroom for Sleep (CBBES) manual (including sleep science information, self-assessment tool and environmental modification recommendation) as the intervention.
Results: There were 6 parent/child participants. The PSEKQ improved slightly (66.66% at baseline to 78.33% at follow-up). Comparing baseline and post-intervention BEAC results demonstrated that parents' ability to assess their child's bedroom and act to modify environmental problems that interfered with sleep had improved. Actigraphy data was inconclusive and as expected, because the intervention focused on the environment, there was no change in parent bedtime beliefs and behavioural measures.
Conclusion: Results support providing parents with a sleep environment psycho-education manual to build knowledge and skills for addressing environmental components of their child's sleep problems. This research is ongoing and future studies will test the CBBES with parents of children with a range of health conditions.
Support (If Any): The Canadian Centre for Disability Studies

0924

GENDER DIFFERENCES IN SLEEP DISTURBANCE AMONG CHILDREN WITH CONCUSSION

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Introduction: There is increasing evidence that gender differences exist among children who sustain concussions. Furthermore, there is evidence that sleep quality plays a significant role in the experience/severity of concussion. It is unknown however if gender plays a modulatory role in the extent of sleep disturbance noted after sustaining a concussion. This study sought to determine whether there are gender differences in sleep disturbance associated with concussion severity in children and adolescents.
Methods: Children and adolescents (ages 9 to 19, N=1971) with a recent history of concussion were evaluated prospectively through IMPACT testing and clinical evaluation. The data obtained included presence and absence of concussion related symptoms including mood changes, headache, and sleep quality measures including fatigue, daytime sleepiness, difficulty falling asleep, sleeping more or less than usual, and recent sleep duration. Composite scores of sleep quality and concussion related symptoms were log transformed and analyzed using univariate analysis.
Results: Females experienced significantly more sleep quality disturbance compared to males ($F(2,1964)=13.28$, $p<0.001$). In addition female participants with poor sleep quality were more likely to exhibit symptoms of depression and anxiety compared to male participants ($F(1,1964)=3.64$, $p=0.04$). Lastly, female participants with higher levels of sleep disturbance were more likely to experience headaches after a concussion compared to male participants with higher levels of sleep disturbance ($F(2,1964)=8.24$, $p<0.001$).
Conclusion: Our study demonstrates that sleep quality differs by gender among children with concussion. This suggests that healthcare providers, schools, athletic trainers, and coaches may need to evaluate concussion differently, taking into account gender and extent of sleep disturbance as recovery may differ depending on these factors. Further

evaluation is necessary to better understand these sleep-related gender differences.
Support (If Any): This research is supported by Georgetown University funds.

0925

SLEEP DISORDERS IN CHILDREN WITH CYSTIC FIBROSIS: A META-ANALYSIS AND SYSTEMATIC REVIEW

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Introduction: Cystic fibrosis (CF) is a disorder affecting mainly the respiratory and gastrointestinal systems. As such, CF is expected to have an impact on sleep, yet studies focusing on sleep in children with CF are scarce and conflicting. We performed a systematic review and meta-analysis of the literature to assess current knowledge on sleep disorders in children with CF, and their relationship with disease severity.
Methods: All publications on sleep and CF in children, appearing in Pubmed, CINAHL and Scopus, up to November 2016 were reviewed. Outcomes included sleep quality, nocturnal cough, oximetry, and polysomnographic (PSG) parameters. Fixed effects models were used to calculate weighted mean differences (WMD).
Results: Ten PSG studies were found; four compared children with CF to healthy age-matched controls. Pooled analysis showed decreased REM percent (WMD -2.6% [95%CI -2.6 to 0.6%]), lower nighttime SaO_2 nadir (3 trials, CF n=67, control n=54; WMD -4.1% [-5.6 to -2.6%]), and lower sleep efficiency (3 trials, CF n=88, control n=52; WMD -8.9%[-14.1 to -3.7%]). One study reported a higher AHI in children with CF, particularly in preschoolers. Six studies reported the relationship between disease severity and nocturnal oximetry: four reported a positive correlation (n=168) while two found no significant correlation (n=64). A single study (n=9) reported improvement in respiratory status with nighttime non-invasive ventilation. Six studies that included questionnaires found more behavioral sleep problems, lower sleep quality, sleep onset and sleep maintenance difficulties in children with CF. One cough recorder study showed higher nocturnal cough rates in children with CF, with high night-to-night variability.
Conclusion: There is both objective and subjective evidence of frequent sleep disorders in children with CF, emphasizing the importance of addressing these concerns on routine patient visits. Additional research is needed, with larger sample sizes and standardized outcomes, in order to better define these sleep abnormalities and their relationship with disease severity.
Support (If Any): No support received.

0926

CONTINUOUS GLUCOSE MONITORING, INSULIN RESISTANCE, AND SLEEP IN ADOLESCENTS WITH CYSTIC FIBROSIS

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Introduction: Diabetes is diagnosed in one in four adolescents with cystic fibrosis (CF) and is associated with increased morbidity and mortality, thus there is a need to identify factors affecting glucose metabolism in CF. Patients with CF have greater objective and subjective sleep problems but the relationship between sleep and metabolic function has not been fully examined. The aim of the current study was to examine the relationship between objectively measured sleep and glucose metabolism in a sample of CF youth.
Methods: Forty-three participants with CF at baseline health (mean age = 13.8 years) and 13 healthy controls (mean age = 15.2 years) underwent an oral glucose tolerance test (OGTT) and one week of concurrent home continuous glucose monitoring (CGM) and actigraphy. Fasting labs included glucose, insulin, and C-peptide. Two-sample independent t-tests and ANOVA tested differences between sleep outcomes in CF vs. control participants with post-hoc Tukey's Honestly Significant Difference test. Spearman's rank correlation coefficients tested correlations between sleep and CGM and insulin sensitivity.
Results: Of the CF participants, 15 had normal glycemia, 17 had abnormal glycemia, and 11 had CF-related diabetes (CFRD) per OGTT. Average sleep duration for the entire sample was 7.5 hours, indicating insufficient sleep. Participants with CF had longer sleep onset latency (SOL), lower sleep efficiency (SE), and higher wake after sleep onset (WASO) than controls. Higher minimum daytime glucoses on CGM correlated negatively with total sleep time and SE. In CF youth with abnormal glycemia or diabetes, poorer insulin sensitivity (lower 1/c-peptide) was seen in those with shorter sleep duration, longer SOL, poorer SE, and greater WASO.
Conclusion: Poor sleep was correlated with higher glucose and lower insulin sensitivity in a sample of youth with CF. Further research is needed to better understand the mechanisms behind this relationship and potential implications for treatment and management of impaired glycemia in youth with CF.
Support (If Any): CFFT grant CHAN16A0 and NIH grants 5K12DK094712-04, UL1 TR001082 (CCTSI)

0927

SLEEP IN SCHOOL AGED CHILDREN WITH TYPE 1 DIABETES

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Introduction: Sleep in children with type 1 diabetes (T1D) can be disrupted for a number of reasons, including nighttime blood glucose (BG) checks, hypoglycemia, and poor sleep habits. Poor sleep in children with T1D may result in daytime fatigue or feelings of anxiety. Few studies have examined sleep in school age children with T1D using actigraphy.
Methods: Children aged 6–12 years and their parents were recruited from an outpatient diabetes clinic. To be eligible, children were diagnosed with T1D at least 2 years with no diagnosed sleep disorder. Children wore an actigraph and kept a sleep diary for seven days and completed the PROMIS pediatric anxiety short form (8b) and fatigue short form (10a). Parent and child completed demographic questionnaires, A1C was assessed at clinic visit. Sleep duration and efficiency was adjusted based on age-based norms. Descriptive statistics and one-sample t-tests were computed to characterize the sample and compare sleep duration and efficiency to normed values for child's age. Using correlational analyses, associations between sleep duration and efficiency with A1C and PROMIS anxiety and fatigue scores were explored.
Results: Children (N=18) were 67% female, 100% Caucasian, and on average 9 years old with T1D for 3 years. Mean A1C was 7.5±0.8% (range: 7–10). Only 4 (22.2%) reported using an insulin pump; all children had nighttime BG checks. Actigraphy revealed mean sleep duration of 7.8 hours (range: 6–10). Children obtained on average 70 minutes less than age-adjusted sleep requirements,

and sleep efficiency was lower than the recommended 90% (p<.001). Deficits in sleep duration and efficiency were moderately negatively associated with higher A1C (r=-.29, -.32, respectively). Mean PROMIS anxiety and fatigue scores were 5.33±4.8 (range: 0–16) and 6.61±11.1 (range: 0–44), respectively, with no significant correlations with sleep duration or efficiency.

Conclusion: School age children with T1D are not be getting the recommended sleep duration, regularly have nighttime BG checks, yet are not reporting elevated levels of fatigue or anxiety. Although the correlations between A1C and sleep variables were not statistically significant, the size of the association suggests an important relationship between sleep and glucose control.

Support (If Any): American Nurse's Foundation

0928

CLINICAL PRESENTATION OF SLEEP DISORDERS IN CHILDREN WITH EHLERS-DANLOS SYNDROME

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Introduction: Ehlers-Danlos Syndrome (EDS) is a genetically-inherited group of connective tissue disorders that predominantly affects the skin, joints, and blood vessels. Adult patients with EDS routinely complain of daytime fatigue and poor sleep quality. Further, these patients are commonly diagnosed with sleep disorders including obstructive sleep apnea (OSA) and periodic limb movement disorder (PLMD). However, the clinical presentation of sleep problems and occurrence of OSA and other sleep disorders in children has not been well established. The aim of our study was to evaluate common presenting symptoms and to determine the occurrence of OSA and other sleep disorders in children with EDS.

Methods: We performed a retrospective review of children with EDS presenting to a tertiary-care sleep clinic between July 2009 and August 2016. Children younger than 18 years-old diagnosed with EDS were included in our study. Demographic information and medical history were collected, and diagnostic polysomnograms were reviewed.

Results: Sixty-one children were included in our study: 36.1% male and 91% Caucasian. The average age of presentation was 13.1±4.0 years-old, but the mean age of onset of symptoms was 9.6±4.0 years-old. The average BMI was 22.3±6.2 and BMIz was 0.67±1.04. The most common presenting symptoms for children seen at our sleep clinic were daytime fatigue (73.8%), daytime sleepiness (67.2%), restless sleep (65.6%), sleep-onset insomnia (57.4%), snoring (50.8%), frequent nighttime awakenings (45.9%), and morning headaches (32.8%). The average apnea hypopnea index was 1.4±1.7, obstructive index 0.9±1.3, and periodic limb movement index 5.3±11.7. The most common diagnoses included behavioral insomnia (32.8%), periodic limb movement disorder (24.6%), primary hypersomnia or narcolepsy (21.3%), OSA (19.7%), organic insomnia (11.5%), and circadian rhythm sleep disorders (6.6%).

Conclusion: In addition to snoring, most children with EDS present with daytime fatigue, daytime sleepiness, restless sleep, sleep-onset insomnia and frequent nighttime awakening. Unlike the adult population, less than 20% of the children in our study were diagnosed with OSA, underlining the importance of screening children with EDS for other sleep disorders. Additional research is needed to evaluate the effect of SDB and other sleep disorders on clinical outcome in children with EDS.

Support (If Any):

0929

THE MANAGEMENT OF SLEEP DISORDERS IN CHILDREN WITH EHLERS-DANLOS SYNDROME

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Introduction: Ehlers-Danlos Syndrome (EDS) is a clinically and genetically rare heterogeneous group of inherited connective tissue disorders. There is evidence for a high frequency of sleep problems in this population based on limited data in adults, specifically high rates of obstructive sleep apnea (OSA), fatigue, low sleep quality and periodic leg movement disorder (PLMD). No data exist regarding OSA and other sleep disorders as well as their management in children with EDS. The aim of this study was to describe the management for various sleep disorders in children with EDS.

Methods: A retrospective review was performed in children with EDS evaluated in the sleep center at CCHMC between July 2009 and August 2016. Children younger than 18 years-old diagnosed with EDS were included in our study. Demographic information and medical history with particular emphasis on clinical management were reviewed.

Results: Sixty-one children met the criteria for entry into analysis (64% females, 91% Caucasian). The average age at presentation and average age at onset of symptoms were 13.1±4.0 years old, and 9.6±4.0 years old, respectively. 22 (36%) were prescribed melatonin and 11 (18%) were recommended cognitive behavioral therapy for insomnia and circadian rhythm disorders. 7 (11%) were prescribed a benzodiazepine mainly for parasomnia or PLMD. 15 subjects were prescribed iron sulfate for possible RLS and PLMD. Intranasal corticosteroids, monteleukast, or anti-histamine were used in 11 (18%) of subjects with mild OSA. One patient was referred to ENT for moderate OSA. None were prescribed CPAp. 6 patients with narcolepsy and 4 patients with idiopathic hypersomnia were treated with modafinil, stimulants or both. Improving sleep hygiene was recommended in 13 (21%) subjects.

Conclusion: Most children with EDS seen in our sleep clinic received medical or behavioral therapy for sleep-onset insomnia, behavioral sleep problems, circadian rhythm sleep disorders, PLMD, and mild OSA. As opposed to adults with EDS, none required CPAP. Our study emphasizes the importance of screening for other sleep disorders. Further study is needed to assess the effect of sleep management on clinical outcomes and quality of life in children with EDS.

Support (If Any):

0930

A SYSTEMATIC REVIEW OF SLEEP QUANTITY, SLEEP QUALITY, SLEEPINESS, AND FATIGUE OUTCOMES FOR PARENTS OF CHILDREN WITH NEURODEVELOPMENTAL DISABILITIES

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Introduction: Sleep problems are common in children with Neurodevelopmental Disabilities (NDDs), with estimates ranging from 25% to 86% (Wiggs, 2001). Short sleep duration, frequent nighttime wakes, and bedtime resistance interfere with parental sleep and aspects of daytime functioning. No previous comprehensive systematic reviews examining sleep outcomes in caregivers of children with NDDs have been published.
Methods: A systematic search of five databases (Cochrane Library, Medline, EBSCOhost CINAHL, PsychINFO, EMBASE) was conducted between June and July 2016. Eligibility criteria included: English, peer-reviewed, full-text journal reports; any study design, except case reports; sample including parent caregivers of a child with a NDD; sleep quantity, sleep quality, sleepiness, and/or fatigue outcomes reported. Studies were appraised using the NHLBI Quality Assessment tools.
Results: Of 7534 citations retrieved, 7444 were removed after screening titles and abstracts for duplicates and exclusion criteria. Screening the 90 remaining full texts left 33 meeting eligibility criteria. Most (n=27) were cross-sectional, included a range of NDDs and were of "poor" (n=14) or "fair" (n=17) quality. One of two "good" quality studies found parents of children with NDDs slept significantly fewer minutes at night than parents with typically developing children (TD). Parents of children with NDDs consistently reported (n=10 studies) significantly poorer subjective sleep quality using the Pittsburgh Sleep Quality Index. No studies compared sleepiness across samples, and fatigue was not measured consistently across studies. Although maternal (n=16) and "parental/caregiver" (n=17) sleep were frequently examined, no studies exclusively reported on paternal sleep.
Conclusion: Parents of children with NDDs report significantly poorer sleep quality compared to parents of TD children. There is a paucity of good quality comparative studies, using well-validated measures, that examine sleep duration, daytime sleepiness, and/or fatigue. Future research should aim to fill this gap, providing greater insight to parents' experiences and identifying targets for intervention design and evaluation.
Support (If Any): N/A

0931

SLEEP PROBLEMS IN PRESCHOOLERS WITH PSYCHIATRIC DISORDERS

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Introduction: Sleep disturbances among preschool-aged children are known to be highly prevalent, even in nonclinical populations. Given the impact of low sleep quality and short sleep duration on health, this question is even more relevant in vulnerable populations, but is less documented. This study aims to determine the prevalence of sleep difficulties in preschool-aged children who consulted in a child psychiatry clinic.
Methods: Children aged between 1 and 6 years (n=276, 201 boys, 75 girls) were evaluated in an early childhood psychiatric clinic between July 2006 and September 2009. All participants were evaluated by a psychiatrist and diagnoses were established according to the DSM-IV-TR criteria. Diagnoses where then pooled into three categories: Behavioral Disorders, Relational Disorders and Communication Disorders. Sleep difficulties were measured using the Child Behavior Checklist for ages 1.5–5 (CBCL/1.5–5) sleep problems subscale and were compared between children with or without each psychiatric nosology with independent t-tests.
Results: Children with Behavioral Disorders had more sleep difficulties than children without this diagnosis (5.55 ± 3.47 vs 4.49 ± 3.6, $p = 0.02$). The same pattern was present for Relational Disorders (5.43 ± 3.7 vs 4.46 ± 3.45, $p = 0.03$), while no differences were observed for Communication Disorders (4.62 ± 3.5 vs 5.22 ± 3.7 $p>0.05$).
Conclusion: Sleep is an important factor in child development. Results of the present study show that preschool-aged children with a psychiatric disorder are more likely to experience sleep difficulties, especially children with behavioral or relational disorders. Sleep difficulties may exacerbate clinical symptoms in this vulnerable population. The bidirectional link between psychopathology and sleep needs to be evaluated as soon as possible in development, in order to promote early identification and intervention related to these concomitant difficulties.
Support (If Any):

0932

RETROSPECTIVE POLYSOMNOGRAPHIC DATA REVIEW OF PERIODIC LIMB MOVEMENTS IN SLEEP IN CHILDREN WITH SICKLE CELL DISEASE AND ITS EFFECTS ON SLEEP

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Introduction: Approximately 1 out of every 365 African-American children is born with sickle cell disease (SCD). According to (Rogers et al., 2011), 15 out of 64 (23.4%) children with SCD are also diagnosed with periodic limb movements in sleep (PLMS). The current study aims to assess the prevalence rate of PLMS in a large inner city of pediatric SCD population. In addition, the study will examine the effect of PLMS has on the sleep architecture for this population.
Methods: The current study is a retrospective chart review. Children between the ages of 2 to 18 with the diagnosis of SCD who underwent a sleep study from January 2005 to December 2015 at Children's National Health System were included in the study. Subjects with a periodic limb movement index (PLMI) ≥ 5/h were included in the PLMS group.
Results: In total, there were 230 patient records that were included for data analysis. Out of those, 103 (44.8%) were male. Average age of participants was 9.3 years. When analyzing PLMS prevalence, there were 52 (22.6%) patients who had PLMS. In addition, 21 (9.1%) of patients had increased leg movements but did not meet criteria for PLMS. Although not significant, there was a notable difference in decreased total sleep time in the PLMS group. Children in the PLMS group had significantly lower stage 3 sleep time percentage (p=0.03), sleep efficacy (p=0.04) and NREM sleep time percentage (p=0.04). PLMS group also had most leg movements in sleep stage 1.
Conclusion: The current study was able to increase the power statistic of the prevalence rate of PLMS in children diagnosed with SCD, by replicating previous study findings with a larger sample size. In addition, our results demonstrated that increased pediatric limb movement also had more sleep disruption in children diagnosed with SCD.
Support (If Any): N/A

0933

ROLE OF PERIODIC LIMB MOVEMENTS DURING SLEEP IN ADOLESCENTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER: DIFFERENTIAL ASSOCIATION WITH INTERNALIZING VS. EXTERNALIZING BEHAVIORS

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Introduction: Attention deficit hyperactivity disorder (ADHD) in children has been associated with sleep disordered breathing (SDB), insomnia, and periodic limb movement disorder (PLMD). However, there is lack of data examining the association of ADHD and PLMD with internalizing and externalizing behavioral outcomes, particularly in adolescents from the general population.
Methods: Data from the Penn State Child Cohort, a random sample of 421 adolescents (12-23y) who underwent 9-hour polysomnography was used. The presence of ADHD was ascertained by parent- or self-report of receiving treatment for the disorder during the clinical history and physical examination. PLMD was defined as a PLM index (PLMI) greater or equal to 5 events per hour of sleep. The Child or Adult Behavior Checklist were used to ascertain internalizing and externalizing behaviors. We adjusted for sex, race, age, eveningness, insomnia symptoms, total sleep time, awakenings, daytime sleepiness, SDB, and body mass index in our analyses.
Results: Adolescents with ADHD had a significantly higher PLMI (5.4±7.3) and prevalence of PLMD (35%) as compared to controls (3.4±5.6, p = 0.006 and 21%, p = 0.004). Significant interactions between ADHD and PLMD showed that adolescents with both disorders had significantly elevated internalizing (e.g., anxious-depressed), attention and externalizing (i.e., rule-breaking, aggression) problems, while adolescents with ADHD-alone had the expected significant elevations in attention and externalizing problems. Adolescents with PLMD-alone did not have significantly elevated internalizing or externalizing problems.
Conclusion: PLMD is significantly more frequent in adolescents with ADHD. Importantly, adolescents with both disorders have worse behavioral outcomes than adolescents with ADHD-alone, particularly in terms of anxiety and depression. Interestingly, PLMD in the absence of ADHD is not significantly associated with behavioral problems. These data suggest that PLMD, rather than comorbid with or causally related to ADHD, is a marker of more severe underlying neurobiological deficits in ADHD.
Support (If Any): National Institutes of Health R01 HL63772, R01 HL97165, UL1 TR000127, C06 RR16499

0934

EVALUATING THE EFFECTS OF GENERAL ANESTHESIA ON SLEEP IN CHILDREN UNDERGOING ELECTIVE SURGERY

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Introduction: Sleep disturbance during early childhood can lead to cognitive impairment, behavioural disorders and emotional dysregulation. There is increasing interest on the factors that may contribute to impaired sleep following surgery. The impact of general anesthesia on sleep has become of emerging interest. The objective of this study is to identify potential effects of a general anesthetic on sleep.
Methods: This is a prospective, observational study with children, aged 18 months to 8 years, undergoing general anesthesia for elective surgery. Subjects underwent actigraphy sleep monitoring for 14 days: 7 consecutive days prior to and following the surgery. Data regarding baseline behaviour patterns were collected using standardized behavioural assessments. One and three months after surgery, the actigraph was worn again for 7 days with completion of behavioural assessments.
Results: Eighteen patients (mean age 4.7 years, 78% male) underwent surgery. All patients received sevoflurane as the inhaled anesthetic agent. The median anesthetic duration was 111 minutes. Between baseline and 7-day postoperative period, actigraphy measures were not significantly different (sleep efficiency: p=0.67, total sleep time: p=0.99, wake after sleep onset: p=0.16, sleep onset latency: p=0.29). Among the 18 patients, 7 patients completed both the 1- and 3-month follow-up, where no significant differences were found in actigraphy measures across all time points. Additionally, no significant differences in mean scores were found for overall internalizing behaviour, (F(1.24, 7.43)=0.28, p=0.66), externalizing behaviour (F(1.23, 7.35)=0.28, p=0.67) and executive functioning (F(1.02, 4.08)=0.28, p=0.83).
Conclusion: In this study, general anesthesia did not cause sleep disturbance or negative behaviour changes in children. These findings are reassuring to both physicians and parents.
Support (If Any): N/A

0935

CHILDREN ON NON-INVASIVE POSITIVE PRESSURE VENTILATION (NIPPV) SHOULD HAVE ANNUAL POLYSOMNOGRAMS

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Introduction: Do children on non-invasive positive pressure ventilator support need yearly polysomnograms? There are no published studies that address if children on outpatient NIPPV should have routine polysomnograms. We reviewed our pediatric NIPPV population to determine if annual polysomnograms resulted in change of settings or oxygen therapy.
Methods: Retrospective chart review of children on non-invasive positive pressure ventilators (BiPAP or CPAP) who had routine annual overnight polysomnograms. Inclusion Criteria: age 16 months - 21 years; overnight non-invasive positive pressure ventilation for >6 hours/day; and had annual polysomnograms at UCLA Sleep Center. All studies were recorded on Nihon Kohden equipment (Nihon Kohden Corporation, Tokyo) using the Polysmith 9.0 software. All studies were interpreted by a sleep-boarded physician in accordance with recommendations of the AASM Manual for Scoring of Sleep and Associated Events. Change to settings was defined as increase/decrease in pressure settings or oxygen dosage; or if patient was able to be discontinue NIPPV support. Data collected: demographics, primary diagnosis, pressure settings, and supplemental oxygen (LPM). Analysis was by proportionate number of subjects (%) who had changes made in their positive pressure settings, supplemental oxygen dosage, and/or were able to be off their positive pressure ventilator support.
Results: 13 pts (M:F, 10:3; mean age 12.7±6.6 yrs.) met inclusion criteria. Primary diagnoses: 8 chronic lung disease; 4 neuromuscular weakness; 1 with other diseases. 12/13 children (92.3%) had changes made to their NIPPV settings or to their oxygen supplementation dose based on the results of overnight polysomnograms. Only 1/13 (7.7%) child did not require adjustment of their NIPPV settings.

Conclusion: Annual polysomnograms resulted in adjustments in the majority of our NIPPV pediatric patients. Hence, we recommend annual polysomnograms be part of the routine management of pediatric patients on chronic non-invasive positive pressure ventilation.
Support (If Any):

0936

DO PEDIATRIC HOME VENTILATOR PATIENTS NEED ANNUAL POLYSOMNOGRAMS?

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Introduction: Do children on chronic home mechanical ventilator support need yearly polysomnograms? There are no published studies that provide evidence that annual polysomnograms are necessary in the routine clinical management of this population. We reviewed our pediatric home ventilator population and assessed if annual polysomnograms resulted in change of ventilator settings or oxygen based on overnight polysomnogram findings.
Methods: Retrospective chart review of children with tracheostomy and on chronic home positive pressure ventilation. Inclusion Criteria: age 6 mo - 21 yrs; tracheostomy; positive pressure ventilation for >6 hours/day; and had annual polysomnograms at UCLA Sleep Center. All studies were recorded on Nihon Kohden equipment (Nihon Kohden Corporation, Tokyo) using Polysmith 9.0 software. Studies were interpreted by the same sleep-boarded physician in accordance with recommendations of the AASM Manual for Scoring of Sleep and Associated Events. Change to settings was defined as increase/decrease in ventilator respiratory rate, oxygen dosage or pressures; or if patient was able to be off ventilator support. Data collected: demographics, primary diagnosis, ventilator settings and FiO_2. Analysis was Fisher's Exact and by proportionate number of subjects (%) who had changes made in their ventilator settings, supplemental oxygen dosage, and/or were able to be off their ventilator.
Results: 36 pts (M:F 22:14; mean age 9.5±5.7 yrs) met inclusion criteria. Primary diagnoses: 12 neuromuscular weakness; 16 chronic lung disease; 8 other diseases. 25/36 pts (69.4%) had changes made to their ventilator settings or oxygen supplementation dose based on the results, while 11 (30.5%) were stable on their current settings. Patients with neuromuscular weakness were not more likely to need ventilator or oxygen changes compared to children with chronic lung disease (p= 0.22, *ns*).
Conclusion: Annual polysomnograms are recommended for routine management of pediatric patients on chronic invasive ventilatory support.
Support (If Any): None

0937

ACCESS TO PEDIATRIC SLEEP LABORATORY SERVICES IN THE SUBURBAN CHICAGO AREA SINCE IMPLEMENTATION OF THE AFFORDABLE CARE ACT (ACA)

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Introduction: Inadequate access to pediatric sleep laboratory services with uneven distribution of accredited sleep centers is one of the major barriers to sleep health in the United States. Implementation of Affordable Care Act in 2010 has changed the healthcare landscape. The aim of this study was to investigate whether new trends in healthcare impacted access to pediatric sleep services.
Methods: We examined data from 7 sleep laboratories over the past 9 years (from 2008 until present) affiliated with academic centers and located in the western and northwestern suburbs of Chicago.
Results: A total of 4996 pediatric PSGs and MSLTs were identified. Ages ranged from 3 months to 18.9 y with an average of 9.3 years. There were 74.4% of diagnostic PSGs conducted on children 6 years and older and 15.8% on children under age 6 y. There were only 5.3 % PSGs conducted with CPAP titration, and 5.4 % were MSLTs.The vast majority of direct referrals to sleep laboratories came from otolaryngology, pediatric pulmonology, child neurology, and child and adolescent psychiatry specialists. Diagnostic codes derived from the PSGs were as follows: Obstructive Sleep Apnea-76.9%; Primary Snoring-9.9%; Central Disorder of Hypersomnolence -6.3%; Parasomnia -3.1%. A total of 557 pediatric PSGs were conducted in 2009 followed by a 17% increase the following year to a total of 652 in 2010. In subsequent years there seems to be a trend toward gradual decrease in the total number of pediatric PSGs and MSLTs as follows: n=623 (2011); n=613(2012); n=646 (2013); n= (2014); n= 583(2015), and n= 579(2016).
Conclusion: Despite increase of access to healthcare and to sleep laboratory services in Chicago suburban communities, the utilization of pediatric sleep services remains grossly unchanged with a trend towards gradual decline over the past 6 years. Other barriers to pediatric sleep health should be explored, such as inadequate sleep awareness by healthcare providers, an insufficient number of pediatric sleep medicine experts, health insurance restrictions/limitations of coverage. The ACA does not seem to have had significant impact toward expanding access to pediatric sleep services, despite grass-root efforts to increase awareness.
Support (If Any):

0938

A SYSTEMATIC REVIEW OF ADHERENCE TO LONG-TERM NON-INVASIVE VENTILATION IN CHILDREN

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Introduction: Adherence to non-invasive ventilation (NIV) has been shown to optimize both day and nighttime gas exchange in children with documented physiological advantages. Minimal hours of treatment required for optimal effect have not been established. Variability in adherence to NIV in children also requires further examination. In this systematic review we summarized the available data on adherence and factors that influence adherence in children using NIV
Methods: This extension of a scoping review on long-term NIV therapies in children identified all publications examining NIV adherence in children; 289 included publications were reviewed to identify those reporting on adherence. Grey literature sources and articles reporting only adherence rates were excluded. Data extraction on study design, sample size, intervention type, adherence measurements, barriers to adherence, and determinants of adherence will be completed
Results: Seventy five manuscripts mentioning adherence were identified from the scoping review of which 27 studies (1138 subjects)

were included for data extraction. Objective measures of adherence were available in 21 (78%) of the studies. Preliminary analysis showed both patient and technology influences contributing to the variable rates of children's adherence (e.g. patient age, interface type). Six studies reported on adherence measures, most commonly (70%) defined as an average of 4 or more hours of NIV use per night at least 5 nights a week. Only one study related adherence to outcome. This study reported longer duration of CPAP use correlated inversely with Epworth Sleepiness Scale scores

Conclusion: This systematic review revealed gaps in the evidence on objective measures used to assess adherence in long term NIV use in children. The relationship between these measures and clinical outcomes in children was also limited. Identification of factors influencing NIV use in children requires further study in order to understand how to better support children to use long term NIV

Support (If Any): None

0939

VIDEOSOMNOGRAPHY: A VALIDATION STUDY OF AUTOMATED SLEEP SCORING IN A PEDIATRIC SAMPLE

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Introduction: The term videosomnography (VSG) captures a range of video-based procedures used to record and subsequently score sleep behaviors. VSG recordings have been behaviorally coded to index breathing disorders, movement related sleep disorders, and to document intervention-based improvements in sleep. Until recently, the time consuming nature of behavioral VSG coding has limited its clinical and research applications. However, with recent technological advancements and the rise of tele-medicine approaches, the use of computer-scored or auto-VSG techniques is a practical and valuable extension of behavioral VSG coding. Within the present study, we employ signal/video-processing techniques to demonstrate the utility of auto-VSG for both research and clinical applications.

Methods: As a part of a larger longitudinal study, 30 families video recorded their infant/toddler's sleep for one night (age $M = 18$ months, $SD = 6.1$ months). These videos were subjected to a series of signal/video-processing techniques within Python and OpenCV. The resulting auto-VSG sleep/wake scores were then compared to actigraphy and behavioral VSG codes. Behavioral VSG codes included sleep onset and offset, awakenings, and core body movements during sleep. All behavioral VSG coders were blind to the sleep/wake codes of the other conditions and were reliably trained (ICC > .80).

Results: Behavioral VSG, actigraphy, and auto-VSG methods were compared using a series of paired *t* tests and *TOST* analyses for sleep onset time, sleep offset time, awake duration, and sleep duration. For each of these sleep parameters, auto-VSG provided comparable estimates to behaviorally coded VSG (all $p < .05$). Actigraphy and auto-VSG demonstrated comparable estimates on only sleep onset time ($p < .05$) and total sleep time ($p < .05$).

Conclusion: Using open-source signal-processing techniques, the present study demonstrated that auto-VSG provides sleep estimates that are comparable to those of behaviorally coded VSG. Auto-VSG was notably faster (5 minutes) than behavioral coding (1 hour) and could provide researchers and clinicians with a minimally evasive sleep assessment method. Although several mass market devices now provide video-based estimates of sleep, this is (to our knowledge) the largest validation study to date of auto-VSG techniques in a pediatric population.

Support (If Any): None

0940

PRENATAL AND EARLY INFANT BRAIN DEVELOPMENT IS RELATED TO CHILDHOOD SLEEP PATTERNS. THE GENERATION R STUDY

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Introduction: Sleep patterns and brain maturation in childhood are closely intertwined. Cross-sectional studies in children have shown that adverse sleep patterns are related to altered brain structures, but the direction of this association has not been explored. This study aims to determine whether structural properties of the fetal and early infant brain are predictive of repeatedly measured sleep patterns until school age.

Methods: Within the Generation R Study, fetal brain growth was measured at 21 (19–23) and 30 (28–33) weeks of gestation. In a subsample of 775 infants, head circumference and volume of lateral ventricles were also measured using cranial ultrasound at 6 weeks postnatal age. Mothers reported sleep duration and sleep problems for 4341 children at 2, 6 months, 1.5, 2, 3 and 6 years. Brain measures were tested as determinants for sleep patterns using general estimating equations (GEE), to account for the correlation between repeatedly measured outcomes.

Results: Larger lateral ventricles in late pregnancy {β=0.05, (0.02;0.1), p-value=0.013} and early infancy {β=0.10, (0.01;0.2), p-value=0.027} were associated with longer sleep duration in toddlerhood. In utero measures of larger head circumference and lateral ventricles were related to less sleep problems between 2 months and 6 years. These associations were partly explained by prenatal smoking exposure and maternal psychopathology.

Conclusion: Variations in ventricular size before and shorty after birth are related to childhood sleep patterns. Larger ventricles, indicating advanced development, are related to longer sleep duration. This study provides evidence for neurodevelopmental origins of childhood sleep problems, which can be observed already prenatally. Future studies should explore the directionality of the associations between early neurodevelopment and sleep patterns using different imaging modalities.

Support (If Any): The first phase of the Generation R Study was made possible by financial support from the Erasmus Medical Centre and The Netherlands Organization for Health Research and Development (Zon MW Geestkracht Program 10.000.1003 and VIDI Grant 017.106.370 to HT). ERAWEB scholarship grant financed by the European Commission was granted to DK (grant agreement 2013–2548/001- 001-EMA-2).

0941

UNILATERAL CONTINUOUS SPIKE AND WAVES DURING SLOW SLEEP (CSWS): CLINICAL AND SLEEP EEG FEATURES

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Introduction: Continuous spikes and wave during slow sleep (CSWS) is an age-related epileptic encephalopathy of childhood that is often

associated with sleep-related seizures, neurocognitive regression, and an EEG pattern characterized by the dominant presence of bilateral spike-wave discharges during sleep. While focal and lateralized electrographic features have been described in association with this entity, there is little known about the clinical and sleep EEG features of unilateral CSWS.

Methods: A retrospective analysis of consecutive 21+-channel pediatric sleep EEG studies at our institution from the years 2011–2016 was performed. If unilateral CSWS was demonstrated, medical charts were then subsequently reviewed for clinical information that included chief complaint and reason for EEG; neurodevelopmental history; neurobehavioral and neuropsychiatric co-morbidities; neurological exam features; and neuroimaging study findings.

Results: Out of a total of 5,190 consecutive pediatric sleep EEG studies performed over this 6-year period, only 4 children (or 0.08%) demonstrated unilateral CSWS (2M;2F; aged 3-3-8.5 years). All but one of these children demonstrated a well-controlled sleep-related seizure disorder that was largely responsive to a singular seizure medication. In addition, all of these childen demonstrated normal speech and language development; an absence of attention deficits or any neurobehavioral or neuropsychiatric co-morbidities; a non-lateralized neurological examination; and a completely normal or benign MR neuroimaging study. Their EEG patterns were characterized by the unilateral and dominant presence of moderate-to-high amplitude spike-wave discharges exclusively relegated to an isolated cerebral hemisphere (3L;1R), while occupying more than 85% of the recording during sustained non-REM sleep; as well as a broad field of involvement that included the ipsilateral parietal and/or frontal regions.

Conclusion: Unilateral CSWS is a rare electroclinical entity that is typically associated with a well-controlled sleep-related seizure disorder. It may be differentiated clinically from bilateral CSWS by a relatively intact neurodevelopment and neurocognition; an age-appropriate language development; and an absence of neurobehavioral abnormalities and attention deficits. It may be distinguished electrographically from the more common benign focal epilepsies of childhood by their broader field of involvement throughout the hemisphere; the absence of independent contralateral spike-wave discharges; and their dominant expression during sustained non-REM sleep.

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0942

PEDIATRIC REM SLEEP WITHOUT ATONIA MAY BE ASSOCIATED WITH BRAINSTEM ABNORMALITIES

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Introduction: The clinical significance of REM sleep without atonia (RSWA) in children remains unclear, especially if not associated with a clinical history or polysomnographic evidence of REM behavior disorder. Moreover, there is no universal criterion to define RSWA in children and many different parameters have been used in various studies.

Methods: A retrospective chart review was conducted on patients observed to have RSWA during polysomnography (PSG) performed from years 2015 to 2016. These children were referred for symptoms of sleep-disordered breathing or sleepiness. RSWA was defined as an obvious increase in muscle tone on chin or leg electromyography with or without large body movements but without arousal during REM sleep. Data with regards to age, sex, medical history, family history, presenting symptoms, medication history, PSG and cranial imaging findings were collected.

Results: Six patients were identified to have RSWA. Ages ranged from 3–15 years. There were 3 males and 3 females. Three had past history of migraines and one had achondroplasia. A family history of obstructive sleep apnea (OSA) was present in 4/6 patients and REM behavior disorder in one. The most common presenting non-sleep symptom was headache (3/6), while the most common sleep related symptoms were snoring (3/6) and excessive daytime sleepiness (3/6). Two patients had parasomnia (dream enactment and sleep walking). None of the patients were taking medications that could affect REM sleep. The most common associated PSG finding was an increased periodic limb movement index (4/6). One patient had mild OSA and another had a diagnosis of long sleep and two SOREM's, in observation for possible narcolepsy. Three out of five patients imaged after PSG had Chiari I malformations (two had symptoms of esotropia, hoarseness and dysphagia with aspiration). The sixth patient, diagnosed with achondroplasia, had narrowing of the foramen magnum and C1 ring hypoplasia in an MRI done two years prior.

Conclusion: Our results suggest that patients presenting with RSWA and concurrent neurologic symptoms may have underlying structural or physiological abnormalities of the central nervous system. Further investigation is warranted in a larger population to accurately define the phenomenon of RSWA in children.

Support (If Any):

0943

DEMOGRAPHICAL AND CLINICAL FACTORS ASSOCIATED WITH PARASOMNIA IN CHILDREN: SECONDARY DATA ANALYSIS FROM THE PHILADELPHIA NEURODEVELOPMENTAL COHORT

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Introduction: Parasomnias are common in children and decrease in frequency with age. Sleepwalking is one of parasomnias associated with NREM sleep in which a child sits up and crawls or walks around. In contrast, bedwetting, or enuresis, is an involuntary urination during sleep and can occur in all sleep stages. A few small studies have previously reported that certain genetic factors and medical conditions are associated with these parasomnias. However, risk factors and how they affect parasomnias have not been revealed.

Methods: We conducted a secondary data analysis of 8719 children (age: 8–22 years) from the Philadelphia Neurodevelopmental Cohort (PNC). Data from the PNC include questionnaires asking if the subjects ever had problems of sleepwalking and/or bedwetting after the age of 5 years. We investigated demographic and clinical data including age, sex, ethnicity, or medical conditions. We compared them between 758 children with a history of sleepwalking and 7778 children without it, and between 1443 children with a history of bedwetting and 7085 children without it, respectively. We performed logistic multivariable regression analysis for sleepwalking and bedwetting by the factors those p-values of odds by univariable regression analysis were less than 0.2.

Results: The odds of increased sleepwalking was significantly ($P<0.05$) associated with male sex, European American ethnicity, and having the following medical history: intrauterine or perinatal problems, migraine or headaches, serious head injury, "bedwetting after 5 years old", frequent motion sickness, allergy to food, insects or hay fever, Ear/Nose/Throat problem, disorder of immune system and rheumatology joint disease. The odds of increased bedwetting were significantly associated with male sex,, African American ethnicity, and

having the following medical history: problems with development, migraine or headaches, diagnosis of epilepsy, motor tic, learning problem, autism, "sleepwalking", hearing, endocrinology, hematology, hepatology, nephrology, oncology, pulmonary and urology/gynecological problems.
Conclusion: Both sleepwalking and bedwetting increase the risk of each other. Characteristics of other risk factors are however, different between the 2 parasomnias with more allergic features in sleep walking and broad organic brain and physical problems in bedwetting, which may suggest distinct pathophysiological mechanisms that underlie these sleep conditions.
Support (If Any): no

0944

SUPERFICIAL WHITE MATTER AND CORTICAL THICKNESS ASSOCIATED WITH PARASOMNIAS IN CHILDREN

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Introduction: The human brain changes during development. Cortical gray matter (GM) and superficial white matter (SWM) may be related to certain neurological diseases. Parasomnias such as sleepwalking and bedwetting are common in children and decrease in frequency by age. Although functional and anatomical changes of youth in neuronal circuits have been suggested in parasomnia, this has never been systematically studied.
Methods: We evaluated multimodal data from 866 children who were part of the Philadelphia Neurdevelopmental Cohort (PNC). The PNC database included semistructured clinical interviews, which included questions to children and their parents regarding problems with sleepwalking and bedwetting after 5 years old (lifetime past or current). We investigated demographic data including age, sex, ethnicity, and medical conditions reported. There were 17 children who reported having current sleepwalking, 774 children without any history of sleepwalking, 42 children having current bedwetting and 702 children without history of bedwetting. Structural MRI data and Diffusion Tensor Imaging data were analyzed to sample values of cortical thickness and mean diffusivity (MD) of SWM at each vertex scattered on the surface of white matter of the brain. In Thickness-MD coordinate system at each vertex, we calculate the distance between the coordinate point, obtained from actual value of thickness and MD, and the regression line made by MRI data of normal children in PNC data. We sampled the distance called ThickMD at vertex point again. The values of Thickness, MD and ThickMD of each vertex were analyzed with the General Linear Model to test for the effects of diseases corrected by age and sex.
Results: There were only limited numbers of vertexes having significant effects of sleepwalking and bedwetting on Thickness and MD. However, there were many vertexes, which spread diffusely over brain, having significant effects of sleepwalking and bedwetting on ThickMD.
Conclusion: Significant effect of diseases on ThickMD rather than thickness and MD would suggest that disconnectivity between cortical GM and SWM beneath the GM are associated with the underlying pathophysiology of parasomnias in children. Larger studies are needed to investigate potential neurobiological mechanisms underling parasomnias.
Support (If Any): no

0945

SLEEP RHYTHMIC MOVEMENTS IN CHILDHOOD: ASSOCIATED BEHAVIORAL, PSYCHOLOGICAL AND MATERNAL CHARACTERISTICS

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Introduction: Sleep rhythmic movements (SRM) are stereotyped behaviors (mainly head-banging, body rocking and head-rolling) occurring during sleep or in the transition between wake and sleep. This parasomnia occurs primarily in childhood and its etiology remains unknown. It has been described as self-soothing mechanism, but evidences remain sparse. While associations between SRM and depression, anxiety, hyperactivity-inattention symptoms and maternal depression were documented, most studies used a retrospective design, which is subject to recall biases. The present study aims to (1)assess the prevalence of SRM in children from 12 to 60 months, and (2)document the association between SRM and psychological problems in children as well as maternal characteristics.
Methods: Mother-child dyads (N=455, 245 boys) were part of the Maternal Adversity, Vulnerability and Neurodevelopment cohort. Presence or absence of SRM was assessed by annual report between ages 12 and 60 months: the mother was asked how frequently her child rocked himself/herself while falling asleep. Maternal sensitivity was assessed at 6 months with the Maternal Behaviour Q-Sort Revised version (MBQS-R). Behavioral problems were assessed at 48 and 60 months with the Children's Behavioral Checklist (CBCL). Maternal depressive symptoms were assessed with the Center for Epidemiologic Studies Depression scale at each time point. Independent samples t-tests were used to assess differences between children with and without SRM.
Results: Results show that the highest prevalence of SRM is at 12 months(6.7%) and the lowest at 60 months(3.8%). Mothers of SRM children had lower scores of sensitivity and cooperation on the MBQS, as well as more depressive symptoms than mothers of non-SRM children. SRM children obtained higher mean total score on the CBCL and higher mean score for internalizing problems.
Conclusion: These preliminary results show associations of SRM with lower maternal sensitivity and higher maternal depression, supporting the possible self-soothing component of SRM. Additionally, results show that SRM children present more internalizing problems. Mechanisms linking SRM, maternal well-being and children characteristics along with the evolution of these associations throughout development remain to be determined and will be further explored.
Support (If Any): Canadian Institutes of Health Research,Ludmer Centre for Neuroinformatics and Mental Health,Faculty of Medecine McGill University

0946

RETROSPECTIVE CHART REVIEW DEFINING CHARACTERISTICS OF LIMB MOVEMENTS ON POLYSOMNOGRAPHY IN CHILDREN WITH ATOPIC DERMATITIS

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Introduction: Sleep disturbances afflict more than half of the 10% of US children with atopic dermatitis(AD). This study aims to

characterize limb movements and sleep architecture in a cohort of patients who underwent PSG and were coincidentally noted to have a diagnosis of AD.

Methods: Retrospective chart review over the past 10 years was performed in patients aged 1.5-17y who underwent polysomnography at Lurie Children's Hospital and were seen for AD within one year of PSG. Severity of AD was categorized as moderate (regular use of ≤class 5 steroids) v. mild. Patients with AHI >5 were excluded. Descriptive statistics were used to characterize the AD patients. AD patients with Limb Movements Index(LMI) > 15/hr were compared to a control group of age matched patients without AD but with LMI > 15/hr. This was done to determine whether arousal patterns related to limb movements was different in AD patients.

Results: Overall, 34 patients met criteria for inclusion, aged 6.4y±3.2 (μ±SD), 50%male, 4 moderate disease. The sleep architecture and efficiency were normal in this cohort of AD with mild disease. However, wake after sleep onset (46min±37.8), limb movement index (32.8 ± 13.9) and arousal indices (14.4 ± 7.5) were elevated compared to Scholle published normative values. Comparing AD with LMI>15/hr (n=7) to children without AD and LMI>15/hr (n=8), total LMI was similar in AD patient compared to controls (24.1 ± 5.8 v. 30.1 ± 9.4, p=0.06), although LMI during wake was greater in AD (118.1/hr±27.1 v 66.4 ± 26.7, p<0.05). LMI with arousals was almost half in AD v. controls (8.6/hr±3.0 v. 16.0/hr±6.8, p<0.01). In the 8 patients with AD who had ferritin measured, only 2 had values slightly below reference range, 20ng/mL in both.

Conclusion: Limb movements in AD occur in higher frequency during wake bouts than in non-AD patients with high nocturnal limb movements. Interestingly, despite our control group having a similar LMI, cortical arousals related to limb movements were much higher in non-AD patients. Further work is ongoing to determine the mechanism by which AD patients are having less cortical arousals related to limb movements as compared to non-AD patients with similar LMI.

Support (If Any):

0947

CLINICAL CHARACTERISTICS OF CHILDHOOD NARCOLEPSY FOLLOWING THE H1N1 PANDEMICS: PRELIMINARY DATA FROM THE PEDIATRIC WORKING GROUP OF THE SLEEP RESEARCH NETWORK

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Introduction: An increased incidence of narcolepsy in children and adolescents has been reported after the 2009 H1N1 pandemic in Europe and China. In addition, some studies have indicated different clinical characteristics in recent cases. However, no data have been reported from the United States.

Methods: The Pediatric Working Group of the Sleep Research Network (PED-SRN) has conducted a retrospective review with a prospective follow-up interview on Pediatric Narcolepsy since 2010. This multi-center collaborative project consists of 20 US pediatric sleep centers. One of the main objectives is to compare clinical characteristics between recent cases (2009-present) and conventional cases (prior to 2009). Subjects aged 0–18 years at the time of narcolepsy diagnosis from 2000–2015 were included. Secondary narcolepsy cases were excluded. The data were obtained from medical records with an additional interview from research coordinators. The study was approved by the IRB from each site, with informed consent when additional interview was needed.

Results: 652 subjects were enrolled into the study, and 648 completed records were analyzed, including 478 recent[R] and 170 conventional[C] cases. The age at EDS onset(9.6 ± 3.7[R] vs 9.8 ± 3.8[C]) and sex(male 51.5%[R] vs 50%[C]) were not different between the two groups. The proportion of African American patients was higher in recent cases(43.1%[R]vs 34.7%[C], P<0.05). Although cataplexy was higher in the conventional cases(65.5%[R] vs 77.1%[C], P<0.05), atypical cataplexy-(17.9%[R] vs 16.0%[C], P<0.05) and persistent frequent cataplexy after treatment(10.9%[R] vs 4.6%[C], P<0.05) were higher in the recent cases. Excessive weight gain(47.9%[R] vs 41.7%[C], P<0.05), sleep onset insomnia(84.1%[R] vs 80%[C], P<0.05), restless sleep(85.6%[R] vs 78.9%[C], P<0.05), and sleep walking(77.4%[R] vs 72.9%[C], P<0.05) were also higher in the recent cases. The presence of HLA-DQB1*0602 was not different between the two groups. The history of recent streptococcal infection(12.6%[R] vs 9.4% [C], P<0.05) and influenza infection(5.9%[R] vs 2.9%[C], P<0.05) were higher in the recent cases.

Conclusion: Conventional and recent cases of narcolepsy showed differences, with recent cases having a higher proportion of African Americans, higher rates of recent streptococcal and influenza infections, and more severe manifestation with higher rates of atypical cataplexy and persistent frequent cataplexy after treatment.

Support (If Any): IIR JazzPharmaceuticals and SRN

0948

IMPAIRED SLEEP-DEPENDENT CONSOLIDATION IN CHILDREN WITH NARCOLEPSY TYPE 1

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Introduction: Sleep plays a key role in memory consolidation, but its influence on learning has scarcely been studied in children affected by sleep disorders. The objective of this work was to evaluate the impact of narcolepsy (NC) on sleep-dependent memory consolidation processes.

Methods: We submitted 14 patients with NC (M_{age}=10.2 ± 0.4 SE, 7 males, total IQ = 125.5 ± 3.7) as well as a control group (CONT, M_{age}=9.8 ± 0.4, 7 males, total IQ =112.1 ± 2.5) matched for age, sex to three memory consolidation tests in the evening (learning session), before a night polysomnographic recording and in the morning (restitution session). These memory consolidation tests included declarative (visuo-spatial and emotional tasks) and procedural (mirror tracing task) learnings. Attention performances were measured before learning and restitution phases. The children also filled a questionnaire on excessive daytime sleepiness (EDS), hyperactivity, insomnia and depressive feelings. Parametric analyses t-student tests and Pearson analyses were done with Statistica® program.

Results: NC patients had significantly higher EDS, hyperactivity and insomnia scores than CONT. Compared to controls, NC patients slept less, with lower efficacy, less N2, more REM and N1. Concerning the learning session, there was no difference in the attentional performances and the three memory tasks between NC and CONT indicating that NC children had no learning difficulties in the evening. However, in the restitution session, NC had significantly impairment in visuo-spatial consolidation process compared to CONT, but not in emotional and procedural memory tasks. In the two groups analyzed together, a positive correlation was found between visuo-spatial memory consolidation and N3 when considering the 2 first sleep cycles. Even, a positive correlation was found between TST, REM sleep and procedural consolidation for the 2 last sleep cycles.
Conclusion: These results suggest that visuo-spatial sleep-dependent consolidation is altered in NC children. Consequently, learning consolidation processes should be integrated in neuropsychological assessments of these children. Moreover, pedagogic and re-educational supervisions of these children should be reconsidered.
Support (If Any): ARC2 (Regional Rhône-Alpes community for academic research) 2013–2016 Agence Nationale de la Recherche (French Research National Agency) 2015

0949

RETROSPECTIVE MULTIPLE SLEEP LATENCY TEST DATA REVIEW OF SLEEP PATTERNS COMPARING DIFFERENT AGE GROUPS IN CHILDREN DIAGNOSED WITH NARCOLEPSY

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Introduction: Little is known about diagnosing narcolepsy in children. Few studies have looked into the sleep architecture for this population. The current study aims to investigate sleep patterns in individuals who have undergone a Multiple Sleep Latency Test (MSLT) in order to identify common sleep patterns and trends in children diagnosed with narcolepsy.
Methods: The current study is a retrospective chart review. Children between the age 6 to 21 years of age who have a confirmed diagnosis of narcolepsy as determined by clinical symptoms and a MSLT between 2005 to 2016. Data collected were analyzed with the statistical software SPSS. Different age groups and MSLT values were analyzed using descriptive and nonparametric statistics.
Results: In total, there were 66 patient records that were included for data analysis. Out of those, 31(47%) were male. Age was broken up into 3 groups (6–10 years; 11–15 years; and 16–21 years). Average age of participants was 12.9 years. When analyzing MSLT variables, it was found that narcolepsy patients in the older age group (16–21 years of age) were found to have longer sleep onset latency (SOL) time on all 5 of the naps provided when compared to the 6–10 year old group and 11–15 year old group. Mean SOL for the 16–21 age group was 5.02 minutes while it was 2.78 and 2.54 minutes for the 6–10 age group and 11–15 age group respectively. There were no differences in sleep onset REM between age groups.
Conclusion: This study found that while each individual enrolled in the study met the diagnostic criteria for narcolepsy, there seems to be individual differences when comparing age groups. Future studies should analyze potential factors that could contribute to these differences of sleep architecture between age groups.
Support (If Any): N/A

0950

NARCOLEPSY WITH AND WITHOUT NSOREMP IN PEDIATRIC PATIENTS

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Introduction: To study the significance of nocturnal sleep onset rapid eye movement period (nSOREMP) in pediatric patients with narcolepsy.
Methods: Retrospective chart review of sleep clinic notes, polysomnography (PSG), and multiple sleep latency test (MLST) reports in 3 to 18-year-old patients who were diagnosed with narcolepsy at the Children's Mercy Hospital Comprehensive Sleep Program.
Results: We analyzed the records of 48 children and adolescents who were diagnosed with narcolepsy from October 2007 to October 2014. Twenty five patients (52%) had nSOREMP. Patients with nSORMP had significantly longer stage 1, and shorter stage 3 sleep on the nocturnal PSG. Patients with nSOREMP also had shorter mean sleep latency, and shorter mean rapid eye movement (REM) latency on MSLT test. We did not find a significant difference in stage 2 and REM sleep percentage, arousal index, periodic limb movement index, apnea hypopnea index, and obstructive apnea index on the nocturnal PSG between patients with or without nSOREMP. Fifty nine percent of patients with narcolepsy and cataplexy (Narcolepsy Type 1) had nSOREMP. This percentage was slightly lower (57.1%) in the younger group of patients (less than 10 years) with narcolepsy and cataplexy.
Conclusion: In children, the presence of nocturnal sleep onset rapid eye movement sleep period is associated with shorter mean sleep latency on the MSLT test, and shorter mean REM latency and higher percentage of stage 1 and lower percentage of stage 3 on nocturnal PSG.
Support (If Any): None.

0951

NAP-RELATED VARIATION IN SLEEP PROPENSITY AND REM TENDENCY ON THE MSLT: IMPLICATIONS FOR PEDIATRICS

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Introduction: It is often assumed that patients are increasingly unlikely to fall asleep (and have REM) toward the latter naps of a clinical MSLT. However very little data is available on this subject, especially as it relates to pediatrics. This study aims to explore age*nap-related changes in the likelihood of sleep and REM over the course of 5 consecutive naps in a large sample of clinical MSLTs.
Methods: Data were extracted from SleepMed's repository of deidentified PSG and 5 nap MSLTs. Sleep onset was defined as initial sleep latency (ISL) and studies were executed as per AASM guidelines. Studies were excluded if <360 minutes of sleep time was recorded on the previous night's PSG or if the patient worked shift/nights. Nap-related variability in sleep/REM was assessed with McNemar tests and mixed model ANOVA.
Results: The final sample was 1767 patients with a mean age of 34 years (range 4–89 years; 70% Caucasian; 63% female). The likelihood of sleep (y/n) was highest for nap1 and nap2 (93% and 91%; p=.50) and decreased thereafter (nap3=88%, nap4=85%, and nap5=75%; all p's<.001). Likewise, sleep latency increased over the course of the MSLT (from 7 to 10 min; p<.001). REM tendency (y/n) was highest for nap2 (22%) and lowest for nap4 (14%). Children <12 years (n=159) were generally less likely to fall asleep and had longer MSLs than those

older (MSL=11.6 vs. 7.5 min; p<.001) and were particularly unlikely to fall asleep as the MSLT progressed (from 82% at nap1 to 54% at nap5). Similar to those older, children had the lowest rate of REM on the 4th nap (15%) but the highest rate on the 1st nap (30%).
Conclusion: These data confirm the hypothesis that sleep becomes more unlikely as the MSLT progresses, at least partially attributable to increasing circadian drive for alertness in combination with dissipated sleep pressure. The finding that REM tendency is non-linearly distributed highlights the importance of a 5-nap MSLT when only 1 REM period is observed in the first 4 naps. Lastly, these data highlight the need for age-appropriated MSLT practice parameters.
Support (If Any):

0952

PREVALENCE OF PSYCHIATRIC DISORDERS IN PEDIATRIC PATIENTS WITH NARCOLEPSY AT THE TIME OF INITIAL DIAGNOSIS

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Introduction: Increased rates of psychiatric symptoms have been reported in adults with narcolepsy. Daytime sleepiness in young patients frequently presents with a spectrum of internalizing and externalizing symptoms that have significant impact on the trajectory of psychosocial, emotional, and academic development. The goal of this study was to further explore complex relationship between psychiatric symptoms and excessive daytime sleepiness in early-onset narcolepsy.
Methods: A retrospective chart review was performed at a pediatric sleep disorders clinic affiliated with several large healthcare systems and a major academic medical center. Pediatric patients under the age of 18 years who met ICSD-3 criteria for Narcolepsy, type 1 and type 2 were selected. Only de novo diagnosed patients were included into data analysis. Clinical, electrophysiological, and demographical characteristics of patients were examined.
Results: There were 74 patients selected that met diagnostic criteria for Narcolepsy, type 1 and type 2. Mean age at the time of initial diagnosis was 14.2±3.2 y (48.6% males), MSLT MSL was 4.8±3.1 min, Mean SOREMs was 2.8±1. A total of 44 patients (59.5%) had one or more established psychiatric diagnosis by the mental health professional at the time of initial sleep evaluation. The most prevalent diagnosis was depressive disorder -29.4%, followed by ADHD -27%, anxiety disorder -19%, and bipolar disorder -13.5%. Headaches and seizure disorders were documented in 12% and 10.8% of children, respectively. Other less frequent conditions included OCD and Autism Spectrum Disorder. One patient had Prader-Willi Syndrome with neurodevelopmental delay. Fifty percent (n=37) of pediatric patients with narcolepsy were prescribed psychopharmacological treatments that included antidepressants -36.4%, psychostimulants- 14.4%, anticonvulsants -13.5%, antipsychotics -12%, Lithium -5.4%, and benzodiazepines -2.7%.
Conclusion: This study demonstrated that early-onset narcolepsy is associated with a high rate of psychiatric morbidities that includes mood disorders, symptoms of anxiety, ADHD, and neurodevelopmental impairments. Many children are being prescribed medications for their psychiatric conditions prior to being diagnosed with narcolepsy. The relationship between narcolepsy and psychiatric development in children and adolescents in poorly understood and warrants future investigation.
Support (If Any):

0953

PREVALENCE OF METABOLIC SYNDROME AND LIVER STEATOSIS IN CHILDREN WITH IDIOPATHIC NARCOLEPSY

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Introduction: To evaluate the prevalence of metabolic syndrome in children with idiopathic narcolepsy.
Methods: Data from 40 children (21 boys) diagnosed with idiopathic narcolepsy between 2010 and 2016 in the National Reference Center for Narcolepsy of Lyon were collected. Metabolic syndrome was defined as the presence of two pathological criteria among the following ones: waist circumference >90th percentile, systolic and or diastolic pressure > 95th percentile, HDL cholesterol <1.03 mmol/L, triglyceride >90th percentile and fasting glycemia > 6.1 mmol/L. To be more pertinent, we also evaluated the prevalence of metabolic syndrome adding the HOMA-IR criteria (>95th percentile). Seventeen of these children underwent an abdominal echography to evaluate liver integrity.
Results: Narcoleptic patients were 12.1±3 years old (5–17 yo.), 85% had cataplexy and 100% HLA DQB1 0602. Sixty percent of them were obese with a mean BMI z-score of +3±2 (-0.08–9.08). A total of 18% of our patients had a metabolic syndrome and 40% of them had at least one metabolic abnormality in addition to waist circumference. Patients with metabolic anomalies showed a greater daytime sleepiness score (Epworth) and a shorter sleep latency during MSLT compared to patients without any metabolic abnormalities. Moreover, Epworth score was positively correlated to waist circumference (r_p: 0.32, p<0.05). Finally, 41% of our patients showed liver steatosis.
Conclusion: The prevalence of metabolic syndrome and liver steatosis was very high in children with idiopathic narcolepsy. A careful metabolic investigation and follow-up of these patients is recommended.
Support (If Any):

0954

LONG-TERM USE OF MODAFINIL AND ARMODAFINIL IN PEDIATRIC PATIENTS WITH NARCOLEPSY.

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Introduction: While modafinil and armodafinil are recommended as first line treatments for excessive daytime sleepiness (EDS) associated with narcolepsy in adults, these medications have not been approved by the FDA for pediatric use. Published studies on the use of modafinil/armodafinil in children and adolescents with narcolepsy are limited. We aimed to investigate long term effectiveness and tolerability of modafinil and armodafinil in pediatric patients with narcolepsy treated at a specialized sleep disorders clinic.
Methods: A retrospective chart review of the past 10 years identified 74 patients (14.2±3.2 y, 36 males) that met ICSD-3 diagnostic criteria

for narcolepsy. Demographical, clinical, electophysiological characteristics, and medication history were included into data analysis.
Results: Modafinil was initially prescribed to 32 patients at a starting dose range of 50-100mg once daily. The majority of patients - 90 % remained on modafinil with a gradual dose increase to a maximum of 400-600mg /day over the course of clinical follow-ups. Average maintenance dose of modafinil was 340mg±162. 31 patients were initiated on armodafinil at a starting dose range of 50-75mg/ day. The maximum dose used was 250-400mg/day with an average maintenance dose of 225mg±66.9. 25 patients sustained clinical response to armodafinil without reported side effects, 6 were switched to modafinil. Almost half of the patients received concomitant treatment for psychiatric disorder(s) which included medications, such as sertraline, citalopram, escitalopram, fluoxetine, venlafaxine, bupropion, aripiprazole, quetiapine, lamotrogine, and lithium carbonate. Six patients required addition of a psychostimulant, methylphenidate or amphetamine/ dextroamphethamine, to achieve optimal control of EDS. Reported side effects included: loss of appetite (n=1), headache and nausea (n=1), anxiety/agitation (n=1).
Conclusion: This chart review demonstrated that modafinil and armodafinil were effective and well tolerated by pediatric patients with narcolepsy over a long period of clinical follow ups (up to 10 years). Concomitant administration of other psychopharmacological agents did not result in any significant side effects. Use of modafinil and armodafinil significantly improved patient's ability to stay awake and did not exacerbate preexisting psychiatric conditions. Prospective, controlled studies of modafinil and armodafinil for the treatment of EDS associated with early-onset narcolepsy are needed.
Support (If Any):

0955

EXCESSIVE DAYTIME SLEEPINESS PERSISTS OVER TIME IN PEDIATRIC CRANIOPHARYNGIOMA

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Introduction: Patients with craniopharyngioma are known to have many long-term deficits secondary to tumor location and treatment, including excessive daytime sleepiness (EDS). EDS negatively impacts emotional/social functioning and daily activities. However, the trajectory of EDS and its response to typical intervention (e.g., psychostimulants) has not been widely studied. We aimed to examine change in EDS over time and whether psychostimulants reduced EDS in a sample of pediatric craniopharyngioma survivors.
Methods: As part of a treatment protocol for pediatric craniopharyngioma (RT2CR), participants were evaluated with polysomnography and multiple sleep latency testing (MSLT) prior to proton therapy and 12–18 months later. Use of psychostimulants at Time2 MSLT was obtained from medical records.
Results: 21 youth with craniopharyngioma (Mean age=10.8 + 3.8 at Time1 and 12.3 + 3.7 at Time2); majority male (66.7%) and white (52.4%) were studied. Most experienced EDS as defined by mean sleep onset latency (SOL) ≤ 10 minutes on MSLT at both Time1 (N=15, 71.4%; SOL mean=6.0±5.4 minutes) and Time2 (N=18, 85.7%; SOL mean=4.9±3.9 minutes). Only 5 (23.8%) participants were prescribed psychostimulants at Time2. Though SOL means qualitatively decreased from Time1 to Time2, a paired samples t-test did not reveal clinically significant worsening ($t(20)=1.40$, $p=.18$). Results were similar for the participants prescribed stimulants at Time2 ($t(4)=.55$, $p=.61$). An independent samples t-test was conducted to evaluate change in mean SOL across time between participants prescribed or not prescribed psychostimulants with no significant difference: $t(19)=-.31$, $p=.31$.
Conclusion: The majority of pediatric patients with craniopharyngioma sampled experienced substantial EDS that worsened clinically but not statistically significantly over time. The use of psychostimulants appears to not have had an impact on EDS; however, the number of children prescribed psychostimulants in the sample is very low and unequal group numbers have likely impacted sufficient power to draw firm conclusions. Tailored interventions to improve the severe EDS in these patients are needed.
Support (If Any):

0956

ADOLESCENT SLEEP DISTURBANCE AMONG A COMMUNITY-BASED SCREEN: PREVALENCE AND CO-MORBIDITY RATES FROM THE SENSE STUDY

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Introduction: There is robust evidence of an association between sleep disturbance, anxiety, and depression in adolescence. However, more research is needed among community samples. The SENSE Study (Sleep and Education: learning New Skills Early) is a 5-year, multi-institutional randomized controlled trial investigating whether a 7-week, cognitive-behavioral and mindfulness-based sleep intervention can improve sleep, anxiety, and depression in adolescents. This project reports on the screening data, highlighting the prevalence and co-morbidity of sleep disturbance, anxiety, and depression among a community based sample of adolescents.
Methods: Participants were 1,491adolescents (58% female; Mean Age =14.40, SD=1.13) recruited from 23 secondary schools across Melbourne, Australia. Participants completed the Pittsburgh Sleep Quality Index (PSQI) to assess sleep disturbances (PSQI scores >5), Spence Children's Anxiety Scale (SCAS) to assess high anxiety (SCAS scores >32 males, >38 females), and the Center for Epidemiologic Studies Depression Scale (CES-D) to assess for elevated depressive symptoms (CES-D scores >16).
Results: Screening data supported high co-morbid sleep, depression, and anxiety symptoms among adolescents within the community. Participants reported elevated scores on the PSQI (M= 6.05, SD=3.16), SCAS (M=30.11, 15.77), and CES-D (M=16.24, SD=10.10). Only 36% of the sample did not show any clinical symptoms, whereas 50%, 44%, and 30% students evidenced above threshold cut-off scores for sleep problems, depressive symptoms, and anxiety symptoms, respectively. The majority of adolescents who reported clinical symptoms scored above the cut-off ranges in more than one domain. Just 14% of students reported only sleep issues, 7% reported only depressive symptoms, and 3% reported only anxiety symptoms, whereas 20% of students reported sleep, depressive, and anxiety symptoms combined.
Conclusion: Results provide converging evidence that sleep disturbance is a prevailing community issue, is common among adolescents, and is commonly co-morbid with anxiety and depressive symptoms. These findings have important implications for the design of adolescent sleep treatment; both clinical and community setting interventions need to consider anxiety- and depression-specific modules for the adolescent sleep improvement.

Support (If Any): National Health and Medical Research Council (NHMRC)-funded grant (APP1027076).

0957

SLEEP PATTERNS OF STUDENTS IN A SPORT STUDIES PROGRAM

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Introduction: Teenagers go through modifications characterized by a delay in sleep-wake pattern. This contrasts with fixed schedules imposed by school demands and therefore may influence daytime functioning. However, specialized school programs, such as Sport Studies, may be more demanding because of additional training hours. The purpose of this study was to investigate sleep patterns of high school Sport Studies students and to verify its association with daytime sleepiness.
Methods: Forty-eight Sport Studies students (15–17 years old) and 411 standard High School students (15–17 years old) completed questionnaires on sleep habits, sleep disorders and daytime functioning at the start of the school year (October). T-tests comparing both groups during school nights (SN) and weekend nights (WN) were performed on total sleep time (TST), bedtime and wake-up time. Then, t-tests were performed to compare both groups for the differences in sleep midpoint with SN and WN (Δsleep midpoint), sleep disorders (SD) and daytime sleepiness (DS).
Results: During SN, Sport Studies students have earlier bedtimes [Sport Studies=10:07PM±45min; High School=10:23PM±53min; t(457)=3.9, p<0.01] and wake-up times [Sport Studies=6:26AM±28min; High School=6:49AM±40min; t(457)=2.0, p<0.05], but no difference in TST [Sport Studies=7:52±62min; High School=7:59±58min; t(448)=0.7, p=0.47]. During WN, similar results were obtained with Sport Studies students having earlier bedtimes [Sport Studies =11:29PM±65min; High School=00:18AM±86min; t(440)=3.8, p<0.01] and wake-up times [Sport Studies=8:56AM±91min; High School=9:54AM±103min; t(455)=3.7, p<0.01] and no differences in TST [Sport Studies=9:03±77min; High School=9:16±91min; t(432)=0.9, p=0.36]. Finally, results showed a significant difference in Δsleep midpoint [t(438)=3.2, p=0.001), less SD (t(377)=2.6, p=0.01] for the Sport Studies students, but no difference between groups in DS [t(444)=1.8, p=0.069].
Conclusion: This study suggests that Sport Studies programs are associated with different sleep habits in teenagers who seem to be shifting their sleep-wake patterns towards an earlier time compared to "regular" students. This earlier shifting is not associated with DS. However, this study did not investigate these sleep patterns and their impact over the course of an entire school year. Moreover, further studies should look more closely at different Sport Studies programs, since great variability exists among them, with programs like swimming having training sessions as early as 5:00AM.
Support (If Any): N/A

0958

DIM LIGHT MELATONIN ONSET AND MOOD IN EVENING CHRONOTYPE ADOLESCENTS: EXAMINING THE MODERATING ROLE OF AGE

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Introduction: A shift toward an evening chronotype and the onset of mood difficulties often occurs during adolescence. While these changes are linked to poorer outcomes, few studies have considered how mood and the circadian rhythm are related in adolescence. This study examines if dim light melatonin onset (DLMO), a measure of endogenous circadian phase, is related to mood ratings, and if these relationships change with age.
Methods: This study is based on a subset of 163 adolescents (94 female, age=14.7), with a self-reported evening chronotype, from an NIMH-funded study. Participants provided saliva for melatonin analysis and rated their evening and morning mood. Statistical analyses controlled for age, sex, depression symptoms, and anxiety symptoms.
Results: Higher negative (z = 3.59, p <.01) and lower positive (z = -1.89, p =.06) evening mood were related to a later DLMO. Age moderated the effect for negative (z = 5.23, p <.01) and positive (z = -4.58, p <.01) evening mood, indicating that these relationships were stronger for younger adolescents. Although the main effect of DLMO on morning negative or positive mood was not significant, moderator analyses suggested that a later DLMO was related to lower morning positive mood for younger adolescents (z = -3.89, p <.01).
Conclusion: Negative and positive evening mood were related to a later DLMO. DLMO was only related to morning positive mood for younger adolescents. These findings indicate that worse evening mood may be related to the shift toward an evening chronotype observed in adolescents, particularly for younger adolescents.
Support (If Any): This research was supported by the National Institute of Mental Health grants R01HD071065-01A1 (AGH) and T32MH020006 (MRD).

0959

IS SLEEP/WAKE VARIABILITY ASSOCIATED WITH LATE CIRCADIAN PHASE IN OLDER ADOLESCENTS?

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Introduction: A well-established literature demonstrates a circadian phase delay during adolescence. Despite this delay in circadian timing, adolescents must wake early for school and typically sleep later on weekends resulting in irregular sleep-wake timing. This analysis examined whether sleep-wake timing variability was associated with circadian phase in high-school students during the school year.
Methods: Forty-six adolescents aged 14–17 years (16.2±1.1 years; 29 females) who reported late bedtimes (>23:00 on school nights; >00:00 on non-school nights) and short school-night sleep duration (<7.5 h) completed the study. Participants slept on their usual sleep schedules for 15 days at home before a dim light melatonin onset (DLMO) assessment (light <5lux), in which saliva was sampled every 30 minutes. DLMO was the time when salivary melatonin levels exceeded 4pg/mL. Nocturnal sleep timing and duration were quantified from wrist actigraphy (11–15 nights; 14.5±1.1 nights). Interquartile ranges (IQR) for sleep onset time, midsleep time, wake-up time, and sleep duration were computed and used as measures of sleep variability. Frequency of daytime naps were also examined.
Results: Average (±SD) school-night bedtime, midsleep time, and wake time were 00:23±0:56, 03:28±0:34 and 06:27±0:31, respectively. School-night nocturnal sleep duration averaged 6.1±1.0h. Average non-school night bedtime, midsleep time, and wake time were 01:21±0:58, 05:28±0:54 and 09:37±1:13, respectively. Weekend nocturnal sleep duration averaged 8.3±1.3h. Frequency of naps ranged from 0 to 9 during the 2 weeks. On average, bedtimes were 1.0±0.1h later, wake times were 3.2±0.2h later, and sleep durations were 2.2±0.2h longer on non-school nights compared to school nights. Variability in bedtime, midsleep time, sleep duration, and nap frequency were not associated with DLMO phase. A trend emerged for more variable wake times to be associated with later DLMOs (r=.28, p=.06).
Conclusion: These data suggest that irregular sleep timing does not predict a later circadian phase, nor does a later circadian phase lead

to more variable sleep patterns in this group of older adolescents. The only exception may be irregular wake-up times; sleeping late on weekends may be more likely in adolescents with a later circadian phase or sleeping late on weekends delays the clock.
Support (If Any): R01HL112756 (SJC)

0960

SLEEP AND EMOTION PROCESSING IN PEDIATRIC POST-TRAUMATIC STRESS DISORDER

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Introduction: Sleep disturbance is a core symptom of Pediatric post-traumatic stress disorder (PPTSD). Given the link between sleep and affective processing, disruptions in sleep-dependent processing of emotional material have been suggested to contribute to symptom maintenance. In this study we sought to asses the relationship between sleep and emotion processing in youth with PPTSD relative to healthy control subjects.
Methods: Seven participants with PTSD (aged 14.5±2.9; CAPS-CA score 64.8±17.8) and three age- and sex- matched controls (aged 12.0±0.8) completed two overnight high-density EEG (256-channel) polysomnography sleep studies. Prior to sleep on night 2, participants rated 70 neutral and 70 negative scenes with respect to level of arousal on a scale of 1–9 using the Self-Assessment Manikin rating system (SAM). The following morning, recall was tested with 100 previously viewed images and 100 new images. Participants again rated images on level of arousal.
Results: Sleep: No significant differences were observed between groups for any PSG variable. However, differences in the percent of NREM stage 2 decreased for both groups during sleep on the task night relative to baseline night, with a larger % decrease in the PTSD group (control %2.29±9.04 vs. PTSD %6.34±0.63). Behavior: Recall accuracy (control 78.3±9.8 vs. PTSD 81.6±15.3) did not differ between groups, nor did recall accuracy for emotional images (control 81.3±10.8 vs. PTSD 77.6±14.8). Ratings of arousal did not distinguish groups at encoding. However, ratings of arousal during the recall session for previously viewed negative images was markedly different in each group. As a group, PPTSD children subtly increased arousal ratings of negative remembered-images from evening to morning (mean night, 6.18±2.31, morning 6.34±2.66) while the control group robustly decreased arousal ratings (7.22±2.67, 2.18±1.21).
Conclusion: Given our sample size, firm conclusions are impossible. However, our results suggest that sleep quality may adversely impact the process of emotional evaluation in children with PTSD.
Support (If Any): none

0961

SHORT SLEEP INDUCES EMOTIONAL EATING AND WORSE MOOD IN TEENS

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Introduction: Prior research indicates that short sleep causes negative changes in mood, emotion regulation, and increased caloric intake in adolescents. Eating as a way to cope with changes in mood may contribute to the relationship between short sleep and greater caloric intake, yet the impact of sleep on emotional eating has not yet been examined. The present study aims to determine if short sleep increases emotional eating and explores whether any increase is related to sleep-specific changes in mood.
Methods: Participants were 47 adolescents aged 14–17 who completed an experimental sleep manipulation protocol with a randomized, cross-over design in which teens experienced 5 consecutive nights of short sleep (SS; 6.5 hours in bed) and 5 nights of healthy sleep (HS; 9.5 hours in bed). At the end of each condition, teens completed the Emotional Eating Scale (measuring how often they ate in response to Anxiety/Anger/Frustration, Depressive Symptoms, and Unsettled Feelings), the Profile of Mood States, and a measure of emotion regulation.
Results: Compared to HS, during SS teens reported increased emotional eating in response to depressive symptoms (p=.019) but not anxiety/anger/frustration or unsettled feelings (p>.05). They also reported an overall decline in mood (all subscales p<.05) and worse emotion regulation (p=.009). Finally, changes in sad/depressed mood during sleep restriction were significantly related to increased emotional eating in response to sadness (p=.01).
Conclusion: Short sleep causes teens to experience a decline in mood, putting them at risk for using maladaptive strategies to cope with this change. Teens report eating more in response to feelings of sadness when sleep restricted, and this increase in emotional eating is related to changes in their mood induced by insufficient sleep. Increases in emotional eating may help explain the relationship between poor sleep and obesity risk in teens.
Support (If Any): Financial support from the US National Institutes of Health (R01 HL120879).

0962

CONCOMITANT AND LONGITUDINAL CHILDHOOD SLEEP CHARACTERISTICS ASSOCIATED WITH EXTERNALIZING PROBLEMS DURING ADOLESCENCE

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Introduction: Sleep problems have been linked to externalizing problems during adolescence. There is limited knowledge as to the temporal childhood sleep characteristics and subsequent adolescent externalizing problems. Our aims were 2-fold: 1) to examine whether sleep characteristics are concomitantly associated with externalizing problems at 15 years and 2) to investigate whether childhood sleep characteristics predicted externalizing problems at 15 years.
Methods: Longitudinal data on 1441 children were collected by questionnaires and interviews from 5 months to 15 years (13 waves). At 15 years, sleep characteristics and externalizing problems were completed according to the adolescent's opinion. Childhood sleep characteristics trajectories (nocturnal sleep duration, nocturnal awakening duration and sleep latency) were completed according to the mother's opinion (2.5 months to 10 years). Pearson correlations, t-tests and Anovas were performed (p<.05).
Results: Concomitant associations were found for sleep need (p=0.01), total sleep time during weekdays (p<0.001), daytime drossiness (p<0.001) and trouble waking up (p<0.001) except for total sleep

time during weekend (n.s). We found that children which followed the long sleep latency trajectory presents significant more externalizing problems at 15 years compared to children which followed the short/normal sleep latency trajectory (p=.02).
Conclusion: Concomitant adolescent sleep problems (sleep need, total sleep time during weekdays, daytime drossiness and trouble waking up) are associated with externalizing problems at 15 years whereas childhood long sleep latency predicted the emergence of externalizing problems at 15 years.
Support (If Any): Institute of Statistics of Quebec.

0963

EMOTION REGULATION PREDICTS PERCEIVED SLEEP DIFFICULTY IN HEALTHY ADOLESCENTS

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Introduction: Adolescence is a time of significant social and neurobiological change, resulting in heightened risk for sleep problems and emotion regulation deficits. Poor sleep is associated with difficulties in emotion regulation in adolescents, but few studies have examined how emotional difficulties relate to both perceived and actual sleep patterns in this age group. The current study examined the extent to which emotion regulation predicts subjective and/or objective sleep difficulties in 13–17 year olds.
Methods: Forty healthy adolescents aged 13–17 years (M = 14.88, SD = 1.30) completed self-report measures of sleep and 6 nights of actigraphy. Adolescents completed the Sleep Self-Report Scale and the Difficulties in Emotion Regulation Scale which includes a total score and 6 subscales evaluating difficulties in emotional responses, goal-directed behavior, impulse control, emotion regulation strategies, and emotional clarity. Actigraphy variables included sleep onset latency, sleep duration, wake after sleep onset, and sleep efficiency, averaged across 6 nights.
Results: Participants with greater difficulties in emotion regulation reported increased sleep problems (r = .601, p = .002). Controlling for age and gender, separate multiple regression analyses found difficulties in impulse control (β= 1.51, p = .014), emotion regulation strategies (β = 0.557, p = .011), and emotional clarity (β = .678, p = .003) to be significant predictors of perceived sleep difficulties. Subjective sleep reports were not associated with actigraphy variables except for sleep duration (r = -.425, p = .006). No significant relationships between emotion regulation and objective sleep variables were observed.
Conclusion: Teens with poorer emotion regulation perceive their sleep to be more disrupted, even when objective measures do not corroborate sleep reports. In particular, adolescents who are less able to make sense of their emotions and who have fewer strategies for controlling them may be poor judges of their sleep.
Support (If Any): University of Houston Small Research Grant

0964

EARLY ADOLESCENTS' PERCEIVED HEALTH AS PREDICTOR OF ACTIGRAPHICALLY ESTIMATED AND SELF-REPORTED SLEEP OUTCOMES

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Introduction: Social, biological, and academic changes impact adolescents' sleep quality, hygiene, and duration. Previous studies have shown that family structure, income, child-parent relationships, school achievement, and psychological well-being predict sleep patterns and self-reported health and well-being. This study examined the relationship between adolescents' self-reported health and actigraphically estimated sleep outcomes.
Methods: Seventh graders from two urban, middle schools (N = 152, females = 90) with start times of 8:37am participated. They completed one week of actigraphy and self-report measures: sleep problems, daytime sleepiness, sleep hygiene, sleep-health competence, and perceived health (Child Health Questionnaire, CHQ). CHQ included scales: Family Cohesion, General Health, General Behavior, Emotional Difficulties). Parents completed a background information questionnaire. Associations between adolescents' perceived health and sleep outcomes (e.g., duration, hygiene, sleep problems, sleep-competence) were examined using linear regression analyses.
Results: Seventh grade participants' actigraphically estimated school-night sleep duration ranged from 385 to 614 min (M = 513, SD = 43) and weekend ranged from 335 to 830 min (M = 532, SD = 70). Perceptions of health were not predictive of school-night sleep; however, adolescents' general health status predicted weekend sleep patterns (e.g., midsleep, duration, onset/offset) with poorer family cohesion and general health tied to more delayed sleep patterns (p's < .05). Adolescents' self-reported behavior difficulties and perceived limitations due to emotional difficulties predicted increased sleep-wake behavior problems, poor sleep hygiene, and lower sleep-health competence (p's < .01). Additionally, being under the care of a physician was associated with decreased daytime sleepiness and fewer sleep-wake behavior problems (p's < .01).
Conclusion: Findings indicate that early adolescents' perceptions of health and physician care are significant predictors of actigraphically estimated weekend sleep, self-reported sleep problems, sleep hygiene, and sleep-health competence. This suggests the importance of better understanding the role of adolescents' perceived health and well-being as a contributor to sleep health.
Support (If Any): NICHD R01 HD047928

0965

SHORTER SLEEP DURATION, INCONSISTENT BEDTIMES, SNORING, AND TROUBLE FALLING ASLEEP PREDICT INCREASED HIGH-RISK BEHAVIORS AMONG A NATIONAL SAMPLE OF AT-RISK ADOLESCENTS

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Introduction: Sleep plays a critical role in impulse-control and decision-making. Pervasive sleep deprivation among adolescents may contribute to their susceptibility to risky behaviors. This study investigates the association between adolescent sleep and risky behaviors in a diverse national sample.
Methods: The Fragile Families and Child Wellbeing Study followed a national urban birth cohort of at-risk children from birth through 15y. In the 15y wave, participants' reported sleeping habits (sleep duration, bedtime consistency, frequency of snoring, and trouble falling asleep) were separately modeled as predictors of risky behaviors (unprotected sex, smoking, drinking, and other substance use) in logistic or ordinary least squares regressions adjusted for sex, ethnicity, mother's education, household income, and adolescent's depressive symptoms.

Results: Preliminary analyses included 2681 adolescents aged 14.4–17.8y (15.5±0.57y), 49.1% female, and 82.1% non-white. Among adolescents reporting having had sex (n=366, 14%), longer sleep duration (in hours) was associated with lower odds of having never used a condom (OR=0.75, 95% CI: 0.58–0.97). Bedtime consistency (OR=0.86, 95% CI: 0.76–0.96; n=2633) and frequent snoring (OR=1.33, 95% CI: 1.04–1.71; n=2633) were negatively and positively associated, respectively, with having ever smoked cigarettes. Among ever smokers (n=133, 5%), trouble falling asleep was associated with earlier age of first cigarette use (β=-0.14, p=0.049). Longer sleep duration was associated with lower odds of having ever used alcohol (OR=0.91, 95% CI: 0.84–0.98; n=2680). Sleep duration (OR=0.77, 95% CI: 0.61–0.96; n=2632) and trouble falling asleep (OR=1.24, 95% CI: 1.08–1.43; n=2632) were negatively and positively associated, respectively, with ever using illicit substances other than marijuana.
Conclusion: While these findings cannot determine causality, they demonstrate positive associations between shorter sleep duration and other sleep disorder symptoms with a range of risky behaviors, adjusting for sociodemographic factors. Interventions aimed at improving adolescents' sleep may help reduce incidence of unsafe sex practices, smoking, drinking, or other substance use.
Support (If Any): R01HD073352 (L. Hale, PI)

0966

AN EXPLORATORY EXAMINATION OF PARENTS' AND TEACHERS' PERSPECTIVES ON STUDENT, PERSONAL, AND FAMILY OUTCOMES ASSOCIATED WITH A DELAYED SCHOOL START TIME

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Introduction: A shift in adolescents' circadian rhythm prompts later bedtimes and awakenings. An early school start time promotes chronic sleep deprivation, which has been associated with worse school performance. We assessed parents' and teachers' perspectives about a two-hour delayed high-school start time before and after the delay.
Methods: Parents and teachers reported expectations and perceptions of delayed start time before and after the 7:30 to 9:30am change (Quantitative data - spring of delayed start year [21 teachers, 18 parents]; Qualitative data - summer before delayed start year [22 teachers, 52 parents] and spring of delayed start year).
Results: Quantitative: (Comparing early to delayed start; collected spring of delayed start year): Teachers reported significantly more sleep on school nights in delayed year and reported that fewer students appeared sleepy during first class. Parents reported students in the delayed start year spent less time in extra-curricular activities, trended towards spending more time on homework, did not sleep more on school nights but paradoxically did sleep longer on weekends.
Qualitative: Prior to delay, teachers reported expectations for more time for sleep, morning commutes, planning, and exercise, as well as negative changes for their own family (e.g., unsupervised children after-school). They expected that less time would be spent on afternoon grading and personal errands. After experiencing the delayed schedule, teachers reported more morning exercise time and sleep, although they disliked leaving work later, delaying family routines, and students missing later classes to participate in sports. Prior to delay, parents expected children would have a more positive attitude about school on the delayed schedule, but also reported concerns about later schedules and sports/class conflicts. After delayed schedule, parents reported more sleep and calmer mornings, although anticipated concerns were confirmed (e.g., sport/homework delays resulted in later nights and morning tiredness).
Conclusion: The delayed start time, while associated with several perceived benefits for various stakeholders, also had downstream challenges with work, family life, and extracurricular activities. Successful change to delayed start time may require systemic changes and future research could consider a holistic view of outcomes.
Support (If Any):

0967

BARRIERS TO HEALTHY SLEEP AND THE ACCEPTABILITY OF A SMARTPHONE APP FOR IMPROVING SLEEP IN AT-RISK ADOLESCENTS

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Introduction: Deficient sleep is highly prevalent in adolescents and contributes to a range of adverse health and behavioral outcomes. Smartphone apps provide inexpensive and readily accessible platforms for engaging adolescents in sleep health promoting interventions, particularly with populations at increased risk of short sleep such as ethnic/racial minority teens. Designing effective apps, however, requires better understanding of the reasons for poor sleep among adolescents as well as their readiness to use sleep health apps.
Methods: We conducted three focus groups (N=27 total, age 14 to 18 years) in adolescents living in low- and middle-income racially/ethnically diverse Boston (MA) neighborhoods. We also interviewed 10 participants who provided specific feedback on two commercially available sleep promoting smartphone apps, one of which each participant had used for 2 weeks preceding the interviews. Focus group discussions and interviews were audio-recorded, transcribed and thematically analyzed.
Results: Reasons for deficient sleep that were common across all groups were: academic demands; disrupted circadian rhythms; environmental, emotional and cognitive factors; and use of stimulants and electronic devices. Reluctance to follow scheduled sleep routines on weekends and feelings of dependency on personal electronic devices emerged as important barriers to the adoption of sleep hygiene recommendations for a majority of the participants. While participants expressed potential interest in an app-based sleep intervention, they were doubtful about successfully adopting sleep hygiene practices, especially on weekends. The overall feedback on two commercial sleep apps was positive, with a good adherence and engagement rate (80% reported usage of 5 days and more per week), and perceived health benefits (70%).
Conclusion: This qualitative research highlights the challenges in addressing aspects of sleep hygiene such as consistency of sleep schedule and use of electronics. The positive responses to use of apps suggest that with appropriate content and design they may be leveraged to promote healthy sleep in adolescents.
Support (If Any): This study was funded by an American Sleep Medicine Foundation Focused Project Award. MQ was supported by a scholarship from the Tuebinger Program for the Advancement of Women in Science.

0968

SEDENTARY ACTIVITY, NOT MODERATE-TO-VIGOROUS ACTIVITY, FILLS THE EXTRA TIME AWAKE WHEN ADOLESCENTS RESTRICT THEIR SLEEP

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Introduction: Most teens obtain less sleep than recommended, with potential negative cognitive and physical consequences. Short sleep leads to increased daytime fatigue, which might be expected to translate to less time spent in physical activity. However, prior research has yet to examine the causal impact of short sleep versus healthy sleep on the activity and sedentary behavior of teens.

Methods: Thirty-nine teens aged 14–18 completed a 3-week home-based experimental sleep manipulation protocol that began with a sleep stabilization week, followed in a randomized, cross-over fashion by 5-night periods of short sleep (SS; 6.5 hours in bed) versus healthy sleep (HS; 9.5 hours in bed). Sleep was verified via wrist-mounted actigraphy. Physical activity during waking hours was measured via a waist-mounted accelerometer to derive average daily time spent in sedentary, light, and moderate-to-vigorous (MVPA) physical activity based on age-based cut points.

Results: During the SS condition, teens slept 6.23 hours and during HS slept 8.61 hours (2.4 hour difference; $p<.001$). Teens in the SS condition averaged significantly more time in daily sedentary activity compared to HS (12.3 hours vs. 10.4 hours, $p<.001$). There was also a slight increase in light activity for teens in the SS condition (1.7 hours vs. 1.5 hours, $p=.005$) with no appreciable difference in MVPA (2.3 hours vs. 2.2 hours, $p=.32$).

Conclusion: When experiencing SS (and therefore more time awake), teens did not significantly increase their MVPA. Instead, teens spent greater time in sedentary and light activity which is unlikely to result in significant benefits to health. These results add to the growing literature that SS is not only directly related to a host of negative consequences, but also does not confer any health benefits associated with more time spent awake.

Support (If Any): Financial support from the US National Institutes of Health (R01 HL120879).

0969

INDUCING MORE SLEEP ON SCHOOL NIGHTS REDUCES SEDENTARY BEHAVIOR WITHOUT AFFECTING MORE VIGOROUS PHYSICAL ACTIVITY IN SHORT- SLEEPING ADOLESCENTS

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Introduction: Nearly half of adolescents sleep less than 7 hours on school nights. Short sleep has been associated with obesity and we previously found that shortening sleep during summer months causes teens to eat more calories. However, there is concern that extending sleep may cut into physical activity time. Correlational findings are mixed on the relationship between sleep and physical activity during the school year, when short sleep is very common on school nights. Here we report results of a pilot study examining the impact of experimental *sleep extension* on the waking sedentary, light, and moderate/vigorous activity of habitually short-sleeping teens.

Methods: Eighteen 14-17-year-olds who regularly slept 5–7 hours on school nights were enrolled in a 5-week protocol during the school year. Week 1 was a baseline to confirm habitual sleep. Participants then completed a pair of 2-week (weekday only) sleep conditions in a randomly counterbalanced order: Prescribed Habitual Sleep (HAB; school-night schedule matching baseline) and Sleep Extension (EXT; 1.5 hours longer in bed on school nights). Teens self-selected their weekend bedtimes. Teens wore wrist actigraphy to assess sleep fidelity and waist-mounted accelerometers to determine amounts of sedentary, light, moderate/vigorous activity during each condition.

Results: School night sleep averaged 6.16 hours during HAB and 7.34 hours during EXT ($p<.001$). Compared to HAB, during EXT teens averaged a 55 minute reduction in daily waking sedentary activity ($p=.001$) with a slight increase in light activity (7 minutes; $p=.048$) but no difference in moderate/vigorous activity ($p=.53$).

Conclusion: Previous research indicates sedentary behavior is associated with obesity risk in teens. This pilot study indicates that, when short-sleeping teens sleep longer, they engage in less sedentary activity without seeming detriment in their moderate/vigorous activity. Further, other research suggests that risk for other negative consequences resulting from short sleep (i.e., higher caloric intake) may be attenuated.

Support (If Any): Cincinnati Children's Research Foundation

0970

SLEEP TIME IS NOT INCREASED IN ORTHODOX JEWISH CHILDREN DESPITE LACK OF SCREEN-TIME

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Introduction: The Orthodox Jewish community in the United States is a distinct cultural group and anecdotally has strong behavior norms, often eschewing mainstream social norms like public schools and electronic device use. Orthodox Jews have one of the highest reproductive rates in the country and make up at least 30% of the US Jewish population under 18 years old. Research findings associate decreased sleep time among children with the ubiquitous presence of electronic devices.

Methods: Through an anonymous paper and online survey of parents, our team compared 63 Orthodox Jewish parents' responses to 23 non-Orthodox parents' about their oldest child's sleep duration/habits and electronic screen time. Respondents used the validated parental portion of the Children's Reported Sleep Patterns (CRSP) questionnaire. Separate questions related to amount of screen time/locations of screens were evaluated in conjunction with the CRSP.

Results: Both groups of parents reported similar sleep durations for children under 8 years. They reported 10 hours of sleep per night with the Orthodox Jewish group having significantly less screen exposure ($p<0.05$). Orthodox parents reported their child having more irregular weekend bedtimes than non-Orthodox parents. Orthodox parents also reported more frequent sleep in alternate sites (other than the child's own bed) than non-Orthodox parents. Both groups showed increased screen time in children with of electronic devices in the bedroom compared to those without electronics in the bedroom ($p<0.05$). The amount of reported sleep in both groups fell within the recommended 9–12 hours for elementary school children and below the 11–13 hours recommended for preschoolers.

Conclusion: Relative decrease in screen time among Orthodox Jewish children did not increase sleep duration. This gives important information on behavioral habits of this rapidly growing population and also suggests an appropriate population in which to study effects of behavioral interventions on sleep without interference from electronic devices.

Support (If Any): Mailing of survey provided by Children's Hospital of the King's Daughters Chairmen's Fund.

0971

SLEEP PATTERN AND USE OF ELECTRONIC DEVICES IN SOUTH-WESTERN NIGERIAN SCHOOL ATTENDING ADOLESCENTS

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Introduction: Sleep problems have been reported to be very common in children and adolescents with many having insufficient sleep. The use of electronic devices and sleep pattern in adolescents has not been well studied in many developing countries. Thus, this study sought to determine the sleep pattern in Nigerian adolescents and their use of electronic devices.
Methods: A descriptive cross-sectional study in which 301 adolescents were studied from nine high schools in Ile-Ife, South-Western Nigeria using multistage sampling technique and a structured questionnaire modified from the adolescent sleep habit survey.
Results: A total 301 adolescents were studied and majority are females (51.8%) with mean age of 14 years and a male-to-female ratio of 1:1.1. The subjective sleep need for majority of the students is 10 hours of sleep and the total sleep duration is 8 hours and 47 minutes, 7 hours and 50 minutes for weekends and weekdays respectively. The respondents have a total of 1 hour, 13 minutes and 2 hours, 10 minutes sleep deficit on weekends and weekdays respectively. However, the total time in bed on weekends and weekdays is 9 hours and 8 hours respectively with sleep onset latency in addition to time awake after sleep onset being 13 minutes and 10 minutes respectively. Less than half of the respondents (46.2%) use or have access to a computer, of which majority are males (23.6%) and the computer are mostly owned by their parents (16.9%). Majority of the students have no access to TV games (56.5%), pc games (65.1%), MP3 (55.8%) while most of the respondents watches TV several times during the day (68.8%) and use cell phone (66.8%).
Conclusion: Insufficient sleep (sleep deficit > 2 hours) occur in most of the adolescents on weekdays. Use of cell phone and watching TV are common in the high school adolescents. There is need to educate them on need for adequate sleep and dangers of prolonged use of electronic devices.
Support (If Any): No support

0972

SLEEP DISTURBANCES IN ADOLESCENTS INVOLVED IN BULLYING

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Introduction: Many adolescents experience difficulties with sleep such as late bedtimes, waking at night, and sleep disruptions. A limited body of evidence suggests that sleep disturbances in adolescents are related to their involvement in aggressive behaviors such as bullying. However, previous studies have been limited by small sample sizes, limited questions about different types of sleep disturbances, and the lack of differentiation between types of bullying. The purpose of this study was to examine differences in sleep disturbances for adolescents who self-identified in the past month as bullies, victims, both bully and victim, or neither bully nor victim.
Methods: The Children's Report of Sleep Patterns (CRSP) was administered to a sample of 820 high school students (56.2% female, 87.5% White, mean age=16, range 14–18) and questions were also asked about their involvement in verbal, physical, social and cyberbullying.
Results: Using ANOVA, differences were found between bully/victim status groups for self-reported symptoms of parasomnias ($F=9.39$, $p<.001$), restless legs syndrome (RLS) ($F=10.62$, $p<.001$), bedtime fears ($F=11.65$, $p<.001$) and insomnia ($F=8.51$, $p<.001$). Post-hoc analyses found that adolescents who both bullied others and were victimized by others reported more symptoms of parasomnias than victims that had not bullied others ($p<.05$), bullies that had not been victimized ($p<.01$), and those not involved in bullying ($p<.001$); higher levels of RLS than victims that had not bullied others ($p<.05$) and those not involved in bullying ($p<.001$); more bedtime fears than bullies that had not been victimized ($p<.001$) and those not involved in bullying ($p<.001$); and higher levels of insomnia than those not involved in bullying ($p<.001$).
Conclusion: The study findings suggest increased sleep disturbances in adolescents who reported both engaging in bullying and being victims of bullying. As there is likely a bidirectional relationship between sleep and aggressive behaviors, additional research is needed to further explore the contribution of participating in or being the victim of aggressive behaviors to sleep disruptions, as well as the impact of sleep disruptions on aggression and victimization.
Support (If Any): None

0973

SLEEP PATTERNS, DISTURBANCES, AND HYGIENE OF ADOLESCENT FEMALE VICTIMS OF SEX TRAFFICKING AND SEXUAL ABUSE

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Introduction: The health of survivors of sex trafficking is understudied. Disturbed sleep is often reported among victims of sexual abuse; however, little data are available on the sleep of adolescent victims. The aim of this study was to describe the sleep patterns, disturbances, and hygiene of adolescent female victims of sex trafficking and abuse.
Methods: Nineteen adolescent girls (12–17 years), residing in a direct-care facility designed to rehabilitate and house victims of sexual trafficking and abuse, reported their current sleep health with the Childhood Report of Sleep Patterns (CRSP, adolescent version). The CRSP assesses sleep patterns, sleep quality, and indices of sleep disturbances (insomnia, parasomnias, restless legs, snoring, bedtime fears and worries), sleep hygiene (bedtime activities, caffeine, electronics use), and sleepiness. Cronbach's alpha coefficients for all sleep disturbance indices were acceptable (>.70). Characteristics of the sample and relationships among the CRSP indices were determined. ANOVA models computed differences in CRSP indices by sleep quality (good-to-great vs. okay-to-poor).
Results: Insufficient sleep (n=12, 63.2%), and okay-to-poor sleep quality (n=11, 57.9%) were present among the majority of girls. About one third (n=6, 31.6%) reported waking almost every night, more than half reported sometimes-to-always experiencing nightmares (n=11, 57.9%), and 10.5% reported frequent snoring (n=2). Greater parasomnia symptoms were associated with frequent snoring ($r_s=.49$, $p=.03$) and greater insomnia scores ($r=.47$, $p=.04$). Greater scores on the bedtime fears and worries scale were associated with greater sleepiness ($r=.58$, $p=.01$), parasomnia symptoms ($r=.55$, $p=.02$), nightmare frequency ($r_s=.54$, $p=.02$), and electronics use before bed ($r=.53$, $p=.02$). Poor quality sleepers had greater scores on the insomnia (M=16.55, SD=3.83

vs. M=12.25, SD=3.85, F(1,17)=5.81, p=.03) and parasomnia scales (M=3.36, SD=1.43 vs. M=2.25, SD=0.46, Welch's F(1,12.7)=5.81, p=.03) compared to good quality sleepers, but no other indices.
Conclusion: In this sample of adolescent female victims of sex trafficking and abuse, the majority experienced poor sleep quality characterized by insomnia and parasomnia symptoms, insufficient sleep duration, frequent awakenings, nightmares, daytime sleepiness, and heightened emotional arousal and electronics use at bedtime. Care settings should assess and manage sleep in this population to ensure proper sleep health.
Support (If Any): None

0974

COMMITMENT LANGUAGE DOES NOT PREDICT THERAPY COMPLIANCE IN ADOLESCENTS WITH DELAYED SLEEP-WAKE PHASE DISORDER

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Introduction: Recent evidence indicates that motivation to change sleep patterns in adolescents is low. Our aim was to evaluate components of adolescents' motivation, and subsequent changes in behaviour in those diagnosed with Delayed Sleep-Wake Phase Disorder (DSWPD).
Methods: 31 adolescents diagnosed with DSWPD (age: 15.87±2.3, 32.3%m) underwent 3 individual behavioural therapy sessions involving morning bright light therapy to phase advance sleep patterns. Adolescents wore portable light glasses each morning and were instructed to advance wake-up times by 30-mins daily. Motivation ratings (0=low-10=high) of desire, ability, need and commitment to change sleep patterns were taken at baseline. Sleep diaries were used during therapy, with sequentially earlier wake-up times in 30-min intervals indicating behavioural compliance.
Results: Following therapy, clients' sleep-onset times were significantly advanced, total sleep time increased and sleep latency decreased. Adolescents attended all 3 sessions, with only 2 dropping out. Adolescents indicated strong desire (M=9.1±1.6) and need (M=8.2±1.3), yet moderate ability (M=6.82±1.31) to advance sleep-wake patterns. Verbal commitment to therapy was associated with ability (r=.77, p<.001) and need (r=.40, p=.02), but not desire (r=.28, n.s.). While therapy lasted 10–21 days (M=18.3±3.0), clients complied between 4–17 days (M=11.1±3.5). Compliance percentage ranged 31.6%-83.3% with a mean of 60.7% compliance. Adolescents' desire to change was positively correlated with compliance (r=.34, p=.08), but their ability, need, and their commitment language did not predict compliance (r=.08, n.s).
Conclusion: Our findings do not support commitment language predicting behaviour change in DSWPD. Instead, clinicians should focus on adolescents' ratings of desire to change when undertaking chronobiologic treatments.
Support (If Any):

0975

THE IMPACT OF DELAYING SCHOOL START TIME ON STUDENTS' WELL-BEING IN A SINGAPORE HIGH SCHOOL

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Introduction: The chronic sleep restriction faced by older adolescents worldwide has led to an increasing push to delay school start times in several countries. Many studies have reported benefits associated with later school start times cross-sectionally, but few studies have measured the impact of later start times within subjects. Such interventions and investigations are especially pertinent to Asia, where the prevalence of sleep restriction among adolescents is higher. Here, we report a within-subjects study assessing the impact of a 45-minute delay in school start time on adolescent students in an all-girls high school in Singapore.
Methods: Data were collected from students in grades 7 to 10 at baseline (April 2016, start time at 07:30) and one month after the 45-minute delay in school start time (August 2016, start time at 08:15). Subjective reports of sleep habits and well-being, such as sleep quality, sleepiness, mood, and depressive symptoms, were obtained via questionnaires.
Results: Students reported going to bed slightly later (23:29 vs 23:20) after the delay in school start time. However, because of a 32-minute delay in rise time on school days (06:31 vs 05:59), students had more time in bed overall (7 h 2 mins vs 6 h 40 mins). Increase in time in bed was positively associated with improvements in self-reported measures of well-being such as reduction in depression scores, sleepiness, tiredness after waking, as well as increase in sleep quality and positive mood (all $P < 0.05$).
Conclusion: The delay in school start time was effective in allowing students to wake up later and to spend more time in bed on school days, which was in turn positively associated with improvements in students' well-being.
Support (If Any): This work was supported by the Far East Organization.

0976

INVESTIGATING CAREGIVER PRACTICE, NURSE KNOWLEDGE, AND ADHERENCE WITH AN INFANT SAFE SLEEP POLICY IN THE INPATIENT SETTING: A QUALITY IMPROVEMENT PROJECT

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Introduction: Despite a significant decline in sleep-related infant deaths after the 1990s "Back to Sleep" campaign, sudden unexpected infant death remains the leading cause of death in U.S. infants over 1 month of age. Infant sleep behaviors modeled in the hospital have been shown to influence subsequent home practices. We sought to investigate our institution's adherence with its own infant safe sleep policy, as well as knowledge and practices of our nursing staff and caregivers of hospitalized infants.
Methods: We surveyed 57 caregivers of hospitalized infants admitted to Children's Medical Center Dallas regarding home sleep practices and observations in the hospital. Subsequently, 61 nurses were surveyed regarding their knowledge of the hospital infant safe sleep policy and practices in caring for hospitalized infants.
Results: The survey population was mostly Hispanic (36%) and Caucasian (31%) with an average infant age of 5.5 months. Caregivers most frequently reported that home infant sleep location was in a crib (42%), in the supine position (68%), for either infant comfort or safety. Many infants were co-sleeping with adult(s) (38%) or unsafe items in their sleep environment (84%). Despite 85% of caregivers reporting awareness of sudden infant death syndrome, 54% felt it could not happen to their infant or were unsure. Most caregivers reported that hospital nursing staff provided no education about infant safe sleep. Observation of crib environments of hospitalized infants revealed widespread unsafe practices. Only 40% of nurses reported

prior training about infant sleep safety. Many nurses (40%) admitted placing infants to sleep in prone or side position. Nurses also frequently reported using blankets for tight swaddling (88%), loose blankets (44%), hats (29%), and positioners/pillows (61%). Less than half reported providing routine education to caregivers about infant safe sleep. Most nurses felt that annual online training regarding infant safe sleep would be beneficial.
Conclusion: Our study revealed that both caregivers and nurses reported engaging in high-risk infant sleep practices. Adherence with the infant safe sleep policy at our hospital needs improvement. Hospital policies should be revised to ensure inpatient safe sleep practices and mandatory education for caregivers and hospital staff.
Support (If Any): None

0977

ORTHODOX JEWISH PARENTS LESS APT TO FOLLOW SAFE SLEEP POSITIONING GUIDELINES

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Introduction: The back to sleep/safe sleep campaign has made a significant change in the rate of SIDS across the United States since 1994. Prone positioning has decreased as has SIDS' incidence. Most information for demographic adherence is based on race, age and socioeconomic factors. Orthodox Jews have a birthrate of approximately 4.1 (nationwide birthrate 2.2) and make up at least 30% of the Jewish children under 18 years of age in the United States. No data exist for SIDS rates or appropriate supine sleep rates among Orthodox Jewish families.
Methods: Through an anonymous paper and online survey, our team compared answers of 63 Orthodox Jewish parents to 23 non-Orthodox parents. Our survey used demographic information modeled after the CDC's Pregnancy Risk Assessment Monitoring System (PRAMS) which included marital status, number of children in the home, parental age, tobacco use, and household income. We tabulated their responses related to the sleep position of their most recent child under 4 months old, similar to the PRAMS questionnaire.
Results: The Orthodox parents reported a rate of infants supine sleeping of 64%. This is significantly below the national rate of 81.9% of Caucasian parents ($p<0.001$). The non-Orthodox parent's rate was 93% in comparison. The relationship remained even after correcting for age of parents and number of children in the household. Both groups were overwhelmingly married, insured, educated beyond high school, employed, and had almost non-existent tobacco use.
Conclusion: Practitioners should attempt to address infant supine sleep positioning more strongly in Orthodox Jews particularly given their high birth rate. Further research is needed to determine why the safe sleep message has not been more broadly accepted by this group.
Support (If Any): Mailing of survey provided by Children's Hospital of the King's Daughters Chairmen's Fund.

0978

PREVENTION OF SUDDEN UNEXPECTED INFANT DEATH (SUID) DURING SLEEP AT NURSERY SCHOOLS

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Introduction: Sudden Unexpected Infant Death (SUID) is reported to occur in about one of every 6000–7000 live births in Japan. SUID occurs mainly during sleep in infancy and prevention of SUID at this age group is very important not only at home but also at nursery school. The aim of the study was to identify activities currently conducted at each nursery schools to prevent SIDS during the nap, and also the sleeping environment at nursery schools.
Methods: A questionnaire asking about the activities related to SUID prevention and the sleeping environment was distributed to all the nursery schools in Ehime Prefecture, Japan. One hundred and eighty eight responses were included in the analysis. Percentage of activities currently conducted at each nursery school and sleep environment during the nap were analyzed.
Results: Percentage of activities including health checkup in the morning, monitoring by the childminder during the nap time, asking about the health condition of baby from the parents, taking care of baby sleeping position, measurement of body temperature, checking vital signs of sleeping baby, stimulate the baby while taking a nap, monitoring of sleeping baby with video recording, and putting a sensor on baby taking nap were conducted in 95.2%, 94.1%, 93.2%, 92.0%, 87.3%, 45.5%, 10.1%, 1.6% and 0.5% of nursery schools respectively. Sleep environment during nap time was controlled for temperature, light exposure and humidity in more than 80% of the nursery schools.
Conclusion: Monitoring of the health condition of the baby and close watch on baby including the body position while napping was made in more than 80% of nursery schools to prevent SUID during nap. Sleep environment was sufficiently controlled in most nursery school.
Support (If Any):

0979

INFANT FEEDING AND NOCTURNAL SLEEP

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Introduction: Breast milk has many advantages, but many caregivers believe that due to the easily digestible nature of breast milk, infants feeding with breast milk would have more nocturnal awakenings. As a result, formula is often given in an attempt to consolidate infant sleep. However, few studies have examined infant feeding and sleep using objective instruments. The purpose of this study was to examine the association between infant feeding and nocturnal sleep patterns.
Methods: This study included 78 healthy 6-month-old infants. Mothers provided information about demographic background, infant feeding patterns, and completed the Extended version of the Brief Infant Sleep Questionnaire and Perceived Stress Scale (PSS). Infant sleep was measured by both actigraphy and sleep diary for 7 consecutive days. Infants were categorized into three different feeding types: infants feeding with exclusive breast milk (n=26, 33.3%), with mixed of breast milk and formula (n=18, 23.1%), or with exclusive formula (n=34, 43.6%). Infants were also categorized into two different feeding practice groups: infants who were breastfed (n=29, 37.2%) and those who were exclusively bottle-fed (n=49, 62.8%).
Results: Actigraphy derived sleep parameters, including actual sleep at night, wake after sleep onset, and fragmentation index, did not differ significantly among infants with different feeding types and practices. Infants who were breastfed had significantly more nocturnal awakenings by maternal report than those who were bottle-fed (1.97 ± 1.45 vs. 1.31 ± 1.28, $p=0.04$). Breastfeeding mothers' PPS scores were significantly higher than mothers who bottle-fed their infants (18.93 ± 6.39 vs. 14.8 ± 6.06, $p=0.004$).
Conclusion: Objective actigraphic sleep estimates are not compromised in infants who are breastfed or fed with breast milk. Mothers who are concerned that breastfeeding would disrupt infant sleep should be encouraged to continue breastfeeding and providing breast

milk. More support should also be given to breastfeeding mothers to reduce their breastfeeding-related stress.
Support (If Any): This research was funded by National Health Research Institute (NHRI-EX105-10229PC).

0980

RELATIONS BETWEEN INFANT FEEDING PRACTICES AND SLEEP QUALITY OR DURATION AT AGE 2 IN THE FRENCH EDEN BIRTH COHORT

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Introduction: Short sleep duration and/or poor sleep quality in childhood have been associated with later poorer health outcomes. Breastfeeding has been associated with frequent night-waking and inconsistently with short sleep duration up to 18 months. Besides mothers may introduce complementary feeding before the recommended age when children presented sleep troubles. We aimed to study the relations between feeding practices up to 8 months and child's sleep at age 2 in a French cohort.
Methods: Analyses were based on the children from the EDEN French birth-cohort recruited between 2003 and 2006. Data were collected prospectively through questionnaires and dietary records at 4, 8 and 2 years old. Night-feeding was assessed from dietary records and breastfeeding duration, age at complementary feeding introduction, night-sleep duration and frequent night-waking from questionnaires. Frequent night-waking was defined as waking each other night or more. Multivariate analyses were performed using linear or logistic regressions when appropriate.
Results: A total of 827 children (48% girls) with complete data were included in the analyses. The mothers were at birth 30 years old. Night-feeding was observed for 22.5% and 9.6% of the children aged 4 and 8 months, respectively. The median age of breastfeeding cessation was 2 months and 5 months for complementary feeding introduction. At 2 years old, the children median night-sleep duration was 11hrs and frequent night-waking was observed for 19.3% of them. Multivariate models showed that night-sleep duration at 2 years old was negatively associated with night-feeding at 4 months (p=0.020), but positively associated with age at complementary feeding introduction (p=0.019) whereas frequent night-waking at 2 years old was positively associated with night-feeding at 8 months (p=0.016).
Conclusion: Results showed that some night-feeding practices during infancy were related to lower night-sleep quality while age at complementary feeding introduction was related to longer night-sleep duration in early childhood.
Support (If Any): L Murcia received the 2016 Master grant from Société Francaise de la Recherche et Médecine du Sommeil (SFRMS)

0981

SLEEP AND PSYCHOLOGICAL DISTRESS: A CROSS-CULTURAL ANALYSIS COMPARING AMERICAN AND TAIWANESE MOTHERS OF LOW-BIRTH WEIGHT PRETERM INFANTS

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Introduction: Sleep disturbances and psychological distress are prevalent among mothers with a hospitalized low-birth-weight preterm infant. However, the extant research was primarily done with mothers in Western cultures. Little is known about whether the findings could be replicated with mothers in other cultures. This study was to explore cultural differences in sleep quality and psychological distress and their association betweenTaiwanese and African-American (AA) mothers during early postpartum.
Methods: Thirty Taiwanese and 28 AA mothers were recruited from a teaching hospital in Taiwan and the Southeastern United States, respectively. Mothers completed a battery of questionnairesmeasuring their sleep, depressive symptoms, and stress. Clinical Risk Index for Babies (CRIB) were also obtained.
Results: Taiwanese infants had greater CRIB scores than AA infants, whereas Taiwanese mothers were older, better educated, and more likely to be married. Infant CRIB scores were not associated with maternal sleep, depressive symptoms, or stress in both cultures. Whereas higher education was correlated with greater stress among Taiwanese mothers, advanced age was correlated less stress among AA mothers. Taiwanese mothers reported greater sleep disturbance and depressive symptoms (but not stress) than AA mothers. For mothers in both cultures, greater sleep disturbance was significantly associated with increased stress. After adjustments for age and education, the significant correlation between sleep disturbance and stress related to infant illness/treatments disappeared among AA mothers.
Conclusion: Both cross-cultural differences and similarities were found in sleep and stress. Greater depressive symptoms and sleep disturbance (but not more stress) experienced by Taiwanese mothers than AA mothers could not be attributed to differences in infant medical risk or maternal sociodemographics, which call for further research. Cultural invariance in the associations ofsleep disturbance with depressive symptoms and stress may indicate a shared underlying mechanism linking sleep to psychological distress.
Support (If Any): This project was supported by the Chiang Ching-kuo Foundation for International Scholarly Exchange and a grant to the Center for Contextual Genetics and Prevention Science at University of Georgia from the National Institute on Drug Abuse (P30 DA027827). The content is solely the responsibility of the authors and does not necessarily represent the official views of NIDA.

0982

SHORT SLEEP DURATION AND OBJECTIVE BEHAVIORAL PATTERNS IN VERY YOUNG AFRICAN AMERICAN AND CAUCASIAN URBAN CHILDREN: A CANDLE STUDY DATA ANALYSIS

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Introduction: Racial and socioeconomic disparities are known to negatively affect sleep duration in school-aged children and adults. Little is known about how very young African American (AA) and Caucasian (C) children (1-year-olds) differ in nocturnal and daytime sleep duration and how this may affect daytime behavioral patterns. The purpose of this study was to determine differences in total sleep duration between AA and C 1-year-olds and how nighttime and daytime total sleep hours and number of minutes awake during the night relates to objective behavioral performance measures.
Methods: We analyzed data from the first-year clinic visits (N=1056) (mean SD) (1.08 years 0.12) of predominantly AA (n=663) and C (n=393) children living in Shelby County, TN enrolled in the Conditions Affecting Neurocognitive Development and Learning in Early Childhood (CANDLE) study. T-tests for differences between total nocturnal and daytime sleep hours and number of minutes awake during the night (all reported by parent) between races and bivariate

correlations determined if sleep periods were associated with Brief Infant Toddler Social Emotional Assessment (BITSEA) total and subscale scores for externalizing and internalizing behavior problems.
Results: AA children slept significantly fewer hours than C children during daytime (7am-7pm) (2.6 1.5 v 2.9 1.1, p<0.001) and nighttime (7pm - 7am) hours (9.2 1.4 v 10.4 1.1) respectively. AA were awake more minutes during the night (18.7 40.9) than C (8.9 25.3, p <0.001). Total nighttime sleep hours were significantly correlated with Externalizing (r= -.20, p < 0.001) and Internalizing BITSEA subscales (r= -.20, p < 0.001) as were nighttime wake minutes (r= .14, p<0.001 and r= .11, p<0.001, respectively). Daytime hours of sleep were non-significantly correlated to the BITSEA scores.
Conclusion: Urban 1-year-old AA children sleep significantly less during nighttime and daytime hours than their C counterparts. Fewer total night minutes of sleep corresponded with higher (i.e, more impaired) scores for externalizing and internalizing behaviors while more minutes of wake during the night resulted in similar behavior patterns. More focus must be given to alerting urban communities of the importance of adequate nighttime sleep for their very young children.
Support (If Any): Urban Child Institute

0983

PARENTING STRESS IS BETTER PREDICTED BY PARENTS' SLEEP QUALITY THAN THEIR CHILD'S SLEEP QUALITY, IN A COMMUNITY SAMPLE.

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Introduction: A vast epidemiological study indicated that children's sleep problems are a parenting stress (PS) risk factor. However, that study did not look at the parents' sleep problems as a potential predictor of PS. In fact, PS has only been associated with parental sleep difficulties when the child presents a chronic health condition (e.g., developmental disability). The purpose of this study is to examine if the parent and child's sleep are important predictors of PS in families not reporting salient sleep or health problems with their child.
Methods: PS and sleep habits of the parent and child were assessed using the Parenting Stress Index-Short Form (PSI-SF), The Pittsburgh Sleep Quality Index (PSQI) and the Child Sleep Health Questionnaire (CSHQ). It is well known that PS is associated to low social support (SS) and socioeconomic status (SES). Consequently, these variables were measured and added to the analyses, using Moi Comme Parent (MCP, social support), the mother's employment status, highest grade completed and family income. Measures were administered to 89 mothers of children (1mth-5y), recruited during community activities. Correlations between PSI-SF, PSQI and CSHQ total scores, MCP score and socioeconomic variables were computed. A multiple linear regression model was then produced with the significant correlations.
Results: No relationship was found between PS and the mother's employment status. Significant associations were found between PS and the mother's highest grade completed (r=-0.27; p<0.01), household income (r=-0.25; p<0.01), positivism of the entourage (r=-0.43; p<0.01), child bedtime resistance (r=0.37; p<0.01), parent's sleep onset latency (SOL, r=0.40; p<0.01) and parent's total sleep time (TST, r=-0.35; p<0.01). Hierarchical regression analyses revealed that, accounting for SS and SES, parent's SOL (β=0.25; p<0.05) and parent's TST (β=-0.19; p<0.05) were significant predictors of PS, whereas children's sleep could not explain a significant proportion of the variance left, with an adjusted R^2 of 0.318 for the model (p<0.01).
Conclusion: Our results confirm that, in this non-clinical population, parents' sleep variables were a significant predictor of PS, whereas the child's sleep variables weren't. Future studies and interventions aiming at PS should consider both child's and parents' sleep variables.
Support (If Any): N/A

0984

THE STABILITY OF PARENT-REPORTED SLEEP PROBLEMS FROM 18 TO 36 MONTHS OF AGE

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Introduction: In young children, parent-reported sleep problems are common and in most clinical settings, parent-reports are the only child sleep information collected at well-child exams. Understanding the stability of these reports and how they may vary by child sex and age can inform clinical recommendations and aid in interpreting and subsequently treating these common concerns.
Methods: As a part of a larger longitudinal study on sleep and development, 100 families reported on their child's sleep problems using the Child Behavior Checklist (CBCL). Scores from the CBCL sleep problems subscale were calculated when children were 18, 24, 30, and 36 months of age. Parent-endorsed sleep problems ranged from 0 to 11 with most parents reporting relatively few concerns, M(SD) = *1.60* (2.22), *2.20* (2.74), *2.22* (2.44), and *2.11* (2.05) at each age, respectively.
Results: When considering the entire sample, within-subject sleep problem/behavior stability declined across development, as indexed by intraclass correlations (ICCs) of .71, .65, and .44 from 18 to 36 months of age. However, stability patterns differed by child sex. Male children (n = 63) followed the pattern highlighted above with less stability from 18 to 36 months. However, for female children (n = 37) within-subject sleep problem/behaviors were relatively stable with age (ICCs = .87, .67, .78). When considering average differences, there was a slight increase in parent-reported sleep problem/behaviors from 18 to 24 months, $F(1, 71) = 6.10$, $p < .05$, but average scores from 24 to 30 and 30 to 36 months were stable. Average sleep problem/behaviors did not differ by child sex.
Conclusion: When considering the persistence or stability of early childhood sleep problem/behaviors, child sex should be considered. Within the present sample, parent-reported sleep problem/behaviors were comparable regardless of child sex. However, these problems were more likely to persist in female children. Although few studies address sleep problems repeatedly young children, the present study is consistent with studies in older children that document only a subset of children presented with persistent sleep problems.
Support (If Any): None

0985

SHORTENED MATERNAL SLEEP MEDIATES THE RELATION BETWEEN TODDLER SLEEP PROBLEMS AND MATERNAL PSYCHOPATHOLOGY

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Introduction: Toddler sleep problems have a major impact on mothers' sleep, putting mothers at risk for shortened nighttime sleep and psychological difficulties. The mechanism of how toddler sleep problems affect maternal psychopathology (i.e. depressive/anxiety symptoms) has not been explored in a cohesive model, particularly among low-income populations. Low-income families frequently co-sleep, a

practice that affects both maternal and toddler sleep duration/quality. The purpose of this analysis is to examine relations between toddler/maternal sleep, including co-sleeping practices, and maternal symptoms of psychopathology, in mothers of low-income toddlers; a population at risk for both poor sleep and mental health problems. We hypothesize that shortened maternal sleep duration mediates relations between toddlers sleep problems and maternal anxiety/depressive symptoms.

Methods: This study utilizes baseline data from low-income mothers of toddlers (ages 12–32 months) who participated in a parenting intervention. Mothers provided demographic information and completed questionnaires on their toddler's sleep (Brief Infant Sleep Questionnaire, BISQ), their own sleep (Pittsburgh Sleep Quality Index, PSQI) and their mental health symptoms (State-Trait Anxiety Inventory, STAI; Beck Depression Inventory, BDI). Moderated mediation models were conducted to predict maternal symptoms of anxiety/depression using the SPSS macro PROCESS, controlling for poverty level.

Results: Sample included 282 mothers, 68% African American, 70% living below the poverty threshold, and 61% co-slept with their toddler. The differences in indirect effects by sleep arrangement were tested in separate models for maternal symptoms of depression and anxiety, respectively. The results showed that toddlers sleep arrangement moderated the mediation effects of maternal sleep duration on the relationship between toddler sleep problems and maternal symptoms of depression (diff= 1.10, 95% bootstrapped CI: .21, 2.46) and anxiety (diff.= .44, 95% BCI: .08, 1.07). Further analysis showed significant mediation effects for depression (mediation effect= .87, CI: .22-1.84) and anxiety (mediation effect= .35 CI: .08-.84) for mothers of toddlers who co-slept, but not of those who slept by themselves.

Conclusion: Findings support the hypothesis that among co-sleeping families, the relation between toddler sleep problems and maternal psychopathology is explained by shortened nighttime sleep. Further investigations should examine whether these relationships exist longitudinally between mothers and toddlers.

Support (If Any): none.

0986

PARENT QUALITY OF LIFE: IMPACT OF A CHILD SLEEP INTERVENTION

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Introduction: While efforts to improve child sleep logically target child health and development, they also have the potential to improve parent quality of life.

Methods: In this ongoing RCT, families of 2.5 to 5 year-olds with behavioral sleep problems received a baseline assessment and were randomized to receive either the SHIP (Sleep Health in Preschoolers) intervention or an active control. The active phase of intervention lasted three months, with a nine-month maintenance phase. Data in this analysis comes from baseline parent surveys and follow-up surveys at 3 and 12 months. Surveys included the Family Impact Module (FIM) from the PedsQL, the Child Sleep Wake Scale (CSWS) and Child Sleep Hygiene Scale (CSHS), and the PROMIS Sleep Disturbance Scale - Short Form. Here, we examine the impact of the intervention on parent quality of life (FIM), and whether effects are mediated by changes in child (CSWS) or parent (PROMIS) sleep, using linear regression adjusted for child sex and age in months, as well as baseline levels of outcomes. Results are presented as standardized effect sizes.

Results: This analysis includes 201 subjects who have completed baseline and 3-month follow-up; 82 also became eligible and completed the 12-month survey to date. Compared to controls, intervention parents reported significantly improved physical functioning (ES = 0.29, $p = 0.01$) and ability to complete daily activities (ES = 0.34, $p < 0.01$) at 3 months, and significantly improved family relationships (ES = 0.52, $p = 0.02$) at 12 months. In mediation analyses, improved parent sleep accounted for more than half of improvement in physical functioning and ability to complete daily activities. Improvement in child sleep was a significant mediator of the changes in both ability to complete daily activities and family relationships, especially in subscales for the child's ability to fall asleep and return to sleep after wakings.

Conclusion: Results suggest that intervening on child sleep can significantly improve parent quality of life across multiple domains. Effects may be mediated not only by gains in parent sleep, but also potentially via increased evening "adult" time for daily activities and relationships.

Support (If Any): NICHD #5R01HD071937

0987

SLEEP AND EXECUTIVE FUNCTIONING AMONG YOUNG CHILDREN PRESENTING TO URBAN PRIMARY CARE CLINICS

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Introduction: Early childhood is a period of rapid cognitive and behavioral development. Poor quality sleep and obstructive sleep apnea (OSA) are associated with worse executive functioning (EF) skills during childhood and adolescence. However, few studies have examined these associations among socio-demographically diverse preschool-aged children. Thus, this study examined sleep patterns and problems and their association with EF skills in primarily low-income young children presenting to urban primary care clinics.

Methods: Caregivers (85% mothers) of 40 children ages 2–5 years (mean age = 3.3 years; 57.5% males; 77% African American; 20% non-Latino White; 2.5% Asian) presenting at primary care clinics completed questionnaires on child sleep (Brief Child Sleep Questionnaire; Pediatric Sleep Questionnaire, Sleep-Related Breathing Disorder subscale), child EF (Behavioral Rating Inventory of EF—Preschool Version), and caregiver depressed mood (Center for Epidemiological Studies Depression Scale—Revised). The majority (62.5%) of caregivers reported an average family income of ≤ $30,000.

Results: Separate linear regressions were used to examine sleep patterns (bedtime, sleep onset latency, night awakenings frequency, nighttime sleep duration), OSA symptoms, and caregiver-perceived sleep problems as predictors of the global executive composite (GEC) clinical T-score, controlling for child age, sex, and caregiver depressed mood. Having increased nighttime awakenings ($b = 5.03$, $p = 0.024$), symptoms of OSA ($b = 5.82$, $p < 0.001$), and caregiver-reported sleep problems ($b = 20.01$, $p = 0.003$) were associated with increased GEC deficits. There were no significant effects for bedtime, sleep onset latency, or nighttime sleep duration.

Conclusion: Night awakenings, OSA symptoms, and caregiver-perceived sleep problems were associated with global executive

functioning impairments among preschool-aged children. Although longitudinal studies on this topic that assess likely bidirectional effects are needed, results underscore the relationship between healthy sleep and positive early childhood development.
Support (If Any): NHLBI, T32HL007953-17

0988

SLEEP SCHEDULE CHARACTERISTICS AND OBESITY IN AMERICAN INDIAN CHILDREN

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Introduction: Little is known about sleep in American Indian (AI) children. Sleep schedule characteristics, including bedtime, sleep duration, and schedule variability, have emerged as a potentially modifiable risk factor for obesity in children. The purpose of this investigation was to characterize sleep schedule characteristics among AI children and evaluate the relationship between sleep schedule and overweight/obesity risk.
Methods: Data were examined from the baseline assessment of children enrolling in the Healthy Children, Strong Families (HCSF2) study, which is a randomized lifestyle intervention trial in 5 diverse rural and urban AI communities nationally among children aged 2–5 years. Sleep characteristics were parent-report. Overweight was defined as a BMI percentile 85-94th percentile and obese as BMI percentile >/=95th percentile for age.
Results: The sample consisted of 450 children, 271 (60%) were normal weight, 80 (17%) were overweight, and 98 (21%) were obese. Total sleep duration increased from 10.3 (1.1) hours at age 2 years to 9.8 (0.9) by age 5 years, and children at all ages had significantly less nocturnal sleep compared to previously published normative data. Sleep characteristics, including bedtime, waketime, sleep duration, sleep latency, and variability from week to weekend were no different among normal versus overweight/obese groups. Likewise, weight status was not associated with any sleep schedule characteristic in either univariate or multivariate analyses controlling for child age, gender, ethnicity, tribal site, parent education level, child screen time, and child activity level.
Conclusion: Pre-school age children living in American Indian communities have less nocturnal sleep compared to previously published normative data. However, there were no significant associations between any examined sleep schedule characteristic and obesity risk.
Support (If Any): Supported by the National Heart, Lung, and Blood Instituted, NIH, Grant #R01HL114912

0989

SENSITIVITY AND SPECIFICITY OF THE SLEEP DISORDERS INVENTORY FOR STUDENTS IN PEDIATRIC INSOMNIA

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Introduction: Pediatric Insomnia may co-occur with obstructive sleep apnea (OSA) and/or periodic limb movement disorder (PLMD). Clinical evaluation should screen for primary sleep disorders and may include standardized surveys to identify risk. The Sleep Disorders Inventory for Students (SDIS) is a screening tool for primary sleep disorders in children and adolescents. The sensitivity and specificity of the SDIS in children referred for evaluation and treatment of insomnia in a pediatric sleep center were explored.
Methods: Insomnia evaluation included a clinical interview and parent completion of the SDIS. Children ages 1.7 - 18.3 years (N=223, M= 8.6 ± 4.9 years) were seen for an insomnia evaluation and completed a clinically indicated diagnostic polysomnography (PSG) within 0.7 ± 4.1 months of clinical evaluation to rule out primary sleep disorders. McNemar's tests compared the proportion of patients identified with OSA (OI≥1) and PMLD (PLMI≥ 5) by PSG in relation to SDIS-OSA and SDIS-PLMD subscales (T-scores ≥ 65).
Results: Thirty percent met pediatric PSG criteria for OSA, while 41.7% had high risk SDIS-OSA scores (McNemar's p=0.017). Significant differences were also observed in those having PSG confirmed PLMD (16.1%) versus high risk SDIS-PLMD scores (38.1%; McNemar's p=0.000). The SDIS-OSA subscale demonstrated 26.7% sensitivity, 67.7% specificity, 37.3% positive predictive value (PPV), and 56.4% negative predictive value (NPV). The SDIS-PLMD subscale demonstrated 36.0% sensitivity, 61.5% specificity, 15.3% PPV, and 83.3% NPV.
Conclusion: Consistent with prior findings, this study demonstrated that pediatric insomnia commonly co-occurred with PSG confirmed OSA (30%) and/or PLMD (16.1%). Careful screening is required and objective testing is warranted when there is clinical suspicion of primary sleep disorders in children with insomnia. The poor sensitivity of the SDIS in this sample indicates the need for additional research to develop improved tools for accurate screening for primary sleep disorders in children with insomnia.
Support (If Any):

0990

MOTHER-FATHER AGREEMENT AND ONE-YEAR STABILITY OF CHILDREN'S SLEEP FUNCTIONING

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Introduction: Mothers and fathers have only moderate agreement in their ratings of children's emotional and behavioral functioning, which in turn has implications for clinical assessment. However, we are unaware of any study that has examined mother-father agreement of children's sleep functioning. The present study evaluated the concurrent and prospective agreement of mother and father ratings of sleep in a large, community-based sample of Spanish children.
Methods: Mothers and fathers separately rated sleep functioning in 536 Spanish children (48% girls) in third grade and again one year later. A Total Sleep Disturbance scale was used, in addition to Sleep Habits, Nighttime Waking, Parasomnia, Sleep Onset Delay, Daytime Sleepiness, and Sleep Duration Variability subscales.
Results: Mean sleep functioning scores did not differ between mothers' and fathers' ratings, with the sole exception of higher Daytime Sleepiness scores on mothers' ratings compared to fathers' ratings in Grade 3 (but not at Grade 4). Similar strong correlations were found between mothers' and fathers' ratings of child sleep, both concurrently and over time. Specifically, for Total Sleep Disturbance scale, mothers' and fathers' ratings were correlated at .79 in Grade 3 (concurrent), .80 in Grade 4 (concurrent), and .64 from Grade 3

to 4 (longitudinal). Similar correlations were found for the Sleep Habits, Nighttime Waking, and Parasomnia subscales. Weaker mother-father correlations were found for the Daytime Sleepiness, Sleep Onset Delay, and Sleep Duration Variability subscales. Within-rater associations over the one-year period were also lower for these three subscales.

Conclusion: Mother and father ratings of their child's sleep functioning generally showed strong agreement and 1-year stability. Agreement and discrepancies in parent ratings can provide information regarding the nature and course of socio-emotional and behavioral functioning. Further study is needed to understand how agreement of sleep ratings specifically can inform clinical practice.

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0991

LONGITUDINAL INDIRECT EFFECTS OF MOTHERS' WORK SCHEDULE FLEXIBILITY ON CHILDREN'S SLEEP: THE MEDIATING ROLE OF BEDTIME ADHERENCE

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Introduction: Among adults, rigid work schedules are negatively associated with sleep health. Less is known about whether parents' work schedules influence children's sleep and how. This study examined associations of mothers' work schedule flexibility with children's sleep over time and whether these associations were mediated by children's bedtime adherence.

Methods: Longitudinal, two-wave data were drawn from a sample of working mothers (Fragile Families and Child Well-Being Study) when the focal child was age 5 and 9 (N=1135). At each wave, mothers rated the flexibility of their work schedule (1=not flexible to 4=very flexible), child's habitual sleep duration (in hours) and difficulty getting to sleep (0=no, 1=yes), and weekday frequency (0–5 nights) with which their child adhered to their bedtime. Mediation (bootstrapping) modeling analyses adjusted for child age and gender, and mothers' sociodemographic characteristics, work hours, and work schedules (night/evening/weekend/variable).

Results: Cross-sectionally, greater mothers' work schedule flexibility predicted more frequent bedtime adherence (p<0.001) which, in turn, predicted children having longer sleep duration (p<0.001) and less difficulty getting to sleep (p<0.001). With every increase in bedtime adherence, average sleep duration was 10 minutes/day longer and the odds of having difficulty getting to sleep were 13% lower. Longitudinally, increases in mothers' work schedule flexibility (from child ages 5 to 9) predicted increases in bedtime adherence (p<0.05), which, in turn, predicted increases in child sleep duration at age 9, by 8 minutes/day more than at age 5 (p<0.001). Increases in mothers' work schedule flexibility predicted decreased likelihood of child's difficulty getting to sleep (p<0.01), but this association was not mediated by changes in bedtime adherence.

Conclusion: Bedtime adherence mediates the association of mothers' temporal work flexibility with their children's sleep. Future interventions should consider how to improve bedtime practices in families with working mothers in order to promote child sleep health.

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0992

DOES A BRIEF SLEEP INTERVENTION FOR STUDENTS STARTING ELEMENTARY SCHOOL IMPROVE CHILD AND PARENT OUTCOMES? A RANDOMIZED CONTROLLED TRIAL

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Introduction: Identifying and treating sleep problems in the first year of elementary school using a brief, behavioral intervention has demonstrated efficacy in reducing sleep problems and has positive roll-on benefits for child psycho-social health, behavior and parent mental health up to 12 months. However, whether such benefits present when the same intervention is delivered by school nurses remains unknown. We aimed to determine whether a brief, behavioral sleep intervention improves child psychosocial health (primary outcome), sleep, and behavior, learning and parent mental health in children transitioning to elementary school.

Methods: *Design:* A translational, effectiveness randomized controlled trial nested within a population survey of parents of school entry children in 46 Melbourne primary schools. *Participants:* Children with moderate/severe sleep problems. *Intervention:* 1–2 consultations between parents and a school nurse trained in flexible yet standardized sleep management techniques. Controls received "usual school nurse care". *Outcomes:* (1) Parent-reported child psychosocial health (PedsQL, primary outcome), sleep, behavior (SDQ) and learning (WIAT-II) and parent mental health (DASS-21) at 6 and 12 months post-randomization. *Analyses*: Intention-to-treat analysis using linear and logistic regression, adjusting for confounders; generalized odds ratios for DASS.

Results: Eighty one percent (5323 / 6635) of parents completed the survey. Child sleep problems were common (23% mild, 13% moderate/severe); 334 (60% of those eligible) families entered the trial. Compared to controls at 6 months, intervention families reported fewer child sleep problems (53% vs. 35%, OR=0.49, 95%CI 0.32 to 0.76, p=0.002), less bedtime delay (mean diff=9min, 95% CI 1min to 18min p= 0.03) and longer school night sleep duration (mean diff=10min, 95% CI 1min to 19min, p=0.03) and parents were less likely to report poor mental health, particularly depressive symptoms (OR 0.7, 0.6 to 1.0, p=0.03). However, children had similar psychosocial health, learning and behavior outcomes, and all 12 month outcomes were similar.

Conclusion: A brief sleep intervention program, delivered soon after school entry by school nurses, initially improved children's sleep problems and parent depressive symptoms, but benefits did not exist at 1 year post-randomization.

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0993

SLEEP INTERVENTION IMPROVES SELF-CONTROL IN SCHOOL-AGED CHILDREN

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Introduction: Evidence suggests that short sleep duration associates with impaired self-control, yet very few studies have assessed the efficacy of a sleep intervention for improving this behavioral domain. Our project measured the impact of a sleep intervention on self-control in school-aged children.

Methods: Sixty-six children (8–11 y, 68.2% female) with complete data, who self-reported sleeping <9.5 h/day were randomized to either a control or sleep intervention condition (i.e., 4-session behavioral intervention to enhance sleep by 1–1.5 h/night). Sleep duration was assessed using a sleep diary, daily call-ins and wrist actigraphy for one week at baseline and one week at 8 weeks post-intervention. Self-control was assessed using the Self-Control Rating Scale (SCRS) completed by each child's parent at baseline and 8-weeks post-intervention. Higher scores on the SCRS indicate greater impulsivity and less self-control. Partial correlations and mixed-model ANOVAs were used for statistical analyses, with age as a covariate.

Results: Baseline sleep duration ranged from 6.7–9.8 h/night. At baseline, children with shorter sleep durations were perceived as having lower self-control by their parents ($r=-0.29$, $p=0.019$). Children randomized to control and sleep intervention conditions did not differ in terms of age, gender, race, baseline sleep duration or baseline SCRS score (p's>0.20). Significant condition*time interaction effects were found for sleep duration ($F(1, 63)=25.54$, $p<0.001$) and SCRS score ($F(1, 63)=4.13$, $p=0.046$). From baseline to 8-weeks post-intervention, children randomized to the sleep intervention exhibited a significant increase in sleep duration (35.9 ± 28.3 minutes nightly, $p<0.001$) and were perceived as having greater self-control by their parents (-11.0 ± 24.8 SCRS score, $p=0.016$); children randomized to the control condition exhibited no change in sleep duration (-8.6 ± 41.1 minutes, $p=0.24$) or in SCRS score (-0.49 ± 17.3, $p=0.88$).

Conclusion: A brief sleep intervention was feasible and effective for increasing sleep duration and improving self-control in school-aged children. These results add to the growing evidence for the importance of sleep for health in children.

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0994

THE BIDIRECTIONAL RELATIONSHIP BETWEEN SLEEP AND INTERNALISING AND EXTERNALISING BEHAVIOUR PROBLEMS DURING THE ELEMENTARY SCHOOL YEARS

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Introduction: Multiple cross-sectional and longitudinal studies have established the association between child sleep problems and behavioral difficulties. However, the directionality of this association is poorly understood and it is unclear whether sleep problems are differentially associated with different types of behavioral difficulties experienced by children. Understanding this relationship will inform the focus and timing of interventions. We aimed to determine the longitudinal and reciprocal relationships among child sleep difficulties and (i) externalizing, (ii) internalizing and (iii) combined behavior difficulties.

Methods: *Design*: Longitudinal data from the first 5 waves of the Longitudinal Study of Australian Children - Kindergarten Cohort, consisting of 4983 children first recruited at 4–5 years in 2004. Data were collected every 2 years and retention was 83% at 12–13 years. *Exposures*: At each of the 5 time points, data on child sleep and behaviour was collected. Sleep difficulties were defined using parent-reported child sleep problem severity and specific difficulties on 4 or more nights of the week. Child behavior was defined using parent-reported Strengths and Difficulties Questionnaire for externalising difficulties (Conduct and Hyperactivity/Inattention subscales), and internalising difficulties (Emotional symptoms subscale). *Analysis*: Cross-lag structural equation models in MPlus were used to examine the direction and magnitude of relationships among children's sleep problems with (i) externalising, (ii) internalising and (iii) overall difficulties.

Results: There was evidence of bi-directional relationships among sleep problems and externalizing difficulties, with greater sleep problems associated with later externalizing behavior and vice versa. However, for internalizing difficulties, sleep was a significant driver of later internalizing difficulties but there was little evidence of the reverse relationship. In the final model including all three constructs, although associations attenuated, the patterns remained significant over time.

Conclusion: Targeting child sleep problems has the potential to lead to better child externalizing and internalizing behavior outcomes. However, interventions targeting behavior may only lead to benefits for children's sleep for those with externalizing but not internalizing difficulties.

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0995

BRIEF BEHAVIORAL INTERVENTION ENHANCES CHILDREN'S SLEEP AND IMPROVES WEIGHT STATUS

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Introduction: Observational and experimental studies provide compelling evidence for enhancing children's sleep to decrease obesity risk. The purpose of the present study was to evaluate the relative efficacy of a brief behavioral intervention to enhance children's sleep and thus improve weight status.

Methods: Seventy-eight 8 to 11 year-old children were enrolled into a 2-month randomized controlled trial to test the efficacy of a 4-session behavioral intervention, relative to control, at enhancing time in bed by 1–1.5 h/night. Behavioral strategies (e.g., goal setting, stimulus control, positive reinforcement) focused solely on changing sleep length. Children were 9.6 ± 1.0 years; 62% female, 49.5% Black; mean zBMI 0.85 ± 1.0. Seventy-six (97%) children completed the study. Sleep period was assessed using sleep diary, daily call-ins and wrist actigraphy for one week at baseline and 8 weeks post-intervention. Height and weight were measured at each time point.

Results: No significant between group differences were observed at baseline for child sleep, BMI, zBMI, age, or sex. A robust effect of intervention was observed for change in actigraph sleep period. Children randomized to intervention enhanced their sleep period by 35 ± 28 minutes/night compared to control (-9 ± 39 minutes/night) ($F(2, 63) = 21.60$, $p < .001$ $d = 1.3$). Although we found no significant group x time effect of intervention on child BMI, post-hoc analysis demonstrated that children randomized to intervention who made clinically meaningful changes in the sleep period (i.e., ≥ 30 minutes/night increase) demonstrated benefits of intervention on BMI (-.08±.40 kg/m^2) compared to all other groups (+.14±.54 to .40±.45 kg/m^2), $F(1, 63) = 5.69$, $p = .02$.

Conclusion: Brief behavioral intervention improved school-aged children's sleep and demonstrated protective effects for weight status among children who enhanced sleep by at least 30 minutes/night. Findings speak to the potential of enhancing children's sleep length as a novel approach for weight regulation.

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0996

SLEEP PROBLEMS AMONG INFANTS AND TODDLERS UNDER MALTREATMENT INVESTIGATION

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Introduction: Little is known about sleep problems among young maltreated children. We examined behavioral sleep problems as predictors of whether parents considered their child's sleep a problem among parents of infants and toddlers under maltreatment investigation.

Methods: Data were from a randomized comparative effectiveness study. Participants were parent-child dyads (baseline child age 10–24 months) recruited from Child Protective Services offices. Parents reported about their child's behavioral sleep problems including nightwakings, difficulty settling into sleep, and difficulty sleeping alone, as well as indicated if they thought their child's sleep was a problem (perceived sleep problem) on a modified *Brief Infant Sleep Questionnaire.* Data were collected immediately post intervention ($n = 223$) and 6-months post intervention ($n = 207$). Multiple logistic regression with sequential predictor entry was used to predict perceived sleep problems (dichotomized, not a problem v. a problem) at both time points. Block 1 included control variables (child gender, age, and treatment assignment); block 2 included concurrent behavioral sleep problems.

Results: At post intervention, control variables failed to distinguish perceived sleep problems, $X^2(3) = 4.87$, $p = 0.181$, Nagelkerke's Pseudo-$R^2 = 0.03$ (79% overall hit rate). Behavioral sleep problems distinguished above and beyond control variables alone, $X^2(5) = 45.72$, $p < 0.001$, Nagelkerke's Pseudo-$R^2_{change} = 0.28$ (83% overall hit rate). Parents reporting nightwakings ($OR = 2.35$) and a somewhat ($OR = 7.21$) or very hard time settling ($OR = 7.52$) were more likely to perceive a sleep problem. 6-month post intervention results were similar: $X^2(3) = 3.13$, $p = 0.372$, Nagelkerke's Pseudo-$R^2 = 0.02$ (77% overall hit rate) and $X^2(5) = 43.13$, $p < 0.001$, Nagelkerke's Pseudo-$R^2_{change} = 0.28$ (80% overall hit rate) for control and behavioral sleep problem blocks, respectively; odds of perceived sleep problems were higher among parents reporting nightwakings ($OR = 3.25$) and a very hard time settling ($OR = 10.35$).

Conclusion: Reported difficulties falling or staying asleep are associated with perceived sleep problems among parents of infants and toddlers under maltreatment investigation.

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0997

CHID SLEEP HABITS QUESTIONNAIRE AND INTERNALIZING/EXTERNALIZING PROBLEMS AMONG DISADVANTAGED MALTREATED PRESCHOOLERS FROM CHILD PROTECTIVE SERVICES

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Introduction: Internalizing and externalizing problems are common problems among preschoolers referred from Child Protective Services for maltreatment. Recent studies showed that sleep regulation is associated with behavioral problems among non-disadvantaged preschoolers or in representative prospective cohorts of children. To our knowledge, no study has investigated this association among disadvantaged maltreated children.

Methods: Seventy-one preschoolers aged from 2 to 5 years (mean=39 months, SD=17 months) were included in the study. These toddlers were recruited from five Child Protective Services in the province of Quebec. Mothers have completed a demographic questionnaire, the Child Sleep Habits Questionnaire and the Child Behavior Checklist.

Results: Linear regressions were found for internalizing problems (p=.001) and externalizing problems (p =.006) in function of the

sleep item «Does not sleep as much as needed » adjusted for sex of the child and age. In this sample, internalizing problems and externalizing problems were strongly correlated (r=.68). Therefore, linear regressions were ran again adjusting for sex, child age and externalizing problem. Only an association was found between the sleep item «Does not sleep as much as needed » and internalizing problems (p =.004).

Conclusion: Sleep regulation seems a stronger indicator for emergence of internalizing problems among disadvantaged maltreated children. Sleep problems could be a helpful indicator for detecting internalizing problems among disadvantaged maltreated preschoolers from Child Protective Services.

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0998

PARENTING INTERACTIVE BEDTIME BEHAVIORS AND SLEEP AMONG TODDLERS LIVING IN SOCIOECONOMICALLY DISADVANTAGED HOMES

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Introduction: Emerging research suggests that sleep duration disparities seen in older children and adults may originate early in life among children living in socioeconomically disadvantaged homes. Parenting may be an important and modifiable influence on sleep in young children. The purpose of this study is to examine the characteristics of sleep and parenting interactive bedtime behaviors (PIBB) among toddlers living in urban socioeconomically disadvantaged homes.

Methods: In this cross-sectional study we recruited parents with healthy toddlers from early head start programs and a community clinic. We obtained objective (9 days/nights of actigraphy) measures of the toddlers' sleep and subjective measures of parenting interactive behaviors. Using the Parental Interactive Bedtime Behavior Survey and subscales (active physical comforting, encourage autonomy, settle by movement, passive physical comforting, social comforting), we examined the associations between PIBB and toddler's sleep characteristics.

Results: The sample included 33 toddlers (Mean age=1.33 years, SD=.54). The toddlers' sleep duration averaged 8.22 hours (SD=.86). There were statistically significant moderate associations between sleep duration and parents' passive physical comforting (PPC) (r=-.41, p=.02). Intra-individual variability in the amount of wake after sleep onset (WASO) was also significantly associated with total PIBB and PPC (r=.37, p=.05; r=.52, p=.002, respectively). Intra-individual variability in the amount of sleep fragmentation within toddlers was significantly associated with total PIBB (r=.36, p=.05).

Conclusion: While active physical comforting (e.g. rocking to sleep, patting or rubbing child's back) is most commonly associated with sleep patterns in infancy and toddlerhood among samples of higher socioeconomic status, findings from this study suggest a stronger association between PPC (e.g. presence of the parent in the room to fall asleep) and less sleep duration and more individual variability in night wakenings. These results will inform future intervention development that may address the role of parenting behavior in promoting health sleep early in life.

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0999

MATERNAL HISTORY OF CHILD ABUSE IS ASSOCIATED WITH INFANT SLEEP CONSOLIDATION DURING THE FIRST YEAR OF LIFE

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Introduction: Infant sleep consolidation is an important developmental milestone that may support optimal child outcomes. The objective of this study was to evaluate if maternal history of child abuse (CA) was associated with infant sleep consolidation in the first year of life and identify modifiable psychosocial mediators of the association.

Methods: This study was a secondary analysis of the All Our Babies study; a Canadian community based mother child cohort. Participants included 1250 women who provided self-report data on history of CA (physical, emotional, or sexual) during pregnancy and infant sleep consolidation (average number of infant night wakings and longest length of night time sleep) at 4 and 12 months postpartum.

Results: Approximately 15% (n = 190) of women reported a history of CA. After controlling for differences in maternal education, income, ethnicity, parity, and infant sex there were significant group differences in sleep consolidation at 12 months (MD = 0.51 hours, 95% CI [0.050, 0.97]), but not 4 months postpartum; women with a history of CA reported less infant sleep consolidation than women without a history of CA. Results of serial mediation indicated a pathway whereby history of CA was associated with higher maternal anxiety at 4 and 12-months. In combination, these two variables fully mediated the relationship between maternal CA and infant sleep consolidation (p < .05).

Conclusion: Findings showed that maternal history of CA was associated with poorer infant sleep consolidation at 12 but not 4 months; maternal anxiety at 4 and 12 months postpartum fully mediated this relationship. For mothers with a CA history, maternal anxiety may play a role in the development of poorer infant sleep consolidation. Treating maternal anxiety in women with a history of CA may represent a target of intervention for preventing or mitigating the development of poor infant sleep consolidation.

Support (If Any): We gratefully acknowledge the All Our Babies Study team and the study participants and their families. An Alberta Innovates Health Solutions Interdisciplinary Team Grant (Preterm Birth and Healthy Outcomes #200700595) and Three Cheers for the Early Years, Alberta Health Services provided funding for the development of the cohort.

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SELF-REPORTED SLEEP AND PEER ACCEPTANCE, REJECTION AND BULLYING FOR CHILDREN RAISED BY GRANDMOTHERS

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Introduction: One in 11 of all children and 1 in 5 African American children live with a grandparent at some point before the age of 18.

Research suggests that children living with grandparents have a higher rate of psychosocial impairments than average children (28–31% vs. 12%) associated with troubled sleep. Peer relationships, especially for children who are raised by non-parental caregivers, can be a source of important social support and protective factor. This study will examine how sleep quality and duration are related to peer acceptance, peer rejection and being bullied.

Methods: KIN Tech RCT twelve month follow up caregiver self-report data examined for sleep duration, quality and peer acceptance, rejection and bullying for 1100 children raised by grandmothers. The MacArthur Health and Behavior Questionnaire was used to assess relationship with peers. Short sleep(<6 hrs) and long sleep(>8 hrs) were coded and univariate, bivariate and ANOVAs were conducted.

Results: 1100 grandmothers raising grandchildren from low SES households (mean=$23,000), middle-aged (m=48), single (70%), African American (47%) caring for multiple relative children (65% caring for more than one child). Mean total sleep time is 7.47 (sd=1.69). Caregivers rated 71% (n=782) of children experience troubled sleep and inadequate sleep;23% (n=249) short sleepers and 48% (n=525) long sleepers. Furthermore, 59% (n=650) of children are being frequently rejected by peers and 55% bullied (n=605). Troubled sleepers were more likely to be rejected by peers [F(3, 1095)=121.66, p=.001] and bullied [F(3, 1095)=221.32, p=.001]. Short sleepers were more likely to be rejected by peers [F(1, 1098)=80.17, p=.000] and bullied [F(1, 1098)=7.70, p=.001]. Long sleepers were more likely to be accepted by peers [F(1, 1098)=13.92, p=<.001] and bullied [F(1, 1098)=19.73, p=.001].

Conclusion: This research suggests that children living with grandparents with troubled and short sleep are more likely to experience rejection by peers and bullying. While growing evidence indicates a bidirectional relationship between psychopathology and sleep, more research is needed to better understand this relationship, especially to sleep, to inform the development of tailored interventions for grandparents to promote healthy sleep for children.

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IMPACT OF SELF REPORTED SLEEP PARAMETERS ON MATH AND READING COMPETENCE FOR CHILDREN RAISED BY GRANDMOTHERS

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Introduction: One in ten grandparents live with their grandchildren. Compared to their peers, significant academic achievement, cognitive, and language deficits have been found for children raised by grandparents. Furthermore, children who experience sleep disturbances and/or short sleep duration, are less likely to excel in academics. This study is the first to examine sleep duration and quality as it relates to math and reading competence for children raised by grandmothers.

Methods: KIN Tech RCT twelve month follow up caregiver self-report data was used to examine sleep duration, quality and academic competence for 505 children raised by grandmothers. The MacArthur Health and Behavior Questionnaire was used to assess math and reading competence. Short sleep(<6 hrs) and long sleep(>8 hrs) were coded and univariate, bivariate and ANOVAs were conducted.

Results: 505 grandmother caregivers from low SES households (mean=$27,000), middle-aged (mean=48.80 years), single (69%), African American (47%) caring for multiple relative children (65% caring for more than one child). 10% (n=50) of children don't have health insurance, 30% (n=147) have health problems and 67% are taking medication. 21% (n=105) of children are short sleepers, 48% (n=242) long sleepers and 71.9% (n=363) have troubled sleep. 37.4% (n=189) of children have poor competence in math and 35.5% (n=179) reading. Children with more troubled sleep were less likely to do well in math and reading [[F(3, 501)=70.29 math; 58.17 reading, p=<.001]. Long sleep was associated with poorer math [F(1, 504)=12.00, p=.000] and poorer reading [F(1, 504)=9.39, p=.001]. Also, long sleep was associated with more medication usage [F(1, 504)= 10.69, p=000]. 25% (n=128) of children are prescribed medicine to help them sleep. This medication usage is associated with poorer math [F(4, 501)= 44.42, p=000] and reading [F(4, 501)= 44.16, p=000] competence.

Conclusion: Although very little is known about how sleep is associated with academic competence for children raised by grandmother caregivers, this study suggests that troubled sleepers and long sleepers struggle with math and reading. More research is needed to develop interventions for grandparents to promote healthy sleep for the children in their care, especially to promote academic outcomes.

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SLEEP DURATION, SLEEP HYGIENE AND PARENTS' SLEEP KNOWLEDGE OF CHILDREN REFERRED FOR POLYSOMNOGRAPHY

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Introduction: Adequate sleep is essential for appropriate growth and development and also avoid neurocognitive, cardiovascular and metabolic consequences of inadequate sleep. Sleep requirements can vary according to age. As parent's knowledge of sleep influences children's sleep habits, there is a need to assess their knowledge of adequate sleep. In children with long standing sleep complaints parents may have heightened awareness of sleep requirements of their children.

Methods: We analyzed a consecutive sample (n=252) of caregiver completed questionnaires of patients between 4- 18 years referred for sleep study (to rule out sleep apnea) to our Pediatric Sleep Program collected over the year 2015.

Results: Median age of our cohort was 8 years, with 131 males (51%). Average bedtime in 4–5 age group (N=66) was 2015 hours (median 2100); 6–12 years (N=125) was 2100 hours (median 2100) and 13–18 years (N=59) was 2230 hours (median 2200). Average sleep duration was 10.17 hours (median 10) in 4–5 age group; 9.82 hours (median 10) in 6–12 years and 8.29 hours (median 8) in 13- 18 years. 70% of the parents chose 'their children's bedtime' that fit their schedule. 51% (113/220) of the children had later wake time (>2 hours) on weekends compared to school nights. 58% (148/252) stated they had difficulty waking children up on school days always or most of the times. 60% (120/198) of the children had TV in the bedroom and watched on most nights before sleep. 20% (49/252) reported using sleep aid to help fall asleep. 80% (192/240) of parents reported children's sleep requirement as '8- 10 hours' even in 4–12 year age range.

Conclusion: Sleep duration in our cohort across all age groups falls at the lower end of the new American Academy Sleep Medicine (AASM) sleep recommendations for children. Sleep hygiene was also poor in this cohort of children, predominantly Caucasian living across urban,

rural and suburban areas. Parents' beliefs of sleep requirements in our cohort falls far short of AASM recommendations. The results of this study demonstrates the knowledge gap of parents and emphasizes need to educate parents regarding age appropriate sleep requirements.
Support (If Any): None

1003

SLEEP DISORDERED BREATHING AND SLEEP RELATED MOVEMENTS IN CHILDREN CLINICALLY REFERRED FOR EVALUATION AND TREATMENT OF INSOMNIA

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Introduction: Pediatric Insomnia may co-occur with primary sleep disorders including obstructive sleep apnea (OSA) and/or periodic limb movement disorder (PLMD). Limited research examining comorbidity of pediatric insomnia with other primary sleep disorders has focused on quantifying prevalence of insomnia symptoms in children referred for sleep disordered breathing evaluation and/or with polysomnography (PSG) confirmed OSA. Because PSG has limited utility for evaluation of primary insomnia there are few pediatric studies reporting PSG parameters for children with clinically diagnosed insomnia. The current study examined sleep and sleep disorders symptoms in children referred for insomnia evaluation who presented with insomnia symptoms in the absence of reported symptoms suggestive of other primary sleep disorders (e.g., snoring).
Methods: Insomnia evaluation included clinical interview and completion of age-specific standardized sleep screening surveys (Child Sleep Habits Questionnaire, Sleep Disorders Inventory for Students, Adolescent Sleep Wake Scale, and Adolescent Sleep Hygiene Scale). Children 7.15 +/- 4.76 years old (N=499, 43.7% female, 81.4% Caucasian) were seen for insomnia evaluation and met ICSD criteria for insomnia. A subset of the insomnia patients (n=94) deemed at risk for OSA, restless legs syndrome (RLS), and/or PLMD were referred for medical sleep evaluation. Available PSG parameters were reported for insomnia patients undergoing medical sleep evaluation.
Results: Nearly 20% (n=94) of the insomnia sample were referred for medical sleep evaluation; 18% (n=17) of the subsample completed polysomnography within 4.06±2.05 months of baseline insomnia evaluation. Five patients met pediatric PSG criteria for OSA (OI≥1) and one patient had a clinically elevated PLMI (≥5). Overall, less than 1% of the insomnia sample met pediatric PSG criteria for OSA and/or PLMD.
Conclusion: Current findings suggest low prevalence of OSA and PLMD in clinically referred children identified before formal evaluation as having significant insomnia symptoms and minimal to no symptoms of other primary sleep disorders.
Support (If Any): N/A

1004

MOTHER KNOWS BEST? COMPARING CHILD AND PARENT REPORT OF SLEEP PARAMETERS WITH POLYSOMNOGRAPHY

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Introduction: Parent or child-report is commonly used to obtain information on sleep in children. Data are lacking comparing the validity of parent- versus child-reported sleep parameters.
Methods: Two hundred and seventy five children (age 9–17) from phase 2 of the Tucson Children's Assessment of Sleep Apnea community cohort study were assessed. Parent and child-report of total sleep time (TST), sleep latency (SL) and sleep efficiency (SE) for a single night was compared to polysomnography (PSG). Wilcoxon signed-rank tests were used to compare the differences between child and parent reports when compared to PSG. Spearman's rho was used to evaluate correlations between child report, parent report and PSG findings
Results: When compared to PSG, children overestimated TST by a median of 32 (Interquartile range [IQR] 6–68) minutes, while parents overestimated TST by 36 (IQR 13 to 70) minutes (p=0.006). Children overestimated SL by 4 (IQR -8 to 20) minutes, while parent report was similar to PSG, with an overestimation of 2 (IQR -10 to 13) minutes (p=0.001). Children overestimated SE by 11% (IQR -1 to 25%, while parents overestimated SE by 8% (IQR -5% to 20%, p=0.06).
Both child-reported TST (r=0.653, p<0.001) and parent-reported TST (r=0.676, p<0.001)) correlated strongly with PSG, but there was no significant difference between child-PSG and parent-PSG correlation (p=0.38). Child-reported SL (r=0.340, p<0.001) and parent-reported SL (r=0.305, p<0.001) also correlated with PSG. No significant difference was seen between child-PSG and parent-PSG correlation (p=0.46). Correlation between child-reported SE (r=-0.029, p=0.63) and parent-reported SE (r=-0.031, p=0.607) were both very poor. No significant difference was seen between parent-PSG and child-PSG correlation (p=0.97).
Conclusion: When compared to PSG, children overestimate TST to a smaller degree than their parents, and overestimate SL to a larger degree than their parents, but these differences appear small. Child and parent report appear to be equally valid for TST and SL, but both reports appear inaccurate for SE.
Support (If Any): Dr. Combs receives research funding from an American Sleep Medicine Foundation Jr Faculty award.

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USE OF TECHNOLOGY MAY OFFSET DEVELOPMENTAL SLEEP TENDENCIES IN CHILDHOOD

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Introduction: Video gaming and television (TV) viewing are risk factors for poor sleep. We investigated the prevalence of the use of this technology, and its impact on sleep schedules in children and adolescents.
Methods: As part of a larger study (range: 5.8 to 17.9 years old, 52.6% females), the (non)use of technology was parentally reported in 151 children. Sleep schedules were queried for week and weekend (Saturday and Sunday). ANCOVA, with age as covariate, was performed to examine the differences in sleep schedules of this youth.
Results: Mean age was 11.0±2.8 years old (95%CI:10.5–11.7), and was not different between groups in terms of the reported (non)usage of technology in the morning [F(2, 89)=.7, p=.5], midday [F(1, 105)=3.4, p=.07] or evening [F(2, 135)=1.1, p=.3]. Of the sample, 62.9% primarily watched TV in the evening whereas 32.7% combined this with video gaming and/or at different times. Compared to youth that does not use technology those that watch TV in the morning showed differences: mainly older children go to bed earlier during the week [resp., 21.1±0.7 vs. 20.8±0.3; F(1, 86)=4.3, p=.04], mainly younger children wake up earlier during the weekend [resp., 9.1±1.1 vs. 8.4±1.7;

F(1, 86)=7.5, p=.007] and mainly younger children sleep less [SPT week: 10±0.8 vs. 9.7±0.5; F(1, 86)=6.7, p=.01 and SPT weekend: 10.9±1.0 vs. 10.6±1.6; F(1, 86)=6.9, p=.01]. Interestingly, no differences were found regarding use of technology at midday and in the evening.

Conclusion: Use of technology in the morning seems to amplify an offsetting effect on sleep tendencies in childhood. That is, during the week an inversed tendency and during the weekend an amplified tendency of sleep development was found. Furthermore, use of technology seems underreported and as a result the adverse impact on sleep tendencies in childhood might go underrecognized.

Support (If Any):

1006

REAL WORLD USE OF A SMARTPHONE APPLICATION INTERVENTION FOR INFANT AND TODDLER SLEEP DISTURBANCES

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Introduction: Bedtime problems and night wakings are highly prevalent in infants and toddlers. Although previously validated in a randomized control trial, this study assessed the effectiveness of an online intervention (Customized Sleep Profile; CSP) utilized in the real world within a mobile application.

Methods: Caregivers (85.2% mothers) of 480 young children (age range 6 to 35.9m, *M* = 12.25m, 50.8% male) used the CSP (free and publicly available smartphone application, Johnson's® Bedtime® Baby Sleep App), completing the Brief Infant Sleep Questionnaire at baseline and again 7 to 28 days later. We analyzed changes in sleep patterns over time, based on whether or not sleep was initially identified as a problem.

Results: Linear mixed models that assessed between- (good vs. problem sleepers) and within-group differences from baseline to follow-up (controlling for child age and time between caregiver data submissions) showed significant improvements across groups in total overnight and daytime sleep in addition to ratings of confidence in managing child sleep ($p < .05$). Relative to baseline levels, at follow-up, only problematic sleepers showed earlier bedtimes ($p < .01$), decreased number and duration of night wakings ($p < .01$), and decreased ratings that sleep was a problem ($p < .001$).

Conclusion: A publicly-available app-based intervention was associated with improved sleep outcomes in real world use. Although changes in sleep cannot be exclusively attributed to implementation of CSP recommendations, it is compelling that changes were observed in key sleep components, particularly for children identified as problematic sleepers. Results provide preliminary support for effectiveness of a publicly-available telehealth tool for infant and toddler sleep disturbances.

Support (If Any): Johnson & Johnson Consumer Inc., Skillman, NJ, USA.

1007

POOR SLEEP IS ASSOCIATED WITH RECURRENT FALLS AMONG OLDER WOMEN IN THE STUDY OF OSTEOPOROTIC FRACTURES

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Introduction: Sleep disturbances and sedative hypnotic medications are risk factors for falls in the elderly. However, little is known about the association of recurrent falls with specific sleep disturbances individually, in aggregate, or with sedative use. We examined the association of two subjective sleep disturbances, poor sleep quality and excessive daytime sleepiness, with recurrent falls among sedative users and non-users.
Methods: This analysis of the Study of Osteoporotic Fractures used excessive daytime sleepiness (defined as Epworth sleepiness scale score of >10) and poor sleep quality by self-report (Pittsburgh Sleep Quality Index score of >5) collected at visit 8. Self-report of recurrent falls (>1 fall in the preceding year) collected during visit 9 was used for analysis. We used logistic regression models with recurrent falls (yes/no) as the dependent variable; each sleep measure, sedative use (antihistamines, sedative antidepressants, sedative benzodiazepines, benzodiazepine receptor agonists, and supplements- melatonin, valerian) and their interaction effect as independent factors; and age BMI, self-rated health, depression, anxiety, use of assistive device, poor vision, and comorbidities as covariates. Comparisons were stratified by sedative medication use as they affect both sleep and falls.
Results: Analysis included 3549 participants (mean age 84±3 years, 19% recurrent fallers). Among sedative non-users, excessive daytime sleepiness and poor sleep quality were significantly associated with recurrent falls (Adjusted Odds Ratio=OR=1.53 [1.20–2.12], p=0.01) and (OR=1.28 [1.02–1.60], p=0.03 respectively). Having both sleep symptoms doubled the odds of recurrent falls in the following year (OR=1.99 [1.38–3.04], p=.001). Among sedative users, magnitudes of ORs indicated elevated risks for those with sleep disturbances, but were not statistically significant.
Conclusion: Excessive daytime sleepiness and poor sleep quality are associated with recurrent falls in women, and the association is clearly identifiable in those not using sedatives.
Support (If Any): Claude D. Pepper Older Americans Independence Center (OAIC- NIA P30 AG024827; PI: Dr. Greenspan)

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ENDOTHELIAL CELL-DERIVED MICROPARTICLES FROM OBSTRUCTIVE SLEEP APNEA HYPOXIA SYNDROME PATIENTS INCREASE HUMAN AORTIC ENDOTHELIAL CELL PERMEABILITY AND DYSFUNCTION

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Introduction: Obstructive sleep apnea hypoxia syndrome (OSAHS) is an independent risk factor for coronary artery disease (CAD). Treatment of OSAHS improves clinical outcome in some CAD patients, but the relationship between OSAHS and CAD is complex. Microparticles (MPs) are shed by the plasma membrane by either physiologic or pathologic stimulation. Here we investigated the role of MPs in the context of OSAHS.
Methods: Patients with both suspected coronary artery stenosis and OSAHS were enrolled and underwent both coronary arteriography and polysomnography. 53 total patients in this study underwent cardiac angiography and PSG, and were divided into 3 groups per cardiac vessel stenosis extent and apnea/hypopnea index (AHI): 1) Control group, characterized by stenosis<50% and AHI<5; 2) CAD group: stenosis≥70% and AHI<5; 3) CAD+OSAHS group: stenosis≥70% and AHI>15. Circulating MPs were isolated from plasma and analyzed by flow cytometry. For permeability assay, FITC-CM-dextran was added in the upper channel after human aortic endothelial cells (HAECs) being stimulated with MPs in the transwell system.
Results: 53 patients were included in the present study, and there was no statistically significant demographic difference (age, sex, BMI, biological data, tobacco abuse, diabetes comorbidity) between the 3 groups. The AHI and 4% oxygen desaturation index (ODI) in the CAD+OSAHS group were significantly greater compared to both the control and CAD groups. Moreover, the mean SaO_2 in the CAD+OSAHS group was decreased compared to the two other groups. CAD+OSAHS patients exhibited greater levels of total MPs (Annexin V^+), erythrocyte-derived MPs ($CD235^+$Annexin V^+), platelet-derived MPs ($CD41^+$ Anexin V^+), and leukocyte-derived MPs ($CD144^+$ Annexin V^+) compared to CAD alone patients or control. CAD+OSAHS patients expressed the greatest level of endothelial-derived MPs of all cellular origin types ($CD144^+$ Annexin V^+). Treatment of human aortic endothelial cells (HAECs) with MPs isolated from CAD+OSAHS patients markedly increased HAEC permeability, and significantly upregulated mRNA levels of ICAM-1, VCAM-1, and MCP-1.
Conclusion: OSAHS+CAD patients harbor increased levels of MPs, particularly the endothelial cell-derived subtype. When administered to HAECs, OSAHS+CAD patient MPs increase endothelial cell permeability and dysfunction.
Support (If Any): International Science & Technology Cooperation Program of China(2015DFA30160).

1009

SLEEP QUALITY MEDIATES RACE-RELATED DIFFERENCES IN PAIN INTENSITY AMONG INNER-CITY WOMEN PRESENTING TO THE EMERGENCY DEPARTMENT

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Introduction: Pain conditions are more common among African Americans than other racial/ethnic groups, however, mechanisms underlying this difference are poorly understood. The current study investigated the role of self-reported sleep characteristics in pain intensity outcomes among a diverse sample of inner-city women presenting to the Emergency Department (ED) for treatment/management of a non-chronic pain condition.
Methods: As part of an ongoing, longitudinal study examining the relationship between acute pain and trauma history among inner-city women presenting to the ED, baseline ratings of pain intensity (at that moment on a 0–10 scale; 0 = no pain - 10 = extreme pain) and self- reported sleep characteristics [PROMIS-Short Form; the previous month's sleep duration (hours) and sleep quality (0–5 scale; 0 Very Poor - 5 Very Good)] were collected from 173 women (M Age = 28.92 years; 63% African-American, 20% Latina/Hispanic, 15% White, 2% Other).
Results: Across the entire sample, pain intensity ratings were significantly correlated with self-reported sleep quality ratings ($r = -0.19$, $p < 0.05$), but not sleep duration. African American participants had significantly higher pain intensity ratings and lower sleep quality ratings than other racial/ethnic groups (all p's < 0.05). Mediation analyses indicated that, after accounting for the effect

of sleep quality on pain intensity, the difference in pain intensity between African American and non-African American participants was no longer significant (Direct Effect =0 .78, SE =0 .40, p >0 .05). Thus, sleep quality mediated the relationship between African American racial/ethnic status and pain intensity (Total Effect = 0.93, SE = 0.39, p <0.05).
Conclusion: Results suggest that sleep quality may play a key role in helping explain race-related differences in pain intensity among African American women. Although African American participants in our sample had significantly higher pain intensity ratings than other racial/ethnic groups, once sleep quality ratings were taken into account, that difference was no longer statistically significant. As data collection for the current study is ongoing, relevant 3 and 6-month follow-up data will be presented to provide additional information on the relationship between sleep and pain overtime from this diverse sample.
Support (If Any): R01DA039522-01A1

1010

MORNING BRIGHT LIGHT TREATMENT IMPROVES FUNCTION AND REDUCES PAIN SENSITIVITY IN FIBROMYALGIA

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Introduction: Fibromyalgia is characterized by chronic widespread pain, mood and sleep disturbance, cognitive dysfunction, and affects over 20 million Americans. Pharmacological treatments (antidepressants, antiepileptics, opioids) often have small treatment effects and adverse side-effects. Exercise therapy requires significant patient motivation, and psychotherapy requires specialized personnel. Here we report on a pilot study in which we tested a home-based morning and evening bright light treatment in patients with fibromyalgia and examined changes in function and pain sensitivity.
Methods: Ten adults (22–59 years) meeting ACR 2010 diagnostic criteria for fibromyalgia participated in a 15-day protocol. Each subject slept at home on their usual sleep schedule for 1 week before an overnight session. During the overnight session, baseline function (Fibromyalgia Impact Questionnaire, FIQ), pain sensitivity (heat threshold and tolerance), and circadian timing (dim light melatonin onset, DLMO) were assessed. The next morning subjects were randomized to either 6 days of a self-administered home morning or evening light treatment (light boxes, 1 hour per day). Afterwards, function, pain sensitivity and circadian timing were reassessed.
Results: On average, subjects completed 84% of the scheduled light treatments. No side effects were reported. Both morning and evening light treatments led to improvements in function and pain sensitivity. However, only morning light treatment led to a clinically meaningful improvement in function (>14% reduction in FIQ) and heat pain threshold ($p<0.05$). Phase advances in circadian timing were associated with an increase in pain tolerance ($r=0.67$, $p<0.05$).
Conclusion: Morning bright light treatment should be further explored as a potentially feasible, acceptable and effective adjunctive treatment for fibromyalgia. The improvement in function was similar to that seen after psychotherapy, and about half of the improvement seen after months of exercise training. Phase advances in circadian timing may be one mechanism by which morning bright light improves function and pain sensitivity in fibromyalgia.
Support (If Any): Fogarty Sleep Research Pilot Grant, Rush University Medical Center.

1011

INSOMNIA AND ACTIGRAPHIC REST-ACTIVITY INDICES PREDICT QUALITY OF LIFE FOLLOWING SURGERY FOR ENDOMETRIAL CANCER

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Introduction: Sleep-wake disturbance, pain, fatigue, and depression are common and persistent issues among gynecologic cancer patients. There is evidence from other populations that sleep-wake difficulties contribute to a pain, fatigue, and depression symptom cluster. The current longitudinal study examined how sleep-wake disturbance contributed to pain, fatigue, and depression in endometrial cancer patients over a 4-month post-surgical recovery period.
Methods: Sixty patients completed actigraphic assessment and self-report measures of insomnia, pain, fatigue, and depression at 1 week/T1, 1 month/T2, and 4 months/T3 post-surgery. Actigraphy was analyzed with a cosinor approach, providing the rest-activity indices of mesor (mean activity level) and amplitude (height of rhythm).
Results: Latent growth curve modeling evaluated the influence of insomnia severity and rest-activity indices (both T1 values and change/slope (T1-T3)) on T3 pain, fatigue, and depression. All analyses adjusted for BMI and invasiveness of surgery and T1 pain, fatigue, or depressive symptoms. Results revealed that more severe T1 insomnia predicted greater T3 pain intensity ($b=.22$;$p=.002$), pain interference ($b=.27$;$p=.001$), fatigue intensity ($b=.65$;$p<.001$), fatigue interference ($b=.25$;$p<.001$), and depressive symptoms ($b=.99$;$p=.001$). Results also indicated that less improvement in mesor and amplitude across recovery predicted greater T3 pain intensity ($b=-.05$;$p=.019$ and $b=-1.42$;$p<.001$, respectively). Less increase in mesor across recovery also predicted greater T3 fatigue interference ($b=-.06$;$p=.001$).
Conclusion: Endometrial cancer patients with more severe post-surgery insomnia experience greater pain, fatigue, and depressive symptoms 4 months later compared to women reporting less insomnia symptoms. Furthermore, patients with less robust improvement in objective mean activity level and differentiation in the rest-activity pattern experience greater pain and fatigue 4 months post-surgery. Results indicate that insomnia severity and lack of improvement in objective rest-activity patterns during surgical recovery are risk factors for poorer quality of life and suggest a potential intervention target for improving recovery in this understudied cancer population.
Support (If Any): This research was supported by grants from NCI (K07 CA136966 and P30CA014520 (UW Carbone Cancer Center)). The UW Center for Sleep Medicine and Research also provided actigraphic devices for this research.

1012

A DANISH LANGUAGE INTERNET-DELIVERED INTERVENTION FOR INSOMNIA IN CANCER SURVIVORS: EFFECTS ON CANCER-RELATED FATIGUE

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Introduction: Sleep difficulties and cancer-related fatigue (CRF) are common co-occurring symptoms associated with breast cancer

treatment. Approximately 40% of breast cancer survivors report clinical levels of CRF. Although sleep problems and fatigue are distinct symptoms, they may be reciprocally related, and thus, treatment for one symptom may impact the other. Cognitive-behavioral therapy for insomnia (CBT-I) has been shown to be a highly effective intervention for individuals with insomnia, but is not widely available due to expense, time constraints, and lack of trained professionals. The Internet, however, has been shown to be feasible for delivering CBT-I. Here we present secondary analyses from a randomized trial investigating the potential efficacy of an Internet-delivered CBT-I to reduce symptoms of CRF in cancer survivors, comparing an intervention group with a wait-list control group.

Methods: 255 Danish breast cancer survivors experiencing significant sleep problems were randomized to the SHUTi (N=133) and waitlist control (N=122) conditions, and 201 and 195 participants completed post-treatment and 6-month follow-up assessments respectively. Sleep quality was measured with the Pittsburg Sleep Quality Index (PSQI); Insomnia with the Insomnia Severity Index (IS); and Fatigue with the FACIT Fatigue Scale (FFS).

Results: At baseline, 38% of all participants had clinical levels of CRF (FFS below 34). A repeated measure GLM analyses showed statistically significant group x time interaction effects for both insomnia severity (ISI) ($p<0.001$; Cohen´s d=1.39], sleep quality (PSQI) ($p<0.001$; d=0.98], as well as CRF (FFS) ($p<0.0001$; Cohen's d = 0.64]. At the 6-month follow up, only 12 % of the intervention group had clinical levels of CRF compared to 31% in the wait-list control group ($p<0.05$).

Conclusion: These findings provide further evidence for web-based programs to be considered as an important means to reducing the burden of both insomnia and fatigue in cancer survivors.

Support (If Any): This research was supported by the TRYG foundation, Denmark.

1013

SHIFT WORK, CHRONOTYPE, AND TYPE 2 DIABETES IN THE UK BIOBANK AND TYPE 2 DIABETES IN THE UK BIOBANK

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Introduction: Night shift work has been associated with a moderate increased risk for type 2 diabetes (T2D). We had previously reported that this association is chronotype-dependent among women. Our current aim was to probe the link between shift work, chronotype and T2D in a large sample of both men and women.

Methods: Of the entire UK Biobank population (N=501,753), we included those who were currently employed, responded to the chronotype question, and free of chronic disease (N=241,512, including 5,982 T2D cases). We used logistic regression to estimate odds ratios (OR) of prevalent T2D and 95% confidence intervals (95%CI) across categories of night shift work and report multi-variable adjusted models, adjusting for age, sex, family history of diabetes, ethnicity, and socio-economic status. Secondary analyses examined whether associations differed by sex, obesity status, and chronotype.

Results: Compared to day workers, participants working night shifts were younger, more often male, with a family history of diabetes, and of non-European ethnicity. Age- and sex-adjusted models showed that participants working irregular schedules usually including night shifts had a two-fold higher T2D risk (OR=2.04; 95%CI=1.91–2.67) when compared to day workers. We did not observe evidence for effect modification by obesity status (p=0.47). When we included BMI in multi-variable adjusted models risk estimates were attenuated: compared to day workers, workers with irregular schedules usually including exposure to night shifts had an increased T2D risk (1.41 (1.17–1.68)); shift work without or only rarely including night shifts: (1.14 (1.04–1.24); irregular shifts including some night shifts (1.10 (0.98–1.22)). Permanent night shift work did not increase T2D risk compared to day work (1.06(0.91–1.23)). We did not observe evidence for effect modification by chronotype (p=0.92) or sex (p=0.07).

Conclusion: Our results add to the body of literature suggesting a link between irregular and rotating night shift work and T2D risk. Unlike earlier studies where chronotype differentially affected T2D risk depending on chronotype, current exposure status does not seem similarly associated with T2D risk. Future research is warranted to further elucidate the role of shift schedule characteristics and chronotype.

Support (If Any): 1R01DK105072-01A1 (Co-PIs: Richa Saxena and Frank AJP Scheer)

1014

INSOMNIA AND GLUCOSE CONTROL IN ADULTS WITH TYPE 2 DIABETES

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Introduction: Previous evidence suggests obstructive sleep apnea (OSA) is associated with impaired glucose control in adults with type 2 diabetes mellitus (T2DM). The purpose of this study was to evaluate if another sleep disorder, moderate to severe insomnia, is associated with worse glucose control in adults with T2DM.

Methods: This study was an analysis of baseline data from participants in an ongoing randomized controlled trial (R01DK096028). Measures included demographics (sex, age, race, marital status, education), insomnia (Insomnia Severity Index [ISI], where scores 0–14 = "no insomnia to mild insomnia" and scores ≥ 15 = "moderate to severe insomnia"). A clinical evaluation included A1C for glycemic control (impaired glycemic control = A1C ≥ 8%); height and weight were measured to calculate BMI. Descriptive statistics include mean (±SD) for continuous variables and percent and frequency for categorical variables. Bivariate associations were examined using chi-square tests, two-sample t-tests, and Pearson correlations. Binary

logistic regression models were conducted to evaluate insomnia as a predictor for impaired glycemic control. Statistical significance was set at $p<.05$.

Results: The sample (N=194) was primarily middle age (mean age=56.8±10.7 years [range: 26–88 years], overweight (mean BMI=34.7±6.8), had suboptimal glucose control (mean A1C=7.9±1.8%), and moderate-to-severe insomnia (41%, n=80). Participants were well distributed by sex (male 46%; n=90), race (white 54%, n=105), married/partnered (37%, n=72), and college graduate (31%, n=60). Higher A1C was significantly associated with younger age; non-white participants and participants with lower education had significantly worse glycemic control ($p<.05$). The final regression model identified moderate/severe insomnia as a significant predictor of impaired glycemic control (A1C ≥ 8%) after controlling for age, sex, race and education.

Conclusion: Moderate-to-severe insomnia was highly prevalent in the sample of adults with T2DM. Our study findings are significant in revealing that insomnia has a negative impact on glucose control. Results suggest testing sleep interventions in persons with T2DM and insomnia to evaluate the effect on glycemic control.

Support (If Any): NIDDK R01DK096028

1015

IMPACT OF SHORT SLEEP DURATION ON MORTALITY RISK ASSOCIATED WITH CARDIOVASCULAR DISEASE AND STROKE

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Introduction: Short sleep duration has been associated with cardiovascular (CVD) and cerebrovascular (CBV) disease and mortality. However, most studies have relied on self-reported measures and treated sleep duration as a sole, independent predictor; thus, its role in predicting mortality is still not well-established. We hypothesized that objective short sleep duration increases the impact of CVD and CBV on mortality.

Methods: 1,741 men and women (48.8±13.6y) from the Penn State Adult Cohort, a random, general population sample studied in the sleep laboratory and followed-up for 16.7±4.6y. Cause of death was ascertained through the National Death Index of the CDC and classified using ICD-9 or ICD-10. CVD was defined by a history of heart disease, including hypertension or diabetes, and CBV by a history of stroke. Polysomnographic (PSG) total sleep time was classified as normal (≥6-h) and short (<6-h) sleep duration based on the median of the cohort. We tested the interaction between PSG sleep duration, CVD, and CBV on mortality using Cox proportional hazard models controlling for multiple potential confounders.

Results: The hazard ratios (95%CI) of mortality associated with CVD and CBV were 1.39 (1.09–1.79) and 1.88 (1.13–3.12), respectively, and a significant interaction (P=0.02) revealed that short sleep duration modified these associations. The risk of mortality associated with CVD and CBV was significantly increased in individuals with short sleep duration (HR=1.83, 95%CI=1.32–2.54 and HR=2.39, 95%CI=1.28–4.44, respectively) but not in individuals with normal sleep duration (HR=0.87, 95%CI=0.59–1.29 and HR=1.26, 95%CI=0.52–3.07, respectively).

Conclusion: The risk of mortality associated with CVD and stroke is significantly increased in adults with objective short sleep duration. It is likely that adults with CVD or stroke and short sleep duration suffer from greater central autonomic and metabolic dysregulation. Clinical trials should test whether lengthening sleep improves the long-term prognosis of adults with CVD or stroke.

Support (If Any): American Heart Association 14SDG19830018 and National Institutes of Health R01 HL51931, R01 HL40916, and R01 HL64415

1016

SLEEP-WAKE TIMING AND STABILITY ARE ASSOCIATED WITH INCREASED BLOOD PRESSURE IN THE SUEÑO ANCILLARY STUDY OF THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS (HCHS/SOL)

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Introduction: In addition to sleep duration there is growing evidence that the timing and variability of the sleep-wake cycle may also be important modifiable cardiometabolic disease risk factors. We aim to evaluate the relationship between objective actigraphy-based measures of sleep-wake timing and stability with cardiometabolic disease risk.

Methods: Using actigraphy to record daily rest-activity patterns for seven days, data regarding sleep-wake timing and stability were obtained from 2156 participants aged 18–64 years in the Sueño ancillary study of the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Measurements of cardiometabolic disease risk (systolic (SBP) and diastolic blood pressure (DBP), fasting levels of glucose and insulin, and insulin resistance) were assessed at the baseline HCHS/SOL visit (2008–2011) while body mass index (BMI) and hypertension diagnosis were determined during the ancillary study visit (2010–2013). Associations were examined using survey linear regression, adjusting for age, gender, background, site, income, acculturation and sleep duration.

Results: Decreased day-to-day stability in sleep habits, as measured by the interdaily stability index, is associated with greater risk for a diagnosis of hypertension (-0.355, $p<0.01$), as well as higher measured SBP (-7.825, $p<0.05$) and DBP (-8.018, $p<0.05$). In addition, later sleep timing, as measured by sleep midpoint is associated with higher SBP (0.733, $p<0.01$) and DBP (0.534, $p<0.01$). These associations remained present after adjusting for age, gender, background, site, income, acculturation, and sleep duration. There is no association between sleep timing or interdaily stability and BMI, insulin resistance or diabetes.

Conclusion: Later sleep midpoint and decreased day-to-day stability in sleep are associated with higher systolic and diastolic blood pressure. These data suggest that additional characteristics of sleep, beyond sleep duration, are important risk factors for cardiovascular health.

Support (If Any): The Hispanic Community Health Study/Study of Latinos was carried out as a collaborative study supported by contracts from the National Heart, Lung, and Blood Institute (NHLBI) to the University of North Carolina (N01-HC65233), University of Miami (N01-HC65234), Albert Einstein College of Medicine (N01-HC65235), Northwestern University (N01-HC65236), and San Diego State University (N01-HC65237).

1017

CLINICAL OUTCOMES OF CONTINUOUS POSITIVE AIRWAY PRESSURE IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA AND NON-DIPPING BLOOD PRESSURE: A PROSPECTIVE COHORT STUDY

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Introduction: Nondipping blood pressure (BP) and obstructive sleep apnea (OSA) both carry an increased risk of cardiovascular events and mortality. We aim to investigate the effects of 6 months of continuous positive airway pressure (CPAP) treatment on blood pressure (BP) and urine albumin/creatinine ratio (ACR) in OSA patients with nondipping patterns.
Methods: We prospectively enrolled adult patients with severe OSA (AHI>30) from November 2010 to December 2015 for ambulatory 24-hr BP study. Baseline 24hr BP was recorded, urine was collected for ACR and peripheral venous blood samples were collected for the analysis of CBC-DC, creatinine, lipid profile, and high sensitivity CRP (hsCRP). After CPAP use, we measured 24-hr BP, hsCRP and ACR at 3 and 6 months separately. Statistical analyses (paired T test, generalized estimating equation) were performed by SAS.
Results: A total of 77 patients were enrolled. At baseline, 42(54.5%) of patients were dippers and 35(45.5%) were non-dippers (a decrease of less than 10% in the average nighttime blood pressure compared with the average daytime blood pressure). In non-dippers, the mean AHI was 70.0 (SD, 22.7), baseline 24-hr mean BP was 125.0(SD, 17.1) mmHg (systolic blood pressure (SBP): 140.1(SD, 19.7) mmHg, diastolic blood pressure (DBP): 95.0(SD, 13.8)mmHg).CPAP treatment decreased SBP by 1.59 mmHg (95% confidence interval (CI):-9.2 to 3.6; p=0.287), and diastolic blood pressure by 3.13 mmHg (95%CI:-7.5 to 0.7; p=0.062). After 6 months of CPAP treatment, 20(57.1%) of non-dippers displayed dipping BP pattern and 15(42.9%) were refractory non-dippers (average day-night BP decrease 14.3±3.6%, 3.0±5.1%; P<0.001). Non-dippers had a reduction in ACR (-14.0±42.7 mg/L) (p=0.061) and those who displayed dipping pattern after CPAP had the most significant reduction in ACR (-7.0±10.25 mg/L) (p=0.010). HsCRP level decreased significantly in non-dippers who had dipping pattern after CPAP (-1.13±3.73 mg/L) when compared with refractory non-dippers (3.05±6.08 mg/L) (p=0.024).
Conclusion: In severe OSA patients with nondipping BP, CPAP treatment for 6 months improved BP pattern. In those who displayed dipper pattern after CPAP, the decrease of ACR was significant. This effect of non-dippers converting to dippers was associated with greater decrease in hsCRP.
Support (If Any): None

1018

RUPTURED CEREBRAL ANEURYSM AND OBSTRUCTIVE SLEEP APNEA: IS ANY LINK THERE?

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Introduction: Obstructive sleep apnea (OSA) is associated with the progression of abdominal and thoracic aortic aneurysms. However, the role of OSA in the overall outcome of intracranial ruptured aneurysms (RIAs) has not yet been known. We have investigated the role of OSA in overall outcome of RIAs.
Methods: Data of 159 consecutive patients were retrospectively reviewed. In this series, we have performed Chi square test to determine the significant difference between two groups. Regression analysis was conducted to identify the predictors of unfavorable outcome of ruptured intracranial aneurysms. A p value of less than 0.05 was considered significant.
Results: The prevalence of OSA in RIAS was five times higher in patients with non-aneurysm group, p=0.002. The number of patients with hypertension (p=0.0001), BMI greater than 30 (p=0.0001), hyperlipidemia (p=0.018), chronic heart disease (CHD, p=0.002) or prior ischemic stroke (p=0.001) was significantly higher in the OSA group. Similarly, the number of wide neck aneurysms (p=0.0001) and aneurysm with greater than 7mm (p=0.004), poor Hunt and Hess grade IV-V (p=0.005), vasospasms, (p=0.03), patients with poor modified Rankin scale (mRS) scores (3–6) was significantly higher in the OSA group (p=0.0001). Interestingly, for the first time both in univariate (p=0.01) and multivariate (p=0.003) regression analysis, OSA was identified as an individual predictor of unfavorable outcome. In addition, hypertension (p=0.04), smoking (p=0.049), chronic heart disease (p=0.01), Hunt and Hess grade IV-V (p=0.04), were revealed as positive predictors of poor outcome of RIAs.
Conclusion: This is a pioneer study to determine the association between OSA and ruptured cerebral aneurysm in terms of comorbidities, size of aneurysm, severity of symptoms and outcomes after treatment. The severity of disease and overall outcome (mRS) of RIAs are affected by the concurrence of OSA. In addition, for the first time, OSA is identified as a positive predictor of unfavorable outcome of RIAs. Therefore, screening for OSA as well as prevention and or treatment of OSA would be beneficial for these patients with RIAs.
Support (If Any): None.

1019

POSITIVE PRESSURE VENTILATION DOES NOT IMPROVE OUTCOME IN PATIENTS WITH SLEEP APNEA AND PULMONARY EMBOLISM: AN ANALYSIS OF THE NATIONAL INPATIENT SAMPLE DATABASE

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Introduction: Positive airway pressure (PAP) therapy is widely used therapy for treatment of both sleep apnea(SA) and hypoxia related to pulmonary embolism(PE). It remains unknown if PAP is associated with improved outcomes in patients with concomitant SA and PE. We evaluated the in-hospital mortality with PAP in patients with SA and PE using data from the 2012 National Inpatient Sample (NIS) database.
Methods: In-hospital all-cause mortality were compared for SA+PE patients(ICD 9 diagnosis codes 327.21, 780.57, 327.23 and 415.1, 415.11, 415.19) on PAP therapy or not (ICD9 procedure code 93.90)from the 2012 version of the NIS dataset. To adjust for multiple confounders, a multivariate-adjusted model including demographic characteristics, and all 17 components of the Charlson comorbidity index was also constructed to assess the outcomes with PAP vs no PAP in SA+PE patients.
Results: Among 5376 SA+PE patients with treated with PAP (N=461) or no PAP (N=4915), 212 patients died during hospitalization. Expectedly, PAP was reserved largely for patients with a higher burden of co-morbidities. In-hospital all-cause mortality with PAP was 7.38% vs 3.62% for no PAP (Odds ratio OR 2.12, 95% CI 1.45–3.10, p<0.001).This difference in mortality persisted even after adjusting for the higher burden of comorbidities of patients on PAP.

Conclusion: PAP was associated with higher mortality in patients with SA and PE. While PAP remains one of the most frequently used therapeutic modalities SA, it doesnot appear to positively influence mortality in patients with concomitant PE.
Support (If Any):

1020

ASTHMA AND SLEEP AMONG HISPANICS

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Introduction: Latinos experience higher asthma disease burden than do Whites. The literature suggests that this disease burden may be due to problems with asthma management and control. Higher disease burden in Latinos may explain why studies show strong associations between sleep and asthma morbidity in Latino children compared with non-Latino white children. The current study investigated the association between asthma and short sleep duration among Latinos.
Methods: We used data from the National Health Interview Survey (NHIS)-2000–2015, which provided demographics, chronic diseases, self-report asthma, and sleep duration. Data were analyzed to assess the prevalence of short sleep duration and asthma among Latinos, as well as the association between short sleep duration and asthma.
Results: Of the total sample of 227,869 Latinos (mean age= 39.91 S.D.=15.65 yrs.), 51.7% were female, 64.2% were currently employed, 19.9% were overweight/obese, 36.8% reported an annual family income less than $35,000, 14% reported their general health to be fair-poor, 27.9% were short sleepers (<7 hrs.) and 9.4% had asthma. We found that 28.9% of Latinos who reported a diagnosis of asthma were short sleepers, which was significantly greater than those without asthma (p<.001). Latinos with asthma were 68% more likely to report short sleep duration compared with those without asthma (OR=1.68, 95% CI=1.60–1.78, p<.001).
Conclusion: Our findings indicate that Latinos with asthma are at significant risk of reporting short sleep duration, which may increase their risk for sleep-related comorbidities such as cardiovascular disease. Future studies should investigate environmental and social factors likely to influence associations between short sleep and asthma among Latinos.
Support (If Any): NIH/NINDS U54NS081765 NIMHD R01MD007716
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SLEEP DISTURBANCE AND PHYSICAL ACTIVITY IN COPD PATIENTS BASED ON NHANES 2005–2006 DATA

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Introduction: Sleep disturbance and physical inactivity in patients with chronic obstructive pulmonary disease (COPD) are associated with negative health outcomes such as COPD exacerbation, hospitalization, and mortality. However, research examining the association between sleep and physical activity in this population is limited. To address this gap, we described characteristics and patterns of sleep disturbance and physical activity and examined the impact of sleep disturbance on hourly averaged physical activity based on National Health and Nutrition Examination Survey (NHANES) data.
Methods: Data for 132 COPD patients (56% male) and a non-COPD comparison group (n=1,990) were drawn from a 2005–2006 NHANES dataset. Physical activity was objectively measured by accelerometer for 7 days. Sleep disturbance, defined as abnormal sleep duration and poor sleep quality, was assessed by survey. Stata 14.0 survey analysis statistics were used to describe sample characteristics and examine relationships between the two variables.
Results: Daily physical activity was significantly lower in COPD patients than in the comparison group (p<.05). We found a significant difference in sleep quality between the COPD and comparison groups (F=4.10, *p*=0.006); 42% of COPD patients reported poor sleep quality as opposed to 26% of the comparison group. Among the COPD patients, those with normal sleep duration (7–8 hours) performed more physical activity during morning hours (6–10 a.m.; all p<.05) than those with abnormal sleep duration, including short sleep (≤6 hours) and excessive sleep (≥9 hours).
Conclusion: This study supports that COPD patients have more severe sleep disturbance and less physical activity than individuals without COPD and suggests that improved sleep could enhance physical activity patterns in these patients. This study further suggests that sleep management may have important health implications in terms of developing interventions to improve physical activity in the COPD population. Further research is needed to identify mechanisms underlying the sleep-physical activity relationship.
Support (If Any): None.

1022

ANALYSIS OF SLEEP DISORDERED BREATHING AND ALVEOLAR HYPOVENTILATION AMONG OBESE HYPOTHYROID PATIENTS UNDERGOING NOCTURNAL POLYSOMNOGRAPHY

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Introduction: Hypothyroidism is associated with depression of hypoxic and hypercapnic ventilatory drives, resulting in alveolar hypoventilation (pCO_2>45 torr). There is dearth of studies describing prevalence of hypoventilation in obese hypothyroid patients undergoing nocturnal polysomnography (NPSG).
Methods: This is a retrospective study of consecutive obese (BMI ≥ 30 kg/m^2) adult hypothyroid subjects who underwent NPSG between November 2015 and October 2016. Data collection included demographics, NPSG variables, end-tidal pCO_2 ($PetCO_2$), peak CO_2, % of total sleep time with $PetCO_2$ >50 torr (pCO_2>50), oxygen saturation (SpO_2) nadir, average sleep SpO_2, comorbidities, and thyroid stimulating hormone (TSH). We used Chi-square test and Wilcoxon's rank order test for statistical analysis.
Results: We identified 53 subjects: 18 with and 35 without alveolar hypoventilation. The demographic variables reported as median (quartile1, quartile3) were: age 58 (47, 68) years, BMI 37.8 (34.1, 44.3), female 66%. The variables which were significantly associated with hypothyroid subjects with alveolar hypoventilation compared to hypothyroid subjects without alveolar hypoventilation were: AHI 40 (19.5,69.7) vs 18.6 (7.7,30) [p=0.038], SpO_2 nadir: 79% (73%,83%) vs 86% (80.5%,88.5%) [p=0.018], average sleep SpO_2: 92% (90%,94%) vs 95% (94%,96%) [p=0.0076], TSH: 2.7 (1.5,7.9) vs 1.28 (0.04,2.36) [p=0.03], peak CO_2: 59.5 (57,62) vs 50 (45,52.5) [p<0.0001] and pCO2>50: 57% (24%,84%) vs 0% (0%,1%) [p<0.0001]. Uncontrolled hypothyroidism was present in 36.4% of the subjects with hypoventilation as compared to 9% of those without hypoventilation, along with a higher percentage of the following comorbidities: hypertension (78% vs 71%), heart failure (39% vs 11%), depression (27% vs 22%) and diabetes (72% vs 31%), with only diabetes being statistically significant [p=0.004].
Conclusion: Adult obese hypothyroid subjects with alveolar hypoventilation have lower average sleep oxygen saturation, lower oxygen saturation nadir, and higher AHI compared to those without hypoventilation.
Support (If Any): None.

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OBSTRUCTIVE SLEEP APNEA AND SECONDARY ERYTHROCYTOSIS: ANALYSIS FROM A LARGE CROSS-SECTIONAL OBSERVATIONAL STUDY

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Introduction: Current hematologic guidelines recommend obstructive sleep apnea (OSA) evaluation in the investigation of secondary erythrocytosis. However, the relationship between OSA and hematocrit is uncertain.

Methods: We evaluated consecutive patients with sleep studies yielding apnea-hypopnea index (AHI) values who completed a prospective sleep questionnaire that included self-reported habits, demographics, medical comorbidities, and medication use. Additionally, the electronic medical record provided laboratory information. Multivariate analysis tested the association between AHI and hematocrit.

Results: We studied 1,604 veterans (age 57.6 ± 13.4 years, 92% male) with 48.2% diagnosed with moderate-severe OSA (AHI ≥15/hour). However, only 7.4% of included patients had a hematocrit ≥48%, with only 1.6% having clinical erythrocytosis. OSA severity defined by AHI was not associated with hematocrit level. Instead, mean nocturnal pulse-oxyhemoglobin saturation (SpO_2; -0.08 points, p=0.04) and awake SpO_2 (-0.17 points; p<0.001) were inversely proportional to hematocrit (per standardized Z-score). Other factors including active tobacco use, increased alcohol ingestion, and exogenous testosterone therapy were also associated with higher hematocrit. Statistically significant predictors of having hematocrit ≥48% included awake hypoxemia (OR 4.7, p<0.001), nocturnal hypoxemia (OR 1.8, p=0.021), diabetes mellitus (OR 0.40, p=0.002), and testosterone therapy (OR 2.9, p=0.001). Although OSA as measured by AHI was not associated with erythrocytosis, OSA (and particularly severe OSA) was associated with nocturnal hypoxemia (OR 7.4, p<0.001). Awake hypoxemia (OR 5.2, p<0.001) and COPD (OR 2.6, p<0.001) were less predictive of nocturnal hypoxemia. However, only 8% of those with moderate-severe OSA who had nocturnal hypoxemia had erythrocytosis.

Conclusion: Clinically significant erthrocytosis appears uncommon in those with suspected or confirmed OSA. Furthermore, hematocrit levels and presence of erythrocytosis appear not associated with OSA as measured by AHI, but rather with awake and nocturnal hypoxemia. Nocturnal oximetry may provide diagnostic utility in the evaluation of unexplained secondary erythrocytosis. Polysomnography may be warranted in those with unexplained nocturnal hypoxemia.

Support (If Any): None.

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SLEEP DISORDERED BREATHING AND CHRONIC KIDNEY DISEASE AMONG MIDDLE-AGED AND ELDERLY JAPANESE POPULATION: TOON HEALTH STUDY

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Introduction: Several epidemiological studies among Western populations suggested that sleep disordered breathing (SDB) might be associated with chronic kidney disease (CKD). However, there were few findings among Asian populations. Thus, the objective of this study was to examine the association between SDB and CKD defined by glomerular filtration rate (GFR) among middle-aged and elderly Japanese population.

Methods: The study was conducted as a cross-sectional design. The participants were consisted of 1958 community-dwelling Japanese (age, 30–79 years; men, 35.5%). The oxygen desaturation index (ODI) was quantified during sleep using a ≥3% oxygen desaturation threshold and categorized as normal (<5.0 events/h), mild (5.0–15.0 events/h), and moderate to severe (≥15.0 events/h). The CKD was defined by GFR<60ml/min/1.73m2. The association between the 3%ODI and CKD was analyzed by using logistic regression analysis after adjustment for potential confounding factors.

Results: Compared with normal SDB, the multivariable-adjusted odds ratio (95% confidential intervals) of CKD for mild and moderate to severe SDB were 1.02 (0.77–1.36) and 1.18 (0.76–1.85), respectively. After stratified by sex, we observed significantly higher multivariable-adjusted odds ratio of CKD for moderate-to-severe SDB in women; multivariable-adjusted odds ratio was 2.93 (1.33–6.45). However, the multivariable-adjusted odds ratio of CKD for moderate-to-severe SDB in men was 0.85 (0.49–1.48).

Conclusion: The findings of this study suggest that moderate-to-severe SDB may be potential risk factor for CKD among middle-aged and elderly Japanese women.

Support (If Any):

1025

SLEEP APNEA AND KIDNEY TRANSPLANT GRAFT SURVIVAL: FINDINGS FROM AN 18-YEAR (1997–2015) HISTORICAL COHORT STUDY

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Introduction: Sleep apnea has been linked to the acceleration of renal failure in end-stage renal disease (ESRD). However, few studies have examined the association of sleep apnea to kidney functioning in ESRD patients post-transplant.

Methods: A historic cohort study of kidney transplant recipients with a failed graft from a single-center examined the association between sleep apnea and kidney transplant graft survival time. Adult patients who were transplanted and failed or died with a functioning graft during the designated study time period (January 1, 1997-September 1, 2015) were included (n=299). Sleep apnea was defined as a diagnosis in a patient's medical record documented prior to graft failure. Graft survival time was defined as graft failure and/or cardiovascular death with a functioning graft, two common outcomes of kidney transplantation associated with ESRD. Non-cardiovascular related deaths with a functioning graft were censored. A Cox regression, stratified by year of transplant surgery, modeled the association of diagnosed sleep apnea with graft survival time. Using backward elimination, models were adjusted for age, gender, functional status, and antigen mismatch.

Results: Sleep apnea prevalence in this cohort was 17%. Due to a significant (p ≤0.01, adjusted model) sleep apnea by transplant year heterogeneity for graft survival time, Cox regression models were stratified. For patients transplanted between 1997–2008, sleep apnea was associated with a decreased (albeit non-significantly) risk of graft failure and/or cardiovascular death (adjusted Hazard Ratio (HR) = 0.67, 95% CI, 0.45–1.01). For patients transplanted between 2009–2015, sleep apnea statistically significantly increased graft failure and/or cardiovascular death risk (adjusted HR = 2.94, 95% CI, 1.12–7.75).

Conclusion: In a single-center cohort of kidney transplant recipients with a failed graft, sleep apnea increased the risk of graft failure and/or cardiovascular death with a functioning graft nearly three-fold among patients transplanted between 2009–2015. Further research is needed to better understand this relationship and whether prevention strategies, including treating sleep apnea, might increase longevity in kidney transplant patients. Data abstraction continuing through January 1, 2017 will allow evaluation of a twenty-year follow-up of this historical cohort study.
Support (If Any): None

1026

GENDER DIFFERENCES IN THE ASSOCIATION BETWEEN SERUM ASYMMETRIC DIMETHYLARGININE, CHRONIC KIDNEY DISEASE, AND QUALITY OF OBJECTIVE/ SUBJECTIVE SLEEP: THE HEIJO-KYO COHORT

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Introduction: Sleep problems are common in individuals with chronic kidney disease (CKD), although the underlying mechanisms are largely unknown. Nitric oxide (NO) plays an important role in regulating physiological process in sleep/wake states; however, the association between serum asymmetric dimethylarginine (ADMA) level, an endogenous competitive inhibitor of NO synthesis, and sleep quality has not been studied yet.
Methods: We measured serum ADMA level along with actigraphic and subjective sleep quality among 1115 elderly individuals with and without CKD (mean age, 71.9 years).
Results: Multivariable analysis adjusted for age, BMI, hypertension, diabetes, and physical activity revealed that, in females, compared with the low-ADMA/non-CKD groups (n = 312), sleep efficiency (SE) was significantly lower in the high-ADMA/CKD (n = 52) by 3.5% for objective (95% CI, 1.1–5.9; P = 0.005) and 4.2% (95% CI, 0.3–8.0; P = 0.034) for subjective but not in the low-ADMA/non-CKD group (n = 179) and the high-ADMA/CKD group (n = 36). In males, no significant associations between ADMA and sleep quality were observed. Consistently, the high-ADMA/CKD group exhibited significantly longer wake after sleep onset by 11.3 min (95% CI, 3.0–19.6; P = 0.008) for objective and 25.9 min (95% CI, 4.9–46.9; P = 0.016) for subjective than that in low-ADMA/non-CKD group in females but not in males. No significant association of ADMA and sleep onset latency was observed in both genders.
Conclusion: Elderly individuals with high ADMA and CKD exhibited poor sleep quality measured objectively and subjectively than those with low ADMA and without CKD. In addition, potential gender differences in the associations were detected in this study. Increased ADMA levels in CKD may be a possible mechanism underlying high prevalence of sleep problems in CKD patients.
Support (If Any):

1027

AN OPEN-LABEL, SINGLE-DOSE, PHASE 1 STUDY OF THE PHARMACOKINETICS AND SAFETY OF JZP-110 IN SUBJECTS WITH NORMAL OR IMPAIRED RENAL FUNCTION AND WITH END-STAGE RENAL DISEASE REQUIRING HEMODIALYSIS

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Introduction: JZP-110 is a selective dopamine and norepinephrine reuptake inhibitor with wake-promoting effects. JZP-110 is renally excreted ~90% unchanged within 48-hours. This study assessed effects of renal impairment (RI) and hemodialysis on JZP-110 pharmacokinetics and safety.
Methods: Study comprised five groups (n=31 adults). Group 1: normal (estimated glomerular filtration rate [eGFR] ≥90 mL/min/1.73 m^2); Groups 2–4: mild, moderate, or severe RI (eGFR 60–89, 30–59, and <30 mL/min/1.73 m^2, respectively); Group 5: end-stage-renal-disease, on hemodialysis. Groups 1–4 received one 75-mg dose on Day 1; Group 5 received one 75-mg dose on Day 1 (followed by 4-hour-hemodialysis), and one 75-mg dose on Day 8 (without hemodialysis). Key pharmacokinetic parameters included: area under plasma concentration-time curve from time 0 to last quantifiable concentration (AUC_{0-t}) or infinity (AUC_{0-inf}); maximum observed concentration (C_{max}); C_{max} time (T_{max}); elimination half-life ($t_{1/2}$); urinary excretion.
Results: Relative to Group 1, geometric mean AUC_{0-inf} increased 53%, 129%, and 339% and mean $t_{1/2}$ was 1.2-, 1.9-, 3.9-fold higher in Groups 2, 3, and 4, respectively. Renal excretion of unchanged JZP-110 was approximately 85.8%, 80.0%, 66.4%, and 57.1% in Groups 1, 2, 3, and 4, respectively. Mean C_{max} and T_{max} did not substantially vary with RI severity. The decrease in JZP-110 clearance was proportional to the decrease in eGFR. Group 5 geometric mean AUC_{0-t} increased 357% and 517% versus Group 1, with and without hemodialysis, respectively; $t_{1/2}$ was >100 hours in both groups; and hemodialysis removed 20.6% of JZP-110. Adverse events (AEs) included headache and nausea (n=1 in Groups 3 and 5, respectively), and one subject in Group 5 discontinued (increased ALT and AST 6 days after dosing). AEs were assessed as related to study drug and mild in severity.
Conclusion: JZP-110 AUC and $t_{1/2}$ increased and urinary excretion decreased with increasing RI, whereas C_{max} and T_{max} were unchanged. JZP-110 was partially cleared through hemodialysis.
Support (If Any): Jazz Pharmaceuticals.

1028

SEVERE PERIODIC LIMB MOVEMENTS IN PATIENTS WITH CIRRHOSIS OF THE LIVER PERIODIC LIMB MOVEMENTS IN PATIENTS WITH CIRRHOSIS OF THE LIVER

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Introduction: Questionnaires indicate that patients with liver disease have disturbed sleep. However, polysomnographic studies to quantify sleep architecture and sleep disorders in this population is lacking. In this study we compared polysomnographic findings of two groups of patients with clinically stable but severe end stage pathology of liver and heart.
Methods: This was a prospective study of consecutive patients with end-stage liver disease, or severe heart failure. Patients underwent full night attended polysomnography along with a number of tests including pulmonary function tests, cardiac nuclear study to measure left ventricular function, complete blood counts. liver and renal function tests and iron studies..All patients were part of prospective studies supported by Veterans Administration grants. All patients with cirrhosis had undergone serial random tests for blood ethanol. Thirty eight consecutive patients without sleep-related disordered breathing were enrolled. Thirty seven patients are the subject of this study,13 patients with cirrhosis and 24 with heart failure. One patient with cirrhosis who tested positive for blood ethanol was excluded. Polysomnograms were scored blindly by one author.
Results: Compared to patients with heart failure, patients with cirrhosis suffered from severe periodic limb movements during sleep

with an index of 39 per hour of sleep. associated with excessive arousals. In patients with cirrhosis, serum iron and ferritin levels were either upper normal limit or elevated. There were significant correlations between severity of periodic limb movements versus blood levels of bilirubin (r= 0.73, p=0.004) and ammonia (r=0.74, p=.017).
Conclusion: This is the first polysomnographic study of patients with stable cirrhosis demonstrating severe periodic limb movements with excessive arousals. Severity of periodic limb movements correlated with blood levels of bilirubin and ammonia which are neurotoxic. The pathobiochemical relevance remains to be established. Since a subset of patients with cirrhosis acquires a syndrome similar to idiopathic Parkinson's disease which per se is frequently associated with periodic limb movements, our results are consistent with this notion. Future studies are needed to determine if periodic limb movements of cirrhosis is an early indication of incident parkinsonian syndrome and if early treatment with dopamine agonists may have an impact.
Support (If Any):

1029

LONGITUDINAL STUDY OF THE INTERACTION BETWEEN SLEEP AND GASTROESOPHAGEAL REFLUX DISORDER IN THE US GENERAL POPULATION

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Introduction: Longitudinal studies of sleep and gastroesophageal reflux disorder (GERD) are scarce. This longitudinal study addresses the question of the place of sleep disorders in the evolution of GERD.
Methods: Interviews were conducted by phone using the Sleep-EVAL system. Subjects were identified by their physicians or the Sleep-EVAL system as having GERD. The interview included socio-demographic information, sleep-wake schedules and sleeping habits. Sleep disorders were identified according to the DSM-IV-TR and ICSD-2. The sample included 13,937 subjects over 18 years old, representative of the adult population of the 8 most populated states of America. The participation rate was 88%. The longitudinal follow up of the sample took place 3 years after the initial interview. Loss at follow up was inferior to 10.5%.
Results: The prevalence of GERD significantly increased with age between Wave 1 and Wave 2: 6% of the total sample reported GERD only at wave 1, 8.5% reported GERD only at Wave 2, and 3.9% reported GERD both at Wave 1 and Wave 2. Insomnia disorder is present at Wave 1 and Wave 2 in 24.5% of the population. At Wave 1 and Wave 2, GERD subjects had high prevalence of sleep dissatisfaction (24.2%), difficulty initiating sleep (15.2%) and non-restorative sleep (15.6%). Nocturnal awakening (33.9%) is the most prevalent symptom associated with GERD. Obstructive Sleep Apnea, Restless Leg Syndrome and Obesity were frequently and significantly associated with GERD.
Conclusion: The longitudinal investigation of the interaction of GERD and Sleep shows that Sleep is a good predictor of of GERD chronicity. In the second wave of this study, the sleep disturbances induced initially by GERD increase the severity of GERD and contribute to its chronicity.
Support (If Any): Unrestricted educational grants from the John Arrillaga Foundation and Takeda Pharmaceuticals.

1030

BELIEFS ABOUT SLEEP IN PEOPLE WITH PSORIASIS: AN IN-DEPTH QUALITATIVE STUDY USING THE COMMON-SENSE MODEL OF SELF-REGULATION FRAMEWORK

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Introduction: Psoriasis a common, complex, long-term inflammatory condition primarily affecting the skin, is associated with significant physical and psychological comorbidity. Sleep disturbance is frequently reported by people with psoriasis and is associated with pre-sleep arousal, itch and low mood. This is the first study to our knowledge that explores in-depth the beliefs people with psoriasis hold about sleep. We used the established Common-Sense Self-Regulation Model (CS-SRM) as a theoretical framework.
Methods: Semi-structured interviews were conducted in a purposive sample of 9 people with psoriasis. The interviewer explored participants' beliefs about their sleep (characteristics of sleep patterns; timeline; causes of good/poor sleep; consequences of poor sleep and beliefs about the curability/controllability of poor sleep) and coping strategies used. Data were analysed using principles of framework and thematic analysis.
Results: Five key themes emerged within the dimensions of the CS-SRM: 1) 'Dissatisfaction with sleep': reduced sleep quality and duration and difficulty initiating sleep; 2) 'Sleep varies by perceptions of psoriasis'; sleep disturbance triggered by psoriasis symptoms, and sleep changes as a function of time since treatment; 3) 'Heightened awareness of psoriasis at night'; symptom management and thoughts/worries about psoriasis contributing to sleep disturbance 4) 'Sleep affecting multiple domains of life'; consequences of sleep disturbance on work, social and family life 5) 'Perceived lack of control of sleep': a constant battle for control over sleep, increased effort to sleep and resigned acceptance of poor sleep.
Conclusion: Patients report strong links between sleep disturbance and psoriasis symptoms and management in a bi-directional manner that require further testing. The CS-SRM appears to be a valid theoretical model for assessing the beliefs about sleep in people with psoriasis.
Support (If Any): This work was supported by a grant from The Psoriasis Association of Great Britain and Northern Ireland (R117541)

1031

ISOTRETINOIN (13-CIS RETINOIC ACID) IS ASSOCIATED WITH A HIGHER FREQUENCY OF SLEEP APNEA SYNDROME: RESULTS FROM THE US FDA ADVERSE EVENT REPORTING SYSTEM (FAERS)

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Introduction: Isotretinoin (13-cis retinoic acid)(ISO) is a synthetic oral retinoid used mainly for the treatment of nodulocystic acne and some other dermatologic disorders. Retinoic acid plays an important role in the regulation of several biological rhythms including sleep. There are no population-based studies of sleep symptoms associated with ISO use.
Methods: We examined the FAERS database (Jan 2004 - March 2016) for sleep-related adverse events (AE) when ISO was used for (i) for all indications, and (ii) acne alone. Medical Dictionary for

Regulatory Activities preferred terms (PT) was searched to identify Individual Safety Reports (ISR) where ISO was documented as the primary suspect for the sleep-related AE. Reporting odds ratios (ROR) with 95% CI were calculated to indicate the strength of the signal for the sleep-related AE from ISO use.

Results: There were 168,341 ISR which specified ISO as the primary suspect in the AE. The overall risk of sleep-related AE with ISO was examined in 2 analyses: (i) ISO used for any indication versus 'all other drugs' in FAERS revealed the following: 106 ISR reporting 'sleep apnea syndrome'(SA) with ISO among 168,235 total AE reported with ISO, versus 9,442 ISR reporting SA with 'all other drugs' among 23,294,181 total AE reported with 'all other drugs' [ROR=1.55 (95% CI 1.28–1.88), p<0.0001]. The ROR for the following sleep-related AE were lower with ISO versus 'all other drugs': Hypersomnia ROR=0.37 (95% CI 0.32–0.42), p<0.001; Insomnia ROR=0.86 (95% CI 0.80–0.92), p<0.001; Nightmare ROR=0.19 (95% CI 0.13–0.3), p<0.001. (ii)ISO used for acne alone versus 'all other acne treatments' revealed the following: 100 ISR reporting SA with ISO among 150,424 total all other AE with ISO versus 1 ISR reporting SA with 'all other acne treatments' among 210,104 total AE with 'all other acne treatments' [ROR=139.69 (95% CI 18.65–958.42), p<0.0001]. RORs for all other sleep-related AE were non-significant.

Conclusion: National pharmacovigilance data indicate a significantly higher frequency of sleep apnea with ISO when compared to all other drugs; the increased frequency was mainly among patients using ISO for acne. This previously unreported finding needs to be followed up with clinical studies.

Support (If Any): None

1032

STUDY II- SLEEP STUDY IN POSTURAL ORTHOSTATIC TACHYCARDIA SYNDROME (POTS)

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Introduction: Postural Orthostatic Tachycardia Syndrome (POTS) is a form of dysautonomia that is estimated to impact between 1,000,000 and 3,000,000 Americans, and millions more around the world. POTS is associated with variety of symptoms like Headache, Abdominal discomfort, Dizziness/ presyncope, Nausea, Fatigue, Lightheadedness, Sweating, Sleep disorder, Tremor, Anxiety, Palpitations,Exercise intolerance. We have conducted Study I in 51 patients to assess Sleep Indices and Patterns in Postural Orthostatic Tachycardia Syndrome (POTS) presented at SLEEP 2015. We want to take the study further and conduct the research in large cohort of patients.

Methods: 374 patients with POTS were refered to our clinic from June 2014 to April 2016. Sleep study is done in all the patients. Epworth Sleepiness Scale, N1,N2,N3, REM stages, Apnea/hypopnea index-(AHI),SpO2, Sleep HeartRate(HR) bpm, Respiratory Disturbance Index(RDI), Periodic Limb Movements of Sleep(PLMS) index and Total sleep efficiency (TSE) are recorded.

Results: Out of 374 patients, 87% are females (n=327; age 32.66±11.17), 13% are males (n=47; age 30.26±12.50), Epworth scale (9.91±5.33), N1 (7.43% ± 6.57%), N2(56.26% ± 14.62%), N3 (22.05% ± 12.67%), REM(29.44±48.97), AHI (1.89±4.73), Spo2 (90.36±10.95), Sleep HR bpm (70.31±10.30), RDI (3.86±6.32), PLMS index(3.26±9.73), TSE% (74.70% ± 15.77%). Out of 374 patients, 109 patients had >10 Epworth scale, 265 patients had <10 Epworth scale; 171 patients had N1<8% and 203 patients had N1>8%; 170 patients had N2<45% and 204 patients had N2>45%; 127 patients had N3<22% and 247 patients had N3>22%; 98 patients had REM >23% and 276 patients had REM<23%; 31 patients had AHI>5 and 343 patients had AHI<5; 335 patients had < 5 PLMS index and 39 patients had > 5 PLMS index; 54 patients had >85% TSE and 320 had <85% TSE.

Conclusion: Patients with POTS had increased N1, N2, N3, decreased REM sleep stage and decreased Total sleep efficiency. Sleep heart rate is normal in all the patients.

Support (If Any): None

1033

THE RELATIONSHIP BETWEEN INSOMNIA SYMPTOM SEVERITY AND FATIGUE IN PERSONS WITH RELAPSING-REMITTING MULTIPLE SCLEROSIS

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Introduction: Fatigue is one of the most debilitating symptoms of multiple sclerosis (MS), and is present in up to 80% of persons with MS (pwMS). It has also more recently been realized that sleep disorders, including insomnia, are highly prevalent in pwMS. Insomnia is often associated with daytime impairments, such as fatigue, however, few studies have examined the extent to which insomnia is related to fatigue in this population. Thus, this study aimed to examine the relationship between insomnia symptom severity and fatigue in pwMS.

Methods: Preliminary analyses were conducted to examine 13 participants with relapsing-remitting MS (RRMS) who completed a demographic questionnaire, the Insomnia Severity Inventory (ISI), the Fatigue Severity Scale (FSS), and the Beck Depression Inventory Fast Screen (BDI-FS). Participants were excluded if they had experienced an exacerbation of symptoms or change in medical regimen within 30 days of participation. A multiple regression analysis, with ISI and BDI-FS as predictor variables and FSS as outcome variable, was utilized to assess the relationships between insomnia symptom severity, depression, and fatigue.

Results: Participants (M age = 45.6, SD = 6.4) were primarily women (n = 9). ISI scores ranged from 2 - 26, with 30.7% endorsing no significant insomnia, 38% endorsing subthreshold insomnia, and 30.7% endorsing clinically significant insomnia (moderate and severe). ISI scores were significantly associated with FSS scores, after adjusting for BDI-FS scores, b=1.50, SE_b=.40, 95% CI_b [.61, 2.40], p < .01. The overall model explained 62% of the variance seen in FSS scores (R^2 = .62).

Conclusion: Insomnia symptom severity is related to severity of fatigue in those with RRMS. Thus, the treatment of insomnia may lead to significant improvements in fatigue in pwMS.

Support (If Any):

1034

PREVALENCE AND FACTORS ASSOCIATED WITH SLEEP DISTURBANCE AND SLEEP APNEA AMONG PEOPLE LIVING WITH HIV

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Introduction: HIV infection had been reported to be associated with sleep disordered breathing (SDB) and insomnia in Westerns. No

large-scale study had been conducted to investigate sleep disturbance in Asian people living with HIV (PLWH). We prospectively investigated the prevalence and predictors of sleep disturbance and obstructive sleep apnea (OSA) among PLWH in Taiwan, especially the role of depression.

Methods: The consecutive HIV outpatients from 2 tertiary centers were recruited from date to date. The body composition, antiretroviral therapy usage, CD4 count, hypnotics/sedatives and illicit drugs usage, Beck depression inventory-II (BDI-II), Berlin Questionnaire, Epworth Sleepiness Scale (ESS), and Pittsburgh sleep quality index (PSQI) were collected. Body mass index (BMI)>24 $kg/m^2$was considered as overweight. Poor sleep quality was defined as PSQI>5 and excessive daytime sleepiness (EDS) was defined as ESS>10 where depression was defined as BDI-II>16. Patients with high-risk Berlin questionnaire were considered as having OSA. Primary outcome was prevalence and predictors of poor sleep quality where secondary outcome was prevalence and predictors of OSA.

Results: A total of 484 consecutive HIV outpatients were recruited. 96.3% participants were men and 95.5% were under antiretroviral therapy. 78% participants had undetectable plasma viral load where the median CD4 count was 535.9 $/mm^3$. 20% participants had OSA. Around 70% patients had poor sleep quality, 27% had EDS, and 26% had depression. Depression was the only independent factor predictive of poor sleep quality (OR: 3.22, 95% CI 1.89–5.50). Factors predictive of OSA included hypnotics/sedatives use (OR:1.75, 95% CI 1.05–2.93), BMI (kg/m^2) (OR:1.13, 95% CI 1.06–1.21), depression (OR: 2.84, 95% CI 1.74–4.63) and antiretroviral agent with combination of integrase inhibitor (OR: 1.72, 95% CI 1.00–2.95). Viral load and CD4 count was not associated with any of poor sleep quality, OSA, and depression.

Conclusion: The prevalence of sleep disturbance and OSA was high among Asian PLWH. Depression was predictive of both poor sleep quality and OSA. Moreover, hypnotics and antiretroviral agent were associated with OSA in addition to obesity.

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1035

EXPLORING DISRUPTED SLEEP IN A POPULATION OF OLDER ADULTS LIVING WITH HIV

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Introduction: Over 1.2 million people in the United States are living with HIV, and more than half are 50 years of age and older. Disrupted sleep negatively impacts this aging population. Aging is known to alter circadian and thermoregulatory mechanisms essential to regulating the sleep cycle, and HIV itself may speed the aging process, contributing to earlier onset, and increased prevalence of disrupted sleep. Poor sleep adversely affects medication adherence, quality of life, and survival, and contributes to daytime sleepiness and fatigue. The purpose of this study was to assess determinants of cognitive function.

Methods: This data is from a randomized controlled pilot study examining cognitive function in older adults with HIV. Twenty-four adults with HIV 50 years of age and older were recruited from an infectious disease clinic at a Midwestern University. Participants' mean age was 56.2 (SD = 5.15), with 14.3 years of education (SD = 1.80). The majority were male (88%), African American (67%), and had been living with HIV for 19.88 years (SD = 8.14). Instruments included the Pittsburgh Sleep Quality Index, the Montreal Cognitive Assessment, and the Center for Epidemiological Studies Depression Scale.

Results: Eighty-eight percent of study participants were classified as poor sleepers (PSQI Global Score >5). Two-thirds of participants reported sleep duration of less than 7 hours most nights over the last month. Nearly 60% experienced delayed sleep onset latency (>30 minutes to fall asleep). Sleep efficiency was also problematic with over half reporting sleep efficiency scores of <75% (total hours of sleep / total hours in bed). Global sleep scores were positively correlated with increased depressive symptoms ($p = .001$), as were the component scores of sleep quality ($p = .001$) and sleep disturbance ($p = .017$). Sleep duration had a positive significant correlation with cognitive function ($p = .018$).

Conclusion: Sleep problems are negatively impacting a large segment of the older HIV population, and advances in HIV care have not included improved sleep for this aging population. Determining specific sleep issues adversely affecting this population is a necessary first step in developing non-pharmacological interventions designed to improve sleep.

Support (If Any):

1036

UNANTICIPATED SLEEP BENEFITS AMONG GAY AND BISEXUAL MEN PARTICIPATING IN AN EHEALTH INTERVENTION TO REDUCE SEXUAL RISK BEHAVIORS

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Introduction: E-health interventions for HIV-positive populations have led to significant declines in transmission risk behaviors, as well as improvements in mental health, antiretroviral therapy (ART) adherence, and overall well-being. But what impact might these interventions have on sleep health? Research has shown that poor sleep quality in persons living with HIV is associated with psychological distress and suboptimal ART adherence, the latter being critical to viral suppression. Thus, e-health interventions targeting mental health, HIV care, and/or sexual risk may inadvertently have a positive effect on sleep quality. Using data from a video-based e-health sexual risk reduction intervention designed for HIV-positive gay, bisexual, and other men who have sex with men (GBMSM), this presentation examines the potential impact of participation on sleep health and related outcomes.

Methods: We randomized 830 men to an intervention or attention control arm. Study assessments were conducted online. Mean age was 39 years; 50% identified as Black or Hispanic/Latino. During study screening and at 9-months post-enrollment, we assessed participants' past month sleep quality (very or fairly bad, very or fairly good) and use of sleep medications. We also assessed recent symptoms of psychological distress, perceived resilience, and ART adherence.

Results: Compared to study screening, participants across study arms reported significant improvement in sleep quality (57% vs. 66%; $p<.001$) and less use of sleep medications (35% vs. 28%; $p<.05$) at 9-months. Good sleepers at 9-months were more resilient than poor sleepers ($p<.001$). In age-adjusted logistic regression analyses, good sleepers had significantly decreased odds of reporting suboptimal ART adherence (Adjusted odds ratio [AOR] = 0.50, 95% Confidence interval [CI] = 0.32–0.78), clinical symptoms of depression (AOR=0.23, CI=0.15–0.34), and clinical symptoms of anxiety (AOR=0.22, CI=0.15–0.33).

Conclusion: Findings suggest that participating in research designed to reduce sexual transmission among HIV-positive men may also lead

to adoption of other healthy behaviors not accounted for in study design (i.e., sleep). This is of particular relevance to GBMSM who bear a disproportionate burden of HIV, but are underrepresented in HIV-associated sleep research.

Support (If Any): This research was supported by a grant from the National Institute of Mental Health (R01 MH100973; PI: Hirshfield).

1037

INSOMNIA IN BREAST CANCER: PREVALENCE, EVOLUTION AND PREDICTORS.

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Introduction: Insomnia is a significant public health problem that is particularly prevalent amongst cancer populations. Highest rates are reported by breast cancer patients, with prevalence estimates ranging from 42%-69%. Psychological adjustment to diagnosis and physical side effects of treatment are potential precipitating factors for insomnia. However, following completion of cancer treatment, insomnia seems to remain a persistent problem in around 25–35% of these patients. In light of this, our aim is to monitor the naturally occurring development and/or remission of insomnia over a 12-month period and to identify potential factors that contribute to these trajectories.

Methods: 173 females (mean age 58 yrs.) with a current diagnosis of non-metastatic breast cancer participated in the study. All completed an insomnia screening interview at baseline and at monthly intervals thereafter until month 12. Based on their responses, patients were classified into one of three groups; good sleepers (GS), insomnia symptoms (ISym) or insomnia syndrome (IS). Patients also completed a range of validated measures of mood, coping, QoL and stress.

Results: Point prevalence of insomnia at pre-diagnosis was 25%, including 8% with IS and 17% with ISym. Prevalence of insomnia increased at diagnosis to 46%, of which, 18% had IS and 28% had ISym. Rates of insomnia remained stable thereafter at around 50% (46.2%-56.3%), comprising 21% (18.2%-24.6%) with IS and 30% (28.1%-32.9%) with ISym. The probability of changing sleep status was explored and at all time-points except one, the most common transitions were to stay a good sleeper (34%-49%) or persist with insomnia (23%-46%). 77% of good sleepers developed insomnia at some point during the 12-month period and 54% went into remission. In terms of predicting insomnia risk, two main factors were identified: chemotherapy (odds ratio=0.08, 95% ci 0.02–0.29, p<.001) and pre-diagnosis ISI score (odds ratio=1.13/unit increase in pre-diagnosis sleep score, 95% ci 1.05–1.21, p=.001).

Conclusion: Insomnia is a prevalent and persistent problem in breast cancer populations. Patients are particularly vulnerable during the period immediately following diagnosis (especially if they have a history of poor sleep) and chemotherapy is a risk factor for persistent insomnia.

Support (If Any): Project Grant from Breast Cancer Campaign

1038

OBJECTIVE CORRELATES OF SLEEP COMPLAINT IN CANCER PATIENTS ON CHEMOTHERAPY TELE-MONITORED AT HOME: NIGHT-BY-NIGHT ANALYSIS.

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Introduction: Current wrist-actigraphy parameters poorly identify the cancer patients, who subjectively report poor sleep. However, most studies average multiple nights of data, not accounting for the changes that can occur while on treatment. Hence, our aim was to understand, on a night-by-night basis, the objective measures which best correlated with subjective sleep complaints.

Methods: We investigated associations between sleep duration, timing, efficiency, latency and fragmentation, objectively measured by wrist-actigraphy, and the severity of self-rated sleep disturbance reported on the following day using a 0–10 scale questionnaire (M.D. Anderson Symptom Inventory) completed on a touch-screen computer at home. We used a dataset of 595 nights in 31 patients with advanced cancer participating in a pilot domomedicine study (inCASA project). First, we evaluated associations between actigraphy parameters and subjective sleep rating with Spearman's correlations. Then, we categorised the objective sleep data into two groups depending on whether sleep disturbance was rated lower or higher than 2, which was previously found as corresponding to a level of intensity comfortable for the patient. Actigraphy parameters were compared in both groups using Mann-Whitney U-test. Multivariate regressions and classification and regression tree analysis were performed to identify independent predictors of subjective sleep.

Results: Sleep complaint severity was negatively correlated with timing of awakening ($r=-0.22$, $p<0.001$), total sleep time ($r=-0.19$, $p<0.001$) and sleep efficiency ($r=-0.19$, $p<0.001$). These associations were confirmed ($p<0.001$), with a median 40-min advance in timing of awakening, a median total sleep time shorter by 36 minutes, and a median sleep efficiency less by 2% for the nights rated as associated to sleep disruption as compared to comfortable sleep.

Conclusion: The night-by-night approach within a multidimensional home tele-monitoring framework identified early awakening, short total sleep time and low sleep efficiency as significant objective correlates of poor sleep complaint in cancer patients on chemotherapy. These findings, if confirmed, will inform the development of both effective interventions and real time assessment in this frail patient population.

Support (If Any): European Commission through the ICT Policy Support Programme project inCASA (Contract CIP 250505, FP7), and the Coordinating Action Systems Medicine (CASyM) through research exchange grants in Systems Medicine.

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SLEEP, FATIGUE, AND DEPRESSIVE SYMPTOMS AMONG GYNECOLOGICAL CANCER POSTSURGICAL TREATMENT PATIENTS IN TAIWAN

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Introduction: Sleep disturbances, fatigue and depression are common symptoms experienced by cancer patients before, during, and after treatment. A few studies have suggested associations among these symptoms and call it as symptom cluster; however, they have rarely been studied together. This study aimed to describe the characteristics of sleep, fatigue, and depressive symptoms among women with gynecological cancer postsurgicaltreatment period, and to explore the associations among the symptoms.
Methods: A total of 170 gynecological cancer women, from outpatient clinic at a teaching hospital in southern Taiwan, participated this study. They completed a battery of questioonaires, including sociodemographic form, General Sleep Disturbance Scale, Lee Fatigue Scale, and Center for Epidemiological Studies Depression to assess their sleep, fatigue, depressive symptoms and the counfounding variables.
Results: The mean age of the participants was 54.8 (SD= 10.7). Majority of them was within one-year postsurgical procedure (42.4%), had either overian cancer (37.6%) or endometrial cancer (35.3%), and diagnozed stage I (58.2%) cancer as indexed by the staging system from the International Federation of Gynecology and Obstetrics (FIGO). About one third of the women reported clinical significant sleep disturbances, fatigue, and depressive symptoms; half of them experienced clinical significant poor sleep quality. Regardless types of cancer and length of duration postsurgical treatment, women reported a compatible severity of poor sleep, fatigue, and depressive symptoms. However, significant differences in sleep disturbances and fatigue severity were observed among women with different FIGO stage of cancer, and those in stage III reported the worst symptoms. After control of age, stage of cancer and duration postsurgical treatment, sleep disturbances along with fatigue severity explained 33% of the variance of depressive symptoms.
Conclusion: Women with gynecological cancer experienced sleep disturbances and fatigue that placed them at risk for poor mental, and may compromise their recovery. Fatigue has been found to impact patients' treatment decision and limit their self-care ability which warrant for further study. Nurses need to assess sleep, fatigue, and depressive symptoms during the early stages of women with gynecological cancer and provide care to promote their sleep and well-being.
Support (If Any): Ministry of Science and Technology, ROC (104WFA0950218)

1040

PATTERNS OF SLEEP DISORDER AMONG ADULT CANCER PATIENTS IN A NIGERIAN HOSPITAL

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Introduction: Sleep disorders are common among oncology patients. It has been reported that one-third to one-half of people with cancer has sleep disturbance. This study aims at assessing the prevalence and pattern of sleep disorders among patients with cancer presenting in a Nigerian hospital and then determine the possible factors that are responsible.
Methods: It is a descriptive cross-sectional study. All the patients attending the oncology unit over a 6-month period are assessed with a self-administered instrument including a questionnaire on Sociodemographic characteristics and anthropometric measures, type of cancer and treatment modality, Karnofsky Performance Status Scale (KPSS), Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS) and Hospital Anxiety Depression Scale (HADS).
Results: As it is an ongoing study, there are 57 participants at present (Male 33.3%). Preliminary report shows that majority (42.6%) has cancer affecting the Gastrointestinal tract with Chemotherapy the treatment of choice in majority (27.8%). The prevalence of poor sleep quality is 50% while about 18% has significant daytime sleepiness. About one-fourth of the study participants also have significant anxiety and depressive symptoms. The factors associated with sleep quality were also explored.
Conclusion: Sleep disorders are frequently underestimated among patients with cancer despite the enormous adverse impact they have on their quality of life. Therefore, adequate assessment of sleep pattern is imperative and should identify factors influencing or causing abnormality in sleep in order to obtain optimal cancer management.
Support (If Any): None

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THE EFFECT OF REDUCING SEDENTARY BEHAVIOR ON SLEEP QUALITY AMONG ADULTS WITH CHRONIC LOW BACK PAIN: A RANDOMIZED CONTROLLED PILOT STUDY

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Introduction: Chronic low back pain (LBP) is a common condition among desk-bound employees due to prolonged sitting and is often associated with impaired sleep quality. This study examined whether an intervention focused on reducing sedentary behavior resulted in improved sleep quality in adults with chronic LBP.
Methods: 24 adults (49.7 ± 10.8 y, 75% female) with chronic LBP, Oswestry Disability Index (ODI) >10 %, and desk-bound jobs with ≥20 h/wk of sitting completed the study. Participants were randomized to one of two 6-mo treatments: (1) a no-treatment control condition (n=12) or (2) an intervention focused on reducing prolonged sitting (n=12). The intervention included behavioral counseling (initial in-person visit, monthly telephone calls), a sit-stand desk attachment with a goal to stand for 2 h each day, and an activity-prompting device that vibrated after 30 min of inactivity. At baseline and 6 mo, sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI), LBP was measured using the ODI, and sitting time (work and overall) was assessed by self-report. Paired t-tests and analysis of covariance examined within- and between-condition changes, respectively, in PSQI, ODI, and sitting time; Pearson correlations evaluated associations between changes in sitting time, pain, and sleep.
Results: At baseline, ODI was 24.4 ± 10.4%, daily sitting time was 6.9 ± 1.1 h (work) and 10.2 ± 1.9 h (overall), and PSQI score was 7.8 ± 3.7. Both conditions reduced overall and work-based sitting time over 6 mo ($P<.01$), with a greater between-condition reduction in sitting time in the intervention ($P\leq.04$). ODI improved from baseline within the intervention condition ($P=.002$), and tended to improve more than control ($P=.09$). Over 6 mo, sleep quality tended to improve with the intervention ($P=.08$); however, the between-group change was nonsignificant ($P=.49$). In the full sample, 6-mo reductions in

sedentary time were correlated with increased total sleep time (TST; r≥-.30), and ODI reduction was correlated with increased TST (r=-.30) and reduced PSQI score (r=.42).
Conclusion: These pilot data provide preliminary evidence that reducing sitting time may improve sleep quality through reduced pain among adults with chronic LBP. Larger trials with more comprehensive sleep assessments are needed to substantiate these findings.
Support (If Any): None

1042
SLEEP MODERATES THE RELATIONSHIP BETWEEN TEMPOROMANDIBULAR JOINT DISORDER AND PRESSURE PAIN THRESHOLD
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Introduction: Recent research suggests a complex reciprocal relationship exists between the experience of pain and various sleep processes. Disturbed sleep increases pain perception and sensitivity, while pain adversely impacts sleep quality and duration. Consequently, sleep disturbance is prevalent among those with chronic pain conditions. The present study examined whether sleep duration and quality moderate the relationship between group status and pressure pain threshold in temporomandibular joint disorder (TMJD).
Methods: Participants were divided into two groups: patients diagnosed with TMJD and pain-free healthy controls. A total of 53 participants (62% TMJD) completed quantitative sensory testing (QST) procedures, including assessment of pressure pain thresholds at multiple body sites (masseter and trapezius). Sleep duration was assessed via self-report of sleep/wake patterns and sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI).
Results: TMJD patients reported receiving significantly less sleep and poorer sleep quality compared to healthy controls; TMJD patients also displayed greater pressure pain sensitivity. Depression, clinical pain severity, and pain catastrophizing were controlled for in the analyses due to the strong correlations between psychosocial factors and clinical pain with measures of sleep and with pain outcomes. Both sleep duration and quality independently moderated the group difference in pressure pain threshold on the trapezius, but not the masseter. Interestingly, TMJD patients receiving more sleep, and reporting greater sleep quality showed decreased pain sensitivity, suggesting that increased sleep duration and greater sleep quality may exert protective effects.
Conclusion: Our finding that sleep duration and quality moderate the group difference in trapezius, but not masseter pressure pain threshold, may suggest a sleep-widespread pain connection and hints that central sensitization mechanisms may be involved. Further research should explore whether the negative outcomes associated with TMJD pain may be alleviated by interventions targeting sleep disturbance.
Support (If Any):

1043
SLEEP AND PAIN AROUND HYSTERECTOMY: A PROSPECTIVE COHORT STUDY
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Introduction: Hysterectomy is the most frequent non-pregnancy-related major surgery in reproductive-aged women. Proper pain management represents a critical peri-operative goal. Although the association of chronic pain and sleep disorders is well known, the relation between perioperative pain and sleep is less studied. This study tested the hypothesis pre-operative sleep patterns would predict post-hysterectomy pain perception.
Methods: A prospective cohort study of women undergoing hysterectomy for benign conditions. Measures included: PROMIS-PI 3a (pain intensity), total sleep time measured by wrist actigraphy and daily sleep diary, and time awake after sleep onset measured by actigraphy and sleep diary. Sleep diary and actigraphy sleep variables were averaged over 7 nights preceding and 7 nights following hysterectomy.
Results: Sixteen women (41 ± 7.3 years old) participated in the study. Repeated measures ANOVA revealed a significant increases from pre- to post-hysterectomy in actigraphy total sleep time (402 ± 43.7 vs. 481 ± 85.8 min, p=.023), and diary time awake after sleep onset (28 ± 11.4 vs. 58 ± 17.7 min, p=.014). Pre-hysterectomy diary total sleep time was negatively correlated with post-hysterectomy pain intensity (r= -.92, p=.01). Pre-hysterectomy actigraphy time awake after sleep onset was positively correlated with post-hysterectomy pain intensity (r=.86, p=.008).
Conclusion: Findings indicated that sleep duration and disturbance increased following hysterectomy. Shorter sleep duration and more disturbed sleep before hysterectomy were associated with greater perceived pain intensity following hysterectomy. These findings suggest that pre-operative sleep interventions could improve pain perception and recovery following hysterectomy.
Support (If Any): National Institutes of Health Grant # K23NR014008 (PI: Nowakowski)

1044
IS PAIN INCONSISTENCY OR AVERAGE PAIN MORE ASSOCIATED WITH SLEEP IN OLDER ADULTS?
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Introduction: Sleep declines in late life. Negative associations between sleep and depression in older adults are well-established. Further complicating daily functioning, pain often coexists with depression and sleep disturbance. While research has shown that higher average levels of pain are associated with poorer sleep, pain can vary significantly from day-to-day. This study addressed how different quantifications of pain (average vs. daily inconsistency) are related to sleep above and beyond known predictors.
Methods: Baseline measures from the Active Adult Mentoring Project were used for secondary analyses. Participants included 82 community-dwelling older adults (mean age=63.37, 82.9% female). Depression was assessed using the BDI-II. Pain, measured on a scale ranging from 0 (no pain) to 10 (worst pain), and sleep efficiency, calculated from data gathered using sleep diaries, were both assessed for seven consecutive days. Pain was operationalized as either the seven-day mean or the seven-day individual standard deviation.
Results: A three-block hierarchical multiple regression was conducted with sleep efficiency as the dependent variable. In block one,

neither age (β=-.04 p=.75) nor gender (β=.09, p=.43) were associated with sleep efficiency. In block two, depression was negatively associated with sleep efficiency (β=-.49, p<.001; ΔR^2=.23, p<.001). In the third block, pain inconsistency was negatively related to sleep efficiency (β=-.21, p<.05) and accounted for significant variance above age, gender, and depression (ΔR^2=.04, p<.05). In contrast, when average pain was entered in stage three, it was not associated with sleep efficiency (β=-.12, p=.28; ΔR^2=.01, p=.28).

Conclusion: Results support an association between sleep disturbance and pain in community-dwelling older adults. The findings indicate that day-to-day fluctuations in pain may be a more meaningful predictor of sleep disturbance than average pain level, as pain fluctuations may indicate weakened biological mechanisms associated with sleep. Given these findings, pain inconsistency warrants further attention as it relates to sleep in older adults.

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INCREASED RISK FOR HEADACHE, BUT NOT OTHER MUSCUOLOSKELETAL PAIN COMPLAINTS, AFTER NIGHT SHIFT IN NURSES

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Introduction: Shiftwork, particularly night work, is considered a risk factor for developing musculoskeletal pain. However, it is not known how pain complaints are related to shift work on a daily basis. The aim of the present study was to determine whether the risk of having musculoskeletal pain complaints in the evening was higher after an evening or night shift, compared to after a morning shift.

Methods: Nurses (N=723, 649 female, aged 22–63 years) working rotating shifts (morning, evening and night), answered questions on circardian rythms, demographic factors, work factors and lifestyle factors. Each evening for a period of 28 consecutive days they answered a smartphone diary about shift type (morning, evening, night, or day off) and pain complaints (headache, neck/shoulder pain, back pain, hand/arm pain and hip/leg pain) on an ordinal scale. Pain scores were dichotomized into pain/no pain. Repeated measures logistic regression analyses were run to determine the odds ratio (OR) of having each pain complaint.

Results: The results showed a higher risk of headache (OR = 1.26, p<.01) and a lower risk of hip/leg pain (OR = .80, p<.05) after nights shifts as compared to after morning shifts. The risk for pain in the neck/shoulder, hand/arm or back did not differ between shifts. The results showed a lower risk for all types of pain on days off (OR = .61-.88, p<.05). Analyses were adjusted for demographic factors, previous pain complaints, sleep problems, psychosocial and mechanical work factors.

Conclusion: The results indicate that nurses in rotating shiftwork have a higher risk for headache after night shifts vs. after morning shifts. However, the nurses does not seem to be more bothered by any of the other musculoskeletal pain complaints in question after evening or night shifts, than after morning shifts.

Support (If Any): The work was supported by the National Institute of Occupational Health

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ASSESSMENT OF SLEEP AND INFLAMMATION IN CHRONIC OROFACIAL PAIN: A PRELIMINARY STUDY

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Introduction: Sleep disturbances, which are commonly reported in Temporomandibular disorder (TMD), may confer increased risk for the development, progression, and persistence of pain through changes in homeostatic regulatory mechanisms including the immune system. The primary purpose of the current pilot study was to examine case-control differences in subjective and objective sleep measures and its relationship with the inflammatory cytokine, Interleukin 6 (IL-6).

Methods: Twenty-five individuals with TMD and 24 healthy controls completed a sleep diary and actigraphy (ActiGraph wGT3X; non-dominat wrist) over a 7-day period. On day 7, blood was collected for analysis of IL-6 levels. Group differences in IL-6 and self-reported sleep quality (0–4 scale) and efficiency in addition to actigraphy-based measures (sleep efficiency; wake after sleep onset, WASO) were averaged and evaluated as dependent variables in analyses of covariance controlling for body mass index (BMI). Data was presented as means and 95% confidence intervals (CI). Associations between sleep and IL-6 were assessed with partial correlations.

Results: Self-reported sleep differed between TMD and healthy controls (HC) such that TMD participants reported poor sleep quality (TMD: 3.39, 3.34-3.45 95%CI; HC: 3.86, 3.81-3.91 95%CI; p<0.001) and lower sleep efficiency (TMD: 86.81, 86.23-87.38 95%CI; HC: 91.99, 91.44-92.56 95%CI; p<0.001). In addition, similar differences were observed for actigraphy-based outcomes including poorer sleep efficiency (TMD: 82.73, 82.32-83.14 95%CI; HC: 85.40, 85.00-85.79 95%CI; p<0.001) and longer WASO (TMD: 76.53, 74.50-78.55 95%CI; HC: 56.74, 54.78-58.68 95%CI; p<0.001) in TMD participants compared to HC. TMD participants also had higher levels of IL-6 (TMD: 13.49, 13.06-13.94 95%CI; HC: 3.67, 3.25-4.09 95%CI; p<0.001). Additionally, IL-6 was associated with self-reported measures whereby higher levels of IL-6 were associated with poorer sleep quality (r=-0.27, p=0.02) and efficiency (r=-0.42, p<0.001). Associations with actigraphy outcomes were not significant.

Conclusion: The current study supports previous studies that individuals with chronic pain commonly report disturbed sleep, which may contribute to clinical pain through a pro-inflammatory imbalance (i.e., enhanced IL-6 roduction). While further analysis regarding the discrepancy between objective and subjective parameters on IL-6 is needed, sleep behaviors should be considered as a method to manage TMD.

Support (If Any): K99DE022368 (NIDCR)

1047

SLEEP DISTURBANCE AND THE IMMUNOLOGICAL ACUTE PHASE RESPONSE IN POSTOPERATIVE HOSPITALIZED ADULTS.

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Introduction: Despite numerous studies documenting sleep disturbance in surgical patients, few studies have examined mechanisms that may contribute to disturbed sleep.

Methods: This descriptive, repeated measures, correlational study examined subjective and objective sleep patterns, and inflammatory and stress responses in postoperative abdominal surgical patients

to explore a possible relationship between sleep and biomarkers of inflammation and stress. Nineteen subjects, mean age 45.63 years (SD=11.44), were enrolled. Actigraphy was used to measure sleep variables over the postoperative period. Salivary biomarkers of the acute phase response IL 1-β and TNF-α and stress response, cortisol, were collected at baseline, and on day 3 and 4. Subjective measures of sleep and systolic blood pressure were measured with biomarkers.

Results: Sleep disturbance occurred in all subjects. Median total sleep time was 8.7 hours on day 1 and then declined to 6.8 hours on day 4, $F=2.9$, $p < 0.05$. Sleep efficiency median 83.8 % day 1 and decreased over the 4 days to 68.1%, $F=6.3$, $p=0.001$. Sleep onset latency within normal limits day 1 and outside the normal range on the remaining days as were number of awakenings and wake after sleep onset. Subjective sleep disturbance with fragmentation, increased sleep onset latency and supplemental daytime sleep was reported by all subjects. The IL1-β measures greatly exceeded the normal range with pre-and postoperative measures ≥ 1070 pg/ml, and for 2 subjects levels were <10900 pg/ml during the 4 post-operative days of hospitalization. TNF-α levels were also elevated, with highest level range of 57.31 to 523.02 pg/ml during the 4 days of hospitalization. Preoperative cortisol levels were elevated. After the third night of sleep during hospitalization, there were significant between median sleep efficiency and IL1-β (r_s=0.76), median sleep onset latency and IL1-β (r_s = -0.55), and median sleep efficiency and TNF-α (r_s=0.55). Correlations between subjective sleep effectiveness scale and cortisol was $r = 0.62$ ($p < 0.006$); sleep effectiveness and systolic blood pressure was $r = 0.55$ ($p < 0.014$).

Conclusion: Most patients experience disturbed sleep and exaggerated inflammatory responses.

Support (If Any): Wayne State University Graduate School & College of Nursing.Sigma Theta Tau International, Zeta Chapter

1048

SLEEP DISTURBANCES EXPERIENCED BY MILITARY BURN SURVIVORS

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Introduction: Due to advances in burn care, many service members survive their injuries. Following discharge, military burn survivors continue to experience sleep disturbances; however we understand little about this population's sleep disturbances. We examined military burn survivors subjective sleep disturbances over time.

Methods: Descriptive data were gathered at: burn center discharge; 3, 6, 12, and 18 months post-discharge. Sleep items were used from the: Burn Specific Health Scale-A (BSHS-A; 1 item), Post-Traumatic Distress Check List- Military (PCL-M; 2 items), and Center for Epidemiologic Studies Depression Scale (CESD; 4 items); demographic and clinical history were collected. Analysis: descriptive statistics and repeated measures ANOVA. Cronbach's alpha determined reliability of the sleep questions "measurement tool." Sleep questions were factor analyzed using exploratory principal components analysis.

Results: 78 service members enrolled, (n=64 at 18 months). Participants were primarily Army (74%), enlisted (96%) and averaging 62 months of service. Most were Caucasian (69%), males (n=97%) with a mean age of 25. They had thermal burns and polytrauma resulting from combat injuries and accidents with a mean total body surface area burned = 24%; average burn unit stay was 44 days. Patients reported persistent nightmares (50%); insomnia (71%); hypersomnia (31%) and excessive daytime sleepiness (63%). Sleep disturbances persisted at 18 month post-discharge. Cronbach's alpha for the sleep questions was .87 and in factor analysis all 7 questions loaded on 1 component, Sleep, with 60% of the variance explained (eigenvalue 4.169). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .83 and Bartlett's Test of Sphericity was significant ($p <.000$; $df=21$).

Conclusion: Knowledge of burn patients' sleep disturbances is critical for rehabilitation progress and psychosocial needs. The 7 questions analyzed are commonly used with military and civilian patients. Reliability and factor analyses indicated these questions can be used to measure sleep in this population, decreasing research burden for the patients.

Support (If Any): This study was funded by the TriService Nursing Research Program.

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PREVALENCE OF SLEEP DISTURBANCES AND THEIR CONSEQUENCES IN PATIENTS AT RISK FOR CARDIOVASCULAR DISEASE

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Introduction: Disturbed sleep is strongly associated with incident cardiovascular disease (CVD). We report the prevalence of sleep disturbances and their sequellae in patients attending our prospective CVD Prevention Program Registry, a population at increased risk of CVD.

Methods: At program entry, patients completed validated questionnaires: Berlin Questionnaire for sleep apnea, Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), and Stanford Fatigue Scale. Means and standard deviations provide descriptive statistics and Pearson correlations describe pertinent associations.

Results: Of 485 consecutive program participants (mean age 60.5 ± 13.6 years, 70% women, 65% White, 27% Black, 4% Hispanic, 5% other) only 11% were diagnosed with coronary disease and 2% with stroke. Screening for sleep apnea was positive in 49% of participants and sleep apnea was previously diagnosed in 26%. Mean PSQI was 7.1 ± 3.9, with 39% normal sleepers (PSQI<5), 43% with mild derangement, 13% moderate, and 5% severe. Mean total sleep time (TST) was 6.3 ± 1.3 hours with only 41% getting the recommended 7 or more hours per night. Of the other participants, 30% slept 6 to 7 hours, and 28% slept less than 6 hours. Mean sleep latency was prolonged at 19.0 ± 26.7 minutes. Mean ESS was 8.7 ± 5.5 but 40% scored in the sleepy range (ESS&gt10 of 24). Mean fatigue score was 4.3 ± 2.4 with 47% scoring in the fatigued range (score&gt5 of 10). Increased levels of perceived stress were strongly correlated with poor sleep quality (*Pr*=0.452) and increased fatigue scores (*Pr*=0.430), and mildly correlated with daytime sleepiness (*Pr*=0.267).

Conclusion: Participants in our CVD prevention program, a population at increased risk for CVD, show evidence of substantial sleep disturbances. Nearly 3/4 of our population screens positive for sleep apnea and a majority experiences poor sleep quality and low TST. Poor sleep quality and consequent daytime symptoms correlate with increased levels of perceived stress, magnifying CVD risk.

Support (If Any): This work is funded by the Henry M. Jackson Foundation for the Advancement of Military Medicine.

1050

UTILITY OF NT-PROBNP TO SCREEN FOR HEART FAILURE WITH REDUCED EJECTION FRACTION IN CENTRAL SLEEP APNEA CONSIDERED FOR ADAPTIVE SERVOVENTILATION

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Introduction: Adaptive servoventilation (ASV) has been demonstrated to better control disordered breathing events in patients with

central sleep apnea (CSA). However, in the recent SERVE-HF trial, increased all-cause and cardiovascular mortality was observed in patients with symptomatic heart failure (HF) with left ventricular ejection fraction (LVEF) ≤45% and CSA treated with ASV. Wait times for echocardiography can vary between 2 to 6 weeks. The aim of this study was to determine whether there is an NT-proBNP level that corresponds to LVEF <45% in candidates for ASV treatment.
Methods: A retrospective chart review of patients with CSA commenced on ASV was performed on a Rochester Epidemiology Project cohort from Olmsted County, MN (n=315). LVEF reported on echocardiography performed closest to date of diagnostic polysomnography and NT-proBNP level obtained within 1 year of echocardiography, were recorded.
Results: A total of 117 subjects (mean age 73.5 ± 12.3 years, 82.1% male, 98.3% white, mean BMI 30.84 ± 6.25 kg/m^2) had NT-proBNP level performed within 1 year of polysomnography. Median EF was 45% (Q1:30, Q3: 60%) and median NT-proBNP 1472 pg/mL (Q1:700, Q3: 3210pg/mL). Forty-eight % of patients had LVEF<45%. NT-proBNP negatively correlated with LVEF (Pearson's correlation coefficient -0.17, p=0.001). The receiver operating characteristic (ROC) curve generated by examining different BNP thresholds for predicting EF< 45, had an area under the curve of 0.63 (SE 0.05, 95% CI 0.53–0.71, p=0.016). NT-proBNP level >453pg/mL corresponded to LVEF<45% with sensitivity of 91% and specificity of 23% (95% CI 13.4–36.0) whereas NT-proBNP >4134pg/mL (LVEF <45%) had a specificity of 90.0% and sensitivity of 30.3% (95% CI 79.5–96.2).
Conclusion: NT-proBNP level >453pg/mL in conjunction with clinical history in patients with CSA, who are candidates for ASV treatment, may help identify those that need further testing with echocardiography to estimate LVEF. NT-proBNP value >4134pg/mL could conceivably eliminate need for routine echocardiography in this group of patients. Addition of other clinical variables might further refine predictive capabilities.
Support (If Any):

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SLOW WAVE SLEEP IN PATIENTS WITH ATRIAL FIBRILLATION

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Introduction: Atrial fibrillation (AF) is the most common cardiac arrhythmia and is associated with poor quality of life and increased morbidity and mortality. Poor subjective sleep quality has been reported in patients with AF. However, objectively measured sleep characteristics of patients with AF remains unclear. Slow wave sleep (SWS) is considered the most restorative sleep stage. The aim of the study was to compare quantity of SWS between patients with and without AF.
Methods: In a retrospective manner, we included patients with and without AF (control) who underwent clinically indicated sleep study at a single sleep center over 3 year period in a consecutive manner. SWS time (N3 sleep time) was compared between the two groups using a Mann-Whitney test. Multiple linear regression was then performed designating log transformed SWS time as a dependent variable adjusting for age, sex and sleep apnea (defined by apnea hypopnea index>15/hr). Analysis was repeated after exclusion of patients on medications with potential influence on sleep architecture.
Results: A total of 183 subjects (133 with AF, 50 without AF) were included. Mean age was 62 (SD: 13) years old and 42% were women. The prevalence of sleep apnea was similar between the two groups (57 % vs.56% for patients with vs. without AF). No significant difference in SWS time was found between the two groups (IQR: 0–19.4 vs. 0–30.4 min, p=0.14). In multivariable analysis, SWS time was significantly lower in patients with AF vs. without AF (Geometric mean difference: 1.9 [95% CI: 1.2–2.8] min, p=0.003). The results remained similar after excluding patients (N=23) on medications with potential influence on SWS.
Conclusion: Patients with AF spent significantly less SWS time (albeit small absolute difference) during sleep compared to those without AF. Whether this represents clinically meaningful difference in sleep quality is unclear and warrants further studies.
Support (If Any): None.

1052

THE EFFECT OF NON INVASIVE VENTILATOR FOR SLEEP APNEA IN ATRIAL FIBRILLATION/FLUTTER PATIENTS

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Introduction: A strong association between obstructive sleep apnea (OSA) and atrial fibrillation/atrial flutter (AF) has been consistently observed in both epidemiological and clinical cohort studies. The effect of treatment with positive airway pressure (PAP) on AF recurrence is not conclusive. This study aims to evaluate the effect of treatment of sleep apnea with PAP on AF recurrence.
Methods: This is a single-center retrospective study conducted at a tertiary referral hospital. All adult patients who had OSA documented by polysomnography (PSG) and had AF intervention (ablation or cardioversion) after PSG from January 1992 to December 2014 were analyzed in this study. The primary outcome was time to recurrence of AF after AF intervention calculated by Kaplan-Meier.
Results: Among 30,188 patients who diagnosed of sleep apnea by polysomnography. 429 patients had a polysomnography-confirmed diagnosis of Sleep Apnea before AF intervention. While 269 patients were "PAP compliance users" the remaining 160 patients were "PAP nonusers." Patients in both groups had similar age, gender; body mass index, ejection fraction, left atrial index, antiarrhythmia medications and rates of diabetes, hypertension, and congestive heart failure. Times to recurrence of AF after AF intervention of PAP users were not significantly different from PAP nonusers (4.8 and 4.1 months respectively, P = 0.7).
Conclusion: Our study found no effect of sleep apnea treatment with PAP in duration of time to recurrence of AF after AF intervention. Left atrial index, type of intervention (cardioversion compared with AF ablation), usage of diuretic, digoxin and sotalol. Type of intervention was the strongest independent predictor of recurrent AF after catheter ablation (OR = 2.03,P = 0.0002). BMI and Left atrial index were also significant with adjust analysis. Increase risk of recurrence AF in high BMI. This finding may impact the clinical management of AF.
Support (If Any):

1053

COMPARATIVE PERFORMANCE OF STANDARD OBSTRUCTIVE SLEEP APNEA SCREENING INSTRUMENTS IN PAROXYSMAL ATRIAL FIBRILLATION

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Introduction: Although the association of obstructive sleep apnea (OSA) and atrial fibrillation (AF) has been well-described, effective OSA screening strategies are not well established
Methods: Sleep Apnea and Atrial Fibrillation Biomarkers and Electrophysiologic Atrial Triggers (SAFEBEAT-NCT02576587,

n=300) is a case control study 1:1 matched by age (±5 years), sex, race and body mass index (BMI±5kg/m^2) including those >18 years with paroxysmal AF (PAF) and controls without AF. Participants underwent administration of STOP-Bang, NoSAS (neck circumference, obesity, snoring and sex), Berlin and Epworth Sleepiness Scale (ESS) questionnaires and16-channel research-grade polysomnography. We examined questionnaire diagnostic performance characteristics for moderate to severe OSA (apnea hypopnea index≥15) separately in PAF and without, including area under the curve (AUC, 95% confidence intervals). Analyses were performed in SAS software (version 9.4; Cary, NC).

Results: The analytic sample was comprised of 300 participants (n=150 cases and n=150 controls): age 61.9 ± 11.9 years, 63.3% male, and BMI 31.4 ± 6.7 kg/m^2. Sensitivity for the 4 questionnaires was lower, albeit comparable, in PAF (range: 52–79%) versus controls (range: 61–75%). NoSAS showed highest sensitivity in PAF (79%). Specificity range was overall lower in PAF (43–60%) versus controls (56–80%) The positive predictive value range was lower in PAF (23–27%) versus controls (54–72%). Conversely, the negative predictive value range was higher in PAF (84–89%) versus controls (63–75%). The AUC was lower in PAF versus controls except comparable for STOP-BANG (0.66, 0.56–0.77 versus 0.65, 0.57–0.74) and higher for NoSAS (0.79, 0.72–0.86 versus 0.64, 0.53–0.75) respectively.

Conclusion: In this systematic assessment of standard OSA screening instruments, the NoSAS questionnaire performed most optimally in terms of sensitivity and reasonable discriminative ability of moderate to severe OSA detection in those with PAF. Further investigation is needed to identify effective OSA screening strategies with focused efforts on development/refinement of novel OSA screening tools in the AF population.

Support (If Any):

1054

SLEEP DISORDERED BREATHING IN PATIENTS SCHEDULED FOR CAROTID ENDARTERECTOMY

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Introduction: Obstructive sleep apnea (OSA) seems to be an independent risk factor for carotid atherosclerosis, but there are limited data on the coexistence of OSA and hemodynamically significant carotid stenosis.The aim of this study was to determine the prevalence of OSA in patients with carotid stenosis and whether carotid plaque removal improves symptoms of OSA and sleep study parameters as was suggested in the literature.Presented data are a part of an ongoing larger study, measuring influence of OSA severity on the histological structure and presence of atherogenesis markers in the carotid artery plaque in endarterectomy specimens.

Methods: Sleep study (WatchPAT) was applied preoperatively in 49 patients scheduled for endarterectomy. 11 out of 49 patients (5 males) with mean BMI of 27,2, had sleep study, Epworth Sleepiness Scale (ESS) and STOP Bang questionnaire pre- and postoperatively (with average 4,5 months follow-up).

Results: Subjects were categorized into 4 groups: mild (n=13), moderate (n=13), severe (n=8) OSA and healthy patients (n=15) according to the sleep study result. Mean pre- and postoperative apnea/hypopnea index (AHI), oxygen desaturation index (ODI) and respiratory disturbance index (RDI) were 14,7(±13,7) and 21,6(±17,5); 9,5(±11,8) and 14,1(±15); 16,8(±13) and 22,5(±17,4), respectively. Mean pre- and postoperative ESS score was 6,4(±5,3) and 6,9(±4,8), respectively. According to STOP Bang questionnaire 2, 4 and 5 subjects had low, intermediate and high risk of OSA preoperatively, respectively. In 4 out of 11 subjects decrease in risk of OSA was observed postoperatively, while in the rest of the group no change was reported.

Conclusion: OSA is more prevalent in patients with carotid stenosis than in general population. According to our results, there is a deterioration in sleep parameters in endarterectomy follow-up, which is opposite to previous studies.

Support (If Any): no support

1055

THE IMPACT OF SHORT SLEEP DURATION ON INSTRUMENTAL ACTIVITIES OF DAILY LIVING (IADL) AMONG STROKE SURVIVORS

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Introduction: Stroke survivors have a heightened risk of having problems with daily functioning. However, it is unclear what behavioral factors increase the likelihood of problems with daily functioning among stroke survivors. Hence, the purpose of this study is to investigate the association between short sleep duration and daily functioning, among stroke survivors.

Methods: For analysis, we used data from the National Health Interview Survey (NHIS) 2000–2015 dataset which contained sociodemographic variables, self-reported stroke, problems with instrumental activities of daily living (IADL), and sleep duration. Data were analyzed to investigate the association between IADL and short sleep duration among stroke survivors.

Results: Of the sample of 1,108,043 individuals (mean age was 45.73 yrs.; S.D.=141.48), 52.7% were female, 77.4% identified as White, 14.2% as Black, 41.3% were married, 62.7% were currently working, 31.1% had families earning less than $35,000 annually, and 87% reported their general health status as Excellent to Good. Thirty percent of stroke survivors reported problems with IADL and 34.4% of respondents who reported problems with IADL were short sleepers. Results from the Binary Logistic regression indicated that stroke survivors (N=14, 350) who are short sleepers were 35% more likely to report problems with activities of daily living, as compared to stroke survivors who did not report short sleep (OR=1.355, 95% CI=1.23–1.49, p<.001), adjusting for the effects of age, sex, race, marital status, health status, and income.

Conclusion: Findings from our study indicate that stroke survivors who experience less than seven hours of sleep per day on average are at increased risk of IADL problems. Future studies should investigate whether improving sleep would improve IADL functioning in stroke survivors.

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1056

REM SLEEP ARCHITECTURE OF STROKE PATIENTS

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Introduction: Research examining sleep in stroke patients suggests disturbances in sleep efficiency, fragmentation, and reduced rapid eye

movement (REM). It is of particular interest as to whether patients with multiple stroke history differ in their profiles of REM architecture, wakefulness during sleep, and sleep efficiency. The objective of this study was to explore the changes in sleep parameters within a sample of stroke patients to determine if multi-stroke history differentiates patient sleep architecture with a specific focus on REM-related functioning compared to controls.

Methods: Patient data collected from the Sleep Heart Health Study (SHHS) cycle 2001–2003 were used (N=5042; mean age of 68) and categorized according to stroke history: no stroke (n=4755), one stroke (n=199), 2 strokes (n=40), and 3 or more strokes (n=48). Total sleep time, sleep efficiency, total arousals of NREM and REM, sleep latency, percent of sleep stages (1, 2, 3 and 4), and REM sleep time were measured using in-home, nocturnal polysomnography. Independent t test and one-way ANOVA were performed.

Results: There was a significant difference in scores for sleep efficiency for patients with a stroke history of two or more strokes t (167) = - 0.259, p = 0.05 and total number of arousals of REM sleep per hour t (273) = 1.328, p = 0.023. A one-way ANOVA on sleep efficiency was significant, F (3, 2913) = 4.736, p = 0.003 and total sleep time was significant, F (3, 5038) = 4.123, p = 0.006 on patient controls compared to patients with one, two, or three or more strokes. A one-way ANOVA on total number of arousals in REM was significant, F (3, 4878) = 3.365, p = 0.018 and REM sleep time was significant, F (3, 2646) = 9.263, p = 0.0001 on patient controls compared to patients with one, two, or three or more strokes.

Conclusion: Stroke patients with multiple strokes (two or more) have more arousals during REM sleep, poor sleep efficiency, and reduced REM sleep compared to controls and stroke patients with a history of one stroke.

Support (If Any): None

1057

SLEEP-RELATED HYPERTENSION: CLINICAL IMPROVEMENT IN HYPERTENSION OVER TIME IN POLYSOMNOGRAPHY CONFIRMED SLEEP-INDUCED HYPERTENSION

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Introduction: Previous work by the same author showed sleep-related hypertension to be a significant problem by measuring systolic BP continuously during polysomnography using PTT. This paper is a follow-up to show improvement of BP in patients with uncontrolled hypertension and sleep-related hypertension employing PAP therapy. This study aimed to determine the impact of treatment with PAP on sleep-related hypertension and conventional hypertension.

Methods: Polysomnographic confirmation of sleep-related hypertension utilizing continuous and non-reactive BP measurement based on PTT (SOMNOscreen, SOMNOmedics GmbH). Follow-up of patients to demonstrate serial improvement in BP by treatment of OSA with PAP therapy and ability to reduce anti-hypertensive medications over 6 months of treatment of OSA.

Results: Significant elevations of BP were found with PTT during diagnostic polysomnography. Significant reductions in daytime systolic and diastolic BP was observed in patients treated with PAP therapy with reduction in anti-hypertensive medications.

Conclusion: 1. Snoring and OSA are associated with increase in sleep related systolic blood pressure

2. Diagnosed systemic hypertension showed improvement in daytime hypertension with treatment of OSA using PAP therapy.

3. Doses of anti-hypertensive medications were reduced and in some cases the medications were completely stopped after treatment of OSA.

Support (If Any): No Support received.

1058

NATIONAL PATTERNS OF SLEEP DISORDERS AND TREATMENT AMONG PATIENTS WITH HYPERTENSION OF CARDIOVASCULAR DISEASE

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Introduction: Sleep disorders are associated with hypertension and cardiovascular diseases (CVD), and treatment of sleep disorders may improve outcomes. To examine burden of sleep disorders, treatment rates, and racial/ethnic differences among patients with hypertension/CVD, we examined the national burden of sleep disorders, compared with rates of sleep disorder treatments, and evaluated whether racial/ethnic disparities exist among patients with hypertension/CVD.

Methods: We analyzed data from a nationally representative US sample of 417,950 adult ambulatory visits from the National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey (NAMCS/NHAMCS), 2005–2012. We identified visits by adults with hypertension or CVD (coronary artery disease, congestive heart failure, or stroke) in which a diagnosis of sleep disorders or complaints were recorded. Primary measures were provision of a sleep study, medication, or behavioral therapy to improve diet, weight loss, or exercise). We conducted multivariate logistic regression analyses to examine sleep disorder treatment by demographic and clinical risk factors.

Results: Sleep apnea was identified in 11.1-per-1,000 visits and insomnia in 10.5-per-1,000 visits, while any sleep disorder was identified in 22.5-per-1,000 visits. Overall, patients with hypertension and a sleep disorder were referred for a sleep study in 7.6% of visits, prescribed sleep medication in 29.7% of visits, and offered behavioral therapy in 31.0% of visits. In adjusted analyses, behavioral therapy was more likely to be provided to patients who were obese compared with those who were normal/overweight (OR=2.89; 95%CI[2.00–4.17];p<0.001), but less likely to be provided to smokers than non-smokers (OR=0.61; 95%CI[0.38–0.99];p<0.05). Non-hispanic blacks were less likely to receive medications than were non-Hispanic whites (OR=0.44; 95%CI[0.21–0.92];p<0.05). There were no differences in sleep study by race/ethnicity, but patients with insomnia were less likely to be referred for a sleep study compared with patients with sleep apnea (OR=0.07; 95%CI[0.03–0.18];p<.001).

Conclusion: Although sleep disorders were observed in a small proportion of patients with hypertension/CVD, the prevalence rates were relatively lower than those reported for the general population. Behavioral therapy was provided in a small number of visits, and non-Hispanic Blacks were less likely to receive medications than non-Hispanic Whites.

Support (If Any): NHLBI (R25HL116378).

1059

POLYSOMNOGRAPHIC CHARACTERISTICS OF PATIENTS WITH REFRACTORY HYPERTENSION COMPARED TO CONTROLLED RESISTANT HYPERTENSION

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Introduction: Refractory hypertension (rHTN), a unique phenotype of antihypertensive treatment failure, is defined as the persistence of uncontrolled high blood pressure (>140/90 mmHg) despite treatment with 5 or more antihypertensive agents. Controlled resistant hypertension (crHTN) is defined as controlled blood pressure requiring 3

or more medications from different classes, including a diuretic. We have previously reported that patients with rHTN exhibit heightened sympathetic tone when compared with those with crHTN. Therefore, this study sought to investigate sleep as a potential mediating mechanism underlying rHTN. We hypothesized that patients with rHTN would have more severe obstructive sleep apnea (OSA) than patients with crHTN as a contributing factor to their heightened sympathetic tone.

Methods: Consecutive patients (n=80) from the UAB Hypertension Clinic with either rHTN (n=29) or crHTN (n=51) were evaluated by overnight polysomnography. Multivariate analysis of variance was used to compare sleep characteristics between these two groups of patients.

Results: Compared with patients with crHTN, those with rHTN were younger (54.6 ± 9.9 versus 58.1 ± 11.6 years) and more likely to be black (75.9% versus 54.9%) and female (69.0% versus 37.3%). Patients with rHTN had more total sleep time (p=0.017) and more time spent in N2 sleep (p=0.002). There were no other significant differences in sleep architecture, number of awakenings, or time spent awake after sleep onset. Patients with rHTN had a higher sleeping heart rate (p=0.040). There were statistically non-significant trends for patients with rHTN to have a higher mean apnea hypopnea index (AHI), as well as for a larger percentage of these patients to have an AHI>5, although these trends were not statistically significant (p=0.367).

Conclusion: These findings indicate that patients with rHTN do not exhibit worse OSA compared with patients with crHTN. Therefore, more severe OSA does not explain the heightened sympathetic tone observed in patients with rHTN.

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1060

EFFECT OF AGE ON THE ASSOCIATION BETWEEN SUBJECTIVE SLEEP QUALITY AND METABOLIC SYNDROME

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Introduction: Many previous studies have reported that self-reported global sleep quality and sleep duration are significantly related to the metabolic syndrome (MetS). However, it is no clear how chronological age affects the association between sleep quality and MetS and thus the aim of this study is to investigate age effect on this relationship.

Methods: The cross-section baseline data of adult men and women (n=22,995, 23-79yr) were collected from health check-up study, including Pittsburgh Sleep Quality Index (PSQI) with concurrently collected components of MetS.

Results: Poor sleep quality (PSQI≥6) and shorter sleep duration showed significant association in people with MetS than those without (20.9% vs 19.0%, p=0.004) after adjusting for age, smoking, alcohol, sex, and exercise. To better clarify the age effect, we classified them by the median age 40 y.. Among the older (> 40 y), global PSQI score was significantly higher (p=0.002) and sleep duration was shorter (p=0.007) in subjects with MetS compared to in those without MetS. However, this patterns was not found for younger adults in this sample.

Conclusion: The current study showed the effect of age on a relationship between subjective sleep quality and MetS. It suggests that satisfactory sleep in older adults (>40 y) may play a crucial role in the prevention of MetS.

Support (If Any): The authors have no conflicts of interest to disclose.

1061

SLEEP DURATION ASSOCIATES WITH METABOLIC AND NON-METABOLIC DISEASES CURATED FROM ELECTRONIC MEDICAL RECORDS IN THE PARTNERS BIOBANK

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Introduction: Sleep duration associates with a host of metabolic and non-metabolic diseases. This investigation examines whether habitual sleep duration associates with diseases curated from electronic medical records (EMR) from the Partners Biobank.

Methods: The Partners Biobank is hospital-based cohort study from the Partners HealthCare hospitals with EMR and genetic data supplemented with health surveys. Diseases were curated from EMR using structured and unstructured data and robust phenotype algorithms [obesity (n=3790), type 1 diabetes (T1D; n=85), type 2 diabetes (T2D; n=792), coronary artery disease (CAD; n=854), stroke (n=113), hypertension (n=4746), congestive heart failure (n=95), depression (n=1264), chronic obstructive pulmonary disorder (n=90), asthma (n=1182), breast cancer (n=797)]. Sleep data were ascertained from a health information survey administered at enrollment to 20,845 participants. Weighted average sleep duration was computed using self-reported weekday and weekend bed and wake-up times. Self-reported sleep durations <3 or >14 hours and self-reported shift-work were excluded. Sleep duration was categorized as <7 (n=1622), 7 to <9 (n=9004), and ≥9 hours per night (n=2697). The relationship between sleep duration and diseases were examined using categorical logistic regression with adjustment for age, sex, race, and body mass index (except obesity), and further adjusted for alcohol intake, employment status, physical activity, and smoking status.

Results: Compared to subjects sleeping 7 to <9 hours per night, those sleeping <7 hours per night had higher adjusted odds ratios (OR) for obesity [OR(95% CI) =1.63(1.45–1.82)], T1D [2.12(1.23–3.68)], T2D [1.521(1.23–1.88)], CAD [1.25(1.01–1.56)], hypertension [1.21(1.07–1.37)], depression [1.23(1.02–1.47)], and asthma [1.25(1.04–1.50)], whereas those sleeping ≥9 hours per night had higher adjusted OR for obesity [1.26(1.14–1.38)], T2D [1.26(1.04–1.52)], CAD [1.32(1.11–1.56)], stroke [1.84(1.22–2.79)], hypertension [1.23(1.11–1.37)], depression [1.80(1.57–2.05)], and asthma [1.24(1.07–1.44)]. The associations between short sleep duration and CAD or depression, and between long sleep duration and T2D were no longer significant when adjusted for additional lifestyle factors.

Conclusion: Confirming earlier observations between sleep and diseases in the Partners Biobank warrants further investigation of the shared biological basis and clinical features linking sleep to disease in this cohort.

Support (If Any):

1062

DO HABITUAL SLEEP PATTERNS MEDIATE THE RELATIONSHIP BETWEEN BODY MASS INDEX AND TYPE-2 DIABETES? RESULTS FROM A POPULATION SAMPLE

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Introduction: Sleep duration and timing have independently been associated with body mass index (BMI) and type-2 diabetes (T2D). The extent to which sleep duration mediates the relationship between BMI and T2D for each sleep timing category (morning, intermediate, evening) remains unclear. Disentangling the complex relationship between sleep duration, timing, BMI, and T2D could shed light on sleep as intervention targets for reducing T2D risk among those with higher BMI.

Methods: Baseline data from the UK Biobank cohort study (N=109,397) were used to generate multigroup path analysis models to identify the direct, indirect, and total effects through which sleep duration (short ≤6hrs; adequate 7-8hrs; long ≥9hrs) mediates the relationship between BMI and T2D, for each sleep timing category. All pathways were adjusted for socio-demographic and cardiovascular risk factors. Model fit was assessed.

Results: Most participants were white (92%), female (55%) and did not attend college (66%). Short sleep duration was reported by 24%, adequate by 68% and long by 8%. Twenty-eight percent of the sample were morning, 64% were intermediate and 8% were evening type. The path models demonstrated small but statistically significant mediation for morning and intermediate types. Among morning types, short (versus adequate) sleep mitigated T2D as BMI increased (β=-0.001, p=0.032). Among intermediate types, long (vs. adequate) sleep exacerbated T2D as BMI increased (β=0.0004, p=0.005). The model provided a good fit to the data (CFI=0.998, TLI=0.839, RMSEA=0.013, WRMR=0.538).

Conclusion: These data provide preliminary evidence that short sleep in morning type persons may not always be deleterious with regard to the BMI-T2D relationship. On the other hand, long sleep in intermediate type persons may be indicative of a worsened BMI-T2D relationship. Prospective work is needed to validate these findings and to examine the effects of sleep duration adjustment, for different sleep timing subgroups, on BMI and T2D outcomes.

Support (If Any): N/A

1063

THE EFFECT OF SLEEP QUALITY ON INTIMATE RELATIONSHIPS AND SEXUAL ACTIVITY IN MEN AND WOMEN WITH TYPE 2 DIABETES

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Introduction: Previous research suggests that impaired sleep may negatively affect sexual response and behavior. In addition, adults with type 2 diabetes (T2D) often experience difficulty with sexual function. The purpose of this study was to explore the relationship of sleep quality as a predictor of sexual activity and intimate relationships in both men and women with (T2D).

Methods: This study employed a cross-sectional design using baseline data from the ongoing Diabetes Sleep Treatment Trial (NIDDK R01DK096028; E. Chasens PI). Instruments included the Pittsburgh Sleep Quality Index (PSQI) and the Intimate Relationships and Sexual Activity (IRSA) subscale from the Functional Outcomes of Sleep Quality questionnaire. Demographic information included age, gender, marital status, and race. Clinical evaluations included BMI (kg/m^2) and A1C. Analysis used descriptive statistics, *t*-tests, and hierarchical linear regression to test moderation effects by gender and age.

Results: The sample (*N*=194) was 53.6% female, 37% married/partnered, 54% White, 31% college educated, middle aged (M = 56.8±11 years), and obese (BMI 34.7±6.8) with suboptimal glucose control (A1C 7.9±1.8%) and with poor sleep quality (PSQI =10.0±4.1). Men were significantly older than women ($p<.05$). Age was significantly associated with the PSQI, BMI, and A1C ($p\leq.05$) but not IRSA ($p=.07$). There were no significant differences by gender on the PSQI, BMI, A1C or IRSA ($p \geq .05$). However, women were significantly more likely to report worse scores on individual item endorsement of questions regarding intimate relationships, desire, arousal, and orgasm ($p <.01$). Using hierarchical regression, sleep quality was identified as a significant independent predictor of IRSA ($\Delta R^2=.196$, F [1, 129] = 26.1, $p=.001$) when adjusting for marital status, age, race, and gender. Interaction effects of sleep quality with age and gender were not significant in the model (gender: $\Delta R^2 =.002$, $p=.61$; age: $\Delta R^2 =.014$, $p=.14$).

Conclusion: In individuals with T2D, perceived sleep quality was a significant predictor of decreased sexual activity and worse intimate relationships. The analysis will be repeated with the final sample to determine the influence of age and gender on sleep quality as a predictor of IRSA.

Support (If Any): Chasens: NIDDK R01DK096028

1064

THE ROLE OF SLEEP AND PHYSICAL ACTIVITY IN REDUCING THE PREVALENCE OF DIABETES IN THE UNITED STATES: AN AGENT-BASED SIMULATION MODEL APPROACH

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Introduction: Diabetes is one of the leading causes of health-related morbidity and mortality in the United States. To reduce the burden of diabetes, several behavioral strategies (e.g., healthy diet and increased physical activity) have been implemented. Unfortunately, these strategies have yielded modest improvements, and in some groups (racial/ethnic minorities) the diabetes burden is mounting yearly. Recent evidence that sleep is associated with increased diabetes risk suggests that sleep may be a novel and potentially impactful target to alleviate this burden. The current study explored the long-term impact of reducing the prevalence of insufficient sleep on diabetes burden in the U.S., relative to potential positive health benefits of physical activity.

Methods: Using a representative sample of 100,000 hypothetical participants who do not experience healthy sleep in an Agent-Based Model simulation (a dynamic simulation technique). In this model, we

investigated whether reducing the prevalence of insufficient sleep (≤6 hrs.) by 10% or 20% would have a significant impact on attenuating the prevalence of diabetes over a 10-year period. We also explored whether similar observations would be made by increasing the prevalence of individuals engaging in 150 mins/week of moderate physical activity as an alternative to healthy sleep, given the difficulty many have experienced in increasing their habitual sleep time.
Results: Based on the simulation model, reducing the prevalence of insufficient sleep by 10% or 20% attenuated the prevalence of diabetes among insufficient sleepers by 1.7% or 2.6%, respectively. By contrast, increasing the prevalence of physical activity by 10% or 20% seemed to be much less impactful. Indeed, the prevalence of diabetes was only reduced by 0.4% or 1.6%, respectively.
Conclusion: Despite mixed results shown in experimental and clinical studies, in this particular model, reducing the prevalence of insufficient sleep at the population level could be more impactful in preventing diabetes than increasing physical activity alone in the United States. Future research should determine whether results of our simulated model could be replicated at the population level.
Support (If Any): NIH/NINDS U54NS081765NIMHD
R01MD007716
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1065

EFFECT OF BIRTHPLACE ON CARDIOMETABOLIC PROFILE AMONG BLACKS WITH METABOLIC SYNDROME AND SLEEP APNEA RISK

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Introduction: Metabolic syndrome poses an increased burden of disease, warranting heightened public health attention. This study assessed effects of birthplace on cardiometabolic profile among blacks with metabolic syndrome and sleep apnea risk, while exploring potential gender-based effects.
Methods: This analysis is based on data from 610 black patients (mean age= 63±11 years female=65%) with evidence of metabolic syndrome and were at risk for sleep apnea using the ARES. Participants from four community-based clinics in Brooklyn, NY provided sociodemographic, medical, and clinical data. Clinical data included body mass index (BMI), blood pressure (BP), high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), and fasting plasma glucose (FPG) or hemoglobin (HbA1c) for those who had a diagnosis of diabetes. General Linear Model (GLM) was used to assess effects of birthplace and gender on cardiometabolic parameters, adjusting for age effects.
Results: Of the sample, 61.6 % were foreign-born blacks (FBB) and 38.4 % were US-born blacks (USB). FBB had significantly lower BMI compared with USB (32.76±0.35 vs. 35.41±0.44, F=22.57), but had significantly higher systolic blood pressure (136.70±0.77 vs. 132.83±0.98; F=9.60) and fasting glucose levels than did USB (146.46±3.37 vs. 135.02±4.27; F=4.40). Men had higher diastolic BP (76.67±0.65 vs. 75.05±0.45; F=4.20), glucose (146.53±4.48 vs. 134.95±3.07; F=4.55) and triglyceride levels (148.10±4.51 vs. 130.60±3.09; F=10.25) compared with women, but women had higher LDL-cholesterol (109.24±1.49 vs. 98.49±2.18; F=16.60) and HDL-cholesterol levels (50.71±0.66 vs. 42.77±0.97; F=46.01) than did men.
Conclusion: FBB have lower levels of obesity, similar rates of hypertension, dyslipidemia, stroke history, but higher rates of diabetes, history of heart disease, and systolic BP compared with USB. Findings may have implications for addressing effects of birthplace and gender on cardiovascular disease outcomes.
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1066

DIFFERENCES PERSIST IN SLEEP QUANTITY BETWEEN HEALTHY CONTROLS AND CONCUSSED INDIVIDUALS 3–12 MONTHS POST-INJURY

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Introduction: Sleep problems are frequently reported following a mild traumatic brain injury (mTBI). These problems have yet to be objectively characterized 3 to 12 months post-injury, a timeframe during which symptoms usually subside. At-home actigraphy and a 40 hour sleep deprivation paradigm were used to explore sleep and performance deficits in participants with mTBI compared to healthy controls.
Methods: Healthy controls and participants with mTBI in the last 3 to 12 months were recruited (N=15). Sleep data were collected with actigraphy over 14 days as volunteers followed normal at-home routines. In the lab, participants experienced 40 hours of sleep deprivation with subsequent recovery sleep. Psychomotor vigilance task (PVT) responses were collected every four hours in lab while participants were awake and the Match to Sample (M2S) task was administered once a day during baseline, sleep deprivation, and recovery.
Results: Based on preliminary descriptive analysis, the mTBI group showed less at-home sleep (< 6 h) than the controls (> 6 h). In addition, the mTBI group showed more variability in average sleep time. PVT performance declined from baseline through the sleep deprivation and returned to baseline during recovery for both groups, but the mTBI group had a longer reaction time (312 ms) compared to controls (264 ms). Performance for controls declined during sleep deprivation on the M2S, while performance was lower at baseline for the mTBI group and remained stable.
Conclusion: Participants with concussion experienced sleep disruption and decrements in performance. This disruption, 3–12 months after injury, suggests that sleep may play a role in the recovery from concussion, and subsequent cognitive decrements. Future research should continue to explore sleep and performance after concussion using objective measures. In addition, measures used to assess TBI should be examined for specificity for concussion related decrements and robust to effects of sleep debt.
Support (If Any): U.S. Army, Military Operational Research Program

1067

SOCIODEMOGRAPHICS, POOR OVERALL HEALTH, CARDIOVASCULAR DISEASE, DEPRESSION, FATIGUE, AND DAYTIME SLEEPINESS ASSOCIATED WITH SOCIAL JETLAG INDEPENDENT OF SLEEP DURATION AND INSOMNIA

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Introduction: Social jetlag (difference between weekday and weekend sleep midpoint) has emerged as an important circadian marker

for health outcomes. Previous studies, though, have rarely focused on general population samples and may be confounded with short sleep and insomnia.
Methods: Data from the Sleep and Healthy Activity, Diet, Environment, and Socialization (SHADES) Study was used. SHADES is a community-based survey of N=1,007 adults age 22–60. Social jetlag was assessed using the Sleep Timing Questionnaire and was calculated by subtracting weekday from weekend sleep midpoint and was represented in hours. N=984 respondents provided complete data. sleep duration was assessed with the NHANES item, and insomnia was assessed with the Insomnia Severity Index[ISI]. Covariates included age, sex, race/ethnicity, education, employment, income, sleep duration (measured using the NHANES item), and insomnia (measured with the Insomnia Severity Index[ISI]. Overall health was self-reported as "Excellent," "Good," or "Fair/Poor." Cardiovascular disease was assessed as history of any condition. Depression was measured with the Patient Health Questionnaire[PHQ], fatigue with the Fatigue Severity Scale[FSS], and sleepiness with the Epworth Sleepiness Scale[ESS]. Regression models, adjusted for all covariates, examined whether social jetlag predicted any of these outcomes.
Results: Greater social jetlag was seen among high-school graduates (B=25.9mins,p<0.05) vs college graduates, and fewer minutes of social jetlag was seen among Blacks/African-Americans (B=-17.9mins,p<0.05), those in the poorest income quintile vs the highest (B=-22.9mins,p<0.05), unemployed (B=-19.0mins,p<0.05). Each ISI point was associated with -2.0 social jetlag minutes (p<0.01), and each hour of sleep was associated with -6.6 minutes (p<0.01). Adjusted for covariates, each hour of social jetlag was associated with a 22.1% and 28.3% increased likelihood of good and fair/poor health, respectively (vs excellent) (p<0.01). Each hour was associated with an 11.1% increased likelihood of heart disease (p<0.05). Additionally, each hour was associated with 0.25 PHQ points, 0.19 ESS points, and 0.56 FSS points (p<0.05).
Conclusion: Social jetlag in a community sample is associated with race/ethnicity, income, education, employment, sleep duration, and insomnia. Adjusting for these, social jetlag is associated with poorer health, heart disease, worse mood, and increased sleepiness and fatigue.
Support (If Any): K23HL110216 and R21ES022931

1068

DIFFERENCES IN SELF-REPORTED AND OBJECTIVE LONG SLEEP TIME: THE MULTI-ETHNIC STUDY OF ATHEROSCLEROSIS

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Introduction: As with short sleep duration, long sleep has been associated with adverse outcomes, however, it is not known whether long sleep duration is intrinsically detrimental or a manifestation of a co-morbid conditions such as sleep disordered breathing, poor sleep and chronic illness. Moreover, previous data has largely relied on a self-reported sleep duration. In this study, we compare the differences among self-reported long sleepers (≥ 9 hours), self-reported non-long sleepers (<9 hours) and objective long sleepers ≥ 9 hours, measured by actigraphy.
Methods: We analyzed data from the Multi-Ethnic Study of Atherosclerosis in participants with completed sleep questionnaires, polysomnography and actigraphy (N=2127). We compared age, socio-demographics, body mass index (BMI), presence of diabetes, Epworth Sleepiness Scale score, apnea hypopnea index (AHI), sleep latency, wake after sleep onset (WASO), total and awake time in bed and sleep efficiency among subgroups of subjective and objective long sleep compared to those without long sleep in bivariate analyses.
Results: The prevalence of self-reported long sleep duration was 23% (498 of 2127), however only 7% (35 of 498) of these actually had ≥9 hours of sleep on actigraphy (2% of sample). Self-reported long sleepers were older (72 ± 9 vs 69 ± 9 years p<0.01), more often female (60% vs 52% p<0.01) with a higher prevalence of diabetes (26% vs 17% p<0.01) but did not differ by BMI, AHI, sleepiness, compared to those reporting <9 hours of sleep. By actigraphy, self-reported long sleepers only slept 7.0 ± 1.6 hours, had greater WASO (42.0 ± 16 vs. 35.8 ± 15 minutes) and greater total time in bed (7.8 ± 1.66 vs. 7.1 ± 1.40 hours) and awake time in bed (49 ± 20 vs. 43 ± 17 minutes) but no difference in sleep efficiency or sleep latency minutes than those reporting <9 hours of sleep.
Conclusion: Self-report of long sleep was much more common than objectively measured long sleep. Only 7% of self-reported long sleepers have objectively assessed long sleep. Self-reported long sleepers had more time awake in bed and greater WASO. These results suggest that inferences regarding the health effects of long sleep duration cannot be reliably made by questionnaire alone.
Support (If Any): MESA Sleep NHLBI RO1L098433, NIH HL098433

1069

YOUNG WOMEN WITH SHORT SLEEP DURATION AND INSOMNIA RUN A HIGH RISK OF DEVELOPING HYPERTENSION AND DIABETES MELLITUS. A 10-YEAR FOLLOW-UP OF THE POPULATION-BASED SHE STUDY.

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Introduction: We aimed to study whether sleep duration, and insomnia are risk factors for incident hypertension and diabetes mellitus in women.
Methods: At baseline and at 10-year follow-up, a random sample of 4,404 women aged 20–87 years without hypertension or diabetes at baseline answered questionnaires on sleep duration (short; <6h/night, normal; 6-<9h/night), insomnia (difficulty inducing sleep (DIS), difficulty maintaining sleep (DMS) or early morning awakening (EMA)), anthropometric measures, lifestyle factors and somatic disease. Outcome was incident hypertension and diabetes at the 10-year follow-up. Age stratified multivariate analysis were adjusted for baseline BMI, smoking, physical activity, and alcohol dependency.
Results: The incidence of hypertension and diabetes were lowest in the reference group with normal sleep duration and no insomnia (10.7% and 2.1%, respectively). The highest incidence was seen in women with short sleep duration both with insomnia (hypertension: 16.5%, and diabetes: 4.7%) and without insomnia (hypertension: 21.3%, and diabetes: 4.2%). Women younger than 40 years with short sleep duration alone had the highest risk of incident hypertension with adjusted OR 3.8 (95%CI 1.3–11.5) in the multivariate analysis. Women younger than 40 years with the combination of short sleep duration and insomnia had the highest risk of developing diabetes with adjusted OR 8.1 (2.1–30.9).
Conclusion: Short sleep duration and the risk for diabetes and hypertension is age dependent in women. Young women -below 40 years- with short sleep duration and insomnia run a high risk of developing diabetes mellitus, while young women with short sleep duration alone run a high risk to develop hypertension. The different risk combination regarding insomnia, or not, indicate different possible underlying

mechanisms when women with short sleep duration develop diabetes and hypertension.
Support (If Any): The SHE study is supported financially by the Swedish Heart Lung Foundation. The authors have no conflicts of interest.

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NOCTURIA AND SLEEP DYSFUNCTION IN MEXICAN WOMEN WITH OSA

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Introduction: To examine the relationship of nocturia to objective sleep quality and subjective sleepiness and fatigue in women with OSA.
Methods: Participants were 20 consecutive female patients, referred to the sleep laboratory for suspicion of sleep disordered breathing at INCMNSZ in México City. We excluded patients taking diuretics, neurodegenerative disease, or were on CPAP treatment. Informed consent was obtained, and the study was approved by the local ethics committee. Twenty women mean age 50.9 ± 14.5 years old, BMI 28.1 ± 6.8 (SD), underwent diagnostic polysomnography (PSG) in laboratory. Validated questionnaires for depression, fatigue, sleepiness were administered prior to the PSG night. Nocturia was defined as ≥2 voids per main habitual sleep period.
Results: By history, nocturia was present in 50% of the women. Mean AHI 8.99 ± 19.3, mean ODI 4% 23.67 ± 34.33. Respiratory parameters did not correlate with the presence of nocturia. Age was positively correlated with nocturia rho=0.613, p=0.004. N2 sleep %, REM sleep %, and sleep efficiency were all lower in relation to nocturia (rho=-0.540, p=0.014; rho=-0.582, p=0.007; rho=-0.533, p=0.016, respectively). Surprisingly, Periodic Leg Movement Index was positively associated with nocturia rho=0.491, p=0.028, whereas the Epworth Sleepiness, fatigue, and depression scale scores were unrelated.
Conclusion: Nocturia is associated with lower sleep efficiency, N2%, and REM sleep %, but not with measures of OSA. The relationship to PLMS may have precedent in previous population-based study that reported an association between RLS and nocturia.
Support (If Any): Support (No)

1071

AMOUNT OF SLOW WAVE SLEEP IS ASSOCIATED WITH THE DISCREPANCIES BETWEEN OBJECTIVE AND SUBJECTIVE SLEEP MEASURES

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Introduction: Discrepancies between objective and subjective sleep measures are common, however, they may be amplified within chronic pain populations. We explored factors hypothesized to contribute to discrepancies between self-report and objective sleep measures (i.e., actigraphy; polysomnography) in Temporomandibular Joint Disorder (TMJD), a chronic pain condition with a high prevalence of sleep disturbances.
Methods: Baseline data was collected from 125 women diagnosed with TMJD and sleep disturbance (Insomnia Severity Index>8) as part of a larger study evaluating psychological interventions for sleep and pain. Assessment included self-report questionnaires, a one-night in-home polysomnography (PSG), 14 days of actigraphy and 14 days of daily diaries measuring standard sleep variables as well as mood and pain.
Results: Correlations between self-report and actigraphy measures of sleep with PSG showed the following: Total Sleep Time (TST) (rs=.62-.70; p<.001); Time in Bed (TIB) (rs=.63-.79; p<.001); Wake after sleep onset (WASO) (rs = .12-.34; ps = .001-.23); Sleep Efficiency (rs = .23-.27; p<.05); and Sleep onset latency (rs=-.01, N.S). Discrepancy between PSG and self-perceptions (by diary) of TST, TIB and WASO were negatively correlated with percent of Slow Wave Sleep (%SWS) (rs = -.24-(-.54); p<.05). Multiple regression analyses demonstrated that higher %SWS was associated with an overestimation of TST, TIB and WASO by self-report relative to PSG even when controlling for same day pain, positive and negative affect, pre-sleep arousal, catastrophizing and demographic variables.
Conclusion: In these women with TMJD with impaired sleep and pain cognitions, perceptions of TST, TIB and WASO were associated with the percent of SWS measured by PSG. Sleep duration and continuity have been shown to impact pain perceptions and endogenous pain modulatory mechanisms. Consequently, future research should focus on interventions designed to deepen and consolidate sleep as a means of not only improving sleep but pain outcomes as well.
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SLEEP TRAJECTORIES FROM ADOLESCENCE TO ADULTHOOD AND THEIR RELATIONSHIP WITH HEALTH OUTCOMES

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Introduction: Sleep is linked to physiological and mental health outcomes. However, little is known about sleep trajectories from adolescence to adulthood and their relationship with health outcomes. We examined sleep trajectories and their relationship with cardiometabolic and mental health in a representative sample over 16 years.
Methods: We tracked participants between 1997 and 2013 from the Panel Study of Income Dynamics study and the Child Development and Transition into Adulthood Supplements (n=3,118; age 10-17y at baseline) who reported their sleep duration up to six times during the study. We used latent class growth modelling to identify distinct sleep trajectories (long sleep (8.7% of the sample), average sleep (72.5%), and short sleep (18.8%)) and assessed their relationship with self-rated health, high blood pressure, obesity, and mental health using logistic and linear regressions controlling for the year of birth.
Results: Compared to the average sleep trajectory, both short and long sleep trajectories were associated with higher odds of poor or fair self-rated health (OR (95% CI), p-value): 1.82 (1.16, 2.84), p=0.01 and 1.89 (0.98, 3.63), p=0.06, respectively). Both short and long sleep trajectories also had greater mental health problems in adulthood (OR 1.66 (1.11, 2.49), p=0.01) and 1.99 (1.07, 3.69), p=0.03), respectively). Only the trajectory of short sleep was associated with higher odds of having high blood pressure (OR 1.81 (1.06, 3.12), p=0.03), greater distress (β (95% CI), p-value: 1.51 (0.73, 2.28), p<0.01) and lower mental well-being (β -0.63 (-1.15, -0.10, p=0.02)) compared to average sleep

trajectory. We found no significant association between sleep trajectories and obesity.

Conclusion: We found evidence that short and long sleep trajectories from adolescence to adulthood are linked to poor physiological and mental health outcomes in adulthood. Individuals that follow a trajectory of short sleep seemed particularly vulnerable to poor mental well-being as young adults. Additional research is needed to extend our understanding of the relationship between sleep trajectories over the lifespan and their effect health outcomes.

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SLEEP, FEAR CONDITIONING, AND SAFETY SIGNAL LEARNING IN VETERANS WITH PTSD

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Introduction: Fear conditioning is critical in the development and maintenance of posttraumatic stress disorder (PTSD), and safety learning is necessary for treatment response. In humans, research suggests REM sleep consolidation is associated with safety signal learning, though no studies have examined this relationship in PTSD.

Methods: Fifteen Veterans with PTSD (age=29.1 ± 4.6, 2F) participated in three consecutive nights of in-lab PSG monitoring. After the first night, they underwent a laboratory paradigm to acquire conditioned fear to a visual cue (CS+), which was paired with an unconditioned stimulus (US) 75% of the time. A second cue was never paired with the US and thus became a safety signal. Twenty-four hours after fear conditioning, participants underwent an extinction learning session and saw both cues repeatedly without the US. Twenty-four hours after extinction learning, participants underwent an extinction recall session, again seeing both cues repeatedly without the US. Acoustic startle probes were delivered to measure participants' reactivity (via blink EMG) to the CS- compared to trials during which the probe was presented in the absence of any visual cue. Bivariate correlations were conducted to examine reactivity to the CS- on the first testing session and its relationship with REM sleep that night. Bivariate correlations also examined the relationship between REM sleep and subsequent reactivity to the CS- for the extinction and recall sessions.

Results: Patients who showed less reactivity to the CS- early in the fear conditioning session had less fragmented REM sleep that night (r=.629, p=.021). REM sleep was not related to CS- reactivity during the extinction session. However, patients with a higher percentage of REM sleep on the last night showed less reactivity to the CS- early in the recall session (r=-.58, p=.038).

Conclusion: This was the first study to examine the relationship between REM sleep and safety learning in PTSD. Results indicated that better initial safety learning was associated with more consolidated REM sleep. Subsequently, more consolidated REM sleep was related to better safety retention on the last day of testing. Future research should examine how improving sleep affects fear and safety learning.

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POSTTRAUMATIC STRESS DISORDER, CANINE COMPANIONSHIP, AND SLEEP: PRELIMINARY FINDINGS

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Introduction: Large numbers of Veterans with post-deployment psychological disorders have reported improvements in sleep in association with canine companionship. Studies have also provided support for an association between canine companionship and lower baseline heart rate. We tested both possibilities in a sample of combat Veterans undergoing inpatient treatment for posttraumatic stress disorder (PTSD) and participating in a Service Animal Training Intervention in which they shared custody of a service canine with another Veteran. Alternating custody enabled within-subjects modeling of associations between canine companionship and sleep.

Methods: 18 military Veterans with deployment-related PTSD underwent mattress actigraphy for up to four weeks yielding 493 nights of sleep data. Mattress actigraphy relies upon accelerometers embedded in a mattress topper. The intended sleep period is delimited manually by blind raters after which sleep parameters are calculated automatically. Participants also rated morning restedness on a five-point scale following a total of 329 nights. Whether or not participants had custody of their service canines was carefully tracked. Linear mixed modeling was applied to the longitudinal data, controlling for AHI, snoring, and body movements. A random intercept was specified for each participant.

Results: Modeling morning restedness detected only main effects of minutes of actigraphic quiescence ($F(1,324) = 4.44$, $p = 0.036$) and canine presence ($F(1,313) = 3.89$, $p = 0.049$), both predictors having positive coefficients. Modeling of sleep heart rate also detected main effects of actigraphic quiescence ($F(1,476) = 5.38$, $p = 0.021$) and of canine presence ($F(1,472) = 5.55$, $p = 0.018$), as well as an effect of snoring ($F(1,478) = 13.23$, $p = 0.0003$). Quiescence and canine presence were negatively associated with sleep heart rate, while snoring was positively associated.

Conclusion: After accounting for other predictors, canine presence was associated with lower sleep heart rate and greater morning restedness in Veterans with PTSD. Preliminarily, these results are consistent with Veterans' reports of positive effects of a familiar canine presence on their sleep.

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1075

VERBAL MEMORY FUNCTIONING MODERATES RESPONSE TO TREATMENT FOR RECURRENT NIGHTMARES IN PTSD

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Introduction: Imagery rehearsal therapy (IR) is arguably the most effective form of cognitive-behavioral therapy (CBT) for the prominent nightmare disturbance in PTSD. CBT for insomnia (CBT-I) may also have efficacy for treating this problem. Although PTSD is associated with cognitive deficits in attention, executive control, and retrospective memory, functions likely essential to CBT outcome, no study has investigated the relevance of these cognitive difficulties for treatment outcome in Veterans with PTSD and recurrent nightmares. Here we examined whether 1) neurocognitive performance and 2) history of traumatic brain injury (TBI) were associated with treatment response in this population.

Methods: In a randomized controlled trial comparing IR to components of CBT-I for PTSD-related recurrent nightmares, 94 U.S. Veterans of Operation Enduring Freedom/Operation Iraqi Freedom (mean age (SD) 37.1 (9.9), 85.3% male) completed tests from the Penn Computerized Neurocognitive Battery (CNB) assessing attention, executive control, immediate and delayed memory, and spatial processing. TBI was assessed with a structured clinical interview. Mixed-effects models were used to examine main effects of TBI and cognitive functioning and interactions with time for primary nightmare and sleep quality outcomes.

Results: Significant verbal immediate memory by time interactions were found for nightmare distress (p<.001), nightmare frequency (p<.005), and sleep quality (p=0.02), even after controlling for overall level of cognitive performance and depression. TBI exhibited main effects on all outcomes (p<.05), but no interactions with time (p's>.10).
Conclusion: Veterans with lower verbal immediate memory functioning showed a poorer response to treatment with two forms of CBT for PTSD-related recurrent nightmares. Individuals with TBI had worse sleep and nightmare symptomatology throughout treatment but did not show altered trajectories of treatment response. Tests of cognitive functioning should be considered in assessing the likelihood that a Veteran with PTSD will benefit from CBT for recurrent nightmares.
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POSTTRAUMATIC STRESS DISORDER (PTSD) WITH NIGHTMARES IS ASSOCIATED WITH A SIGNIFICANTLY LOWER FREQUENCY OF SUICIDAL BEHAVIOR: RESULTS FROM A NATIONALLY REPRESENTATIVE US SAMPLE

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Introduction: Recurrent distressing dreams (nightmares) are one of the core symptoms of PTSD (DSM-5). Nightmares (NM) have been associated with rapid eye movement (REM) sleep. A disturbance of REM sleep is considered to be a hallmark of PTSD. It is also recognized that REM sleep plays a central role in emotional regulation. We examined the frequency of suicidal behavior (SB) and depression in PTSD patients who sought medical attention for nightmares (PTSD+NM) versus all other PTSD visits (PTSD-NM), in a nationally representative US sample.
Methods: We examined an estimated±SE 27,588,109±2,900,885 (unweighted count=3341) PTSD-related patient visits (mean ± SE age: 39.28±0.65 years; 67.0% ±2.1%, female) from 1995–2011 in the National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey, both nationally representative surveys of patient visits. Each patient visit is assigned up to 3 ICD-9-CM diagnoses and up to 3 'Reasons for Visit' (RFV). The study variables were defined as follows: PTSD - ICD-9-CM code 309.81; Nightmares (NM)- ICD-9-CM code 307.49 or RFV 'Nightmares' (code 1135.3); Suicidal Behavior (SB)- ICD-9-CM supplemental E codes titled 'Suicide and self-inflicted injury' (E950-E959) or RFV 'Suicide attempt' (code 5820.0) or RFV 'Intentional overdose' (code 582.01); Depression- ICD-9-CM codes: 296.2, 296.3, 296.82, 311, 296.20–296.36, 300.4.
Results: There were an estimated±SE 498,169±143,660 (unweighted count=57; 1.8% ±0.4% of all PTSD visits) NM visits. There were an estimated±SE 93,813±40,633 SB (unweighted count=31; 0.3% ± 0.1% of all PTSD visits) visits in the PTSD sample. Interestingly, none of the PTSD patients with SB were in the PTSD+NM group (ie., all were PTSD-NM group). The odds ratio (OR) for SB in the PTSD-NM group versus all other patient visits in the 2 databases, was 6.102 (95% CI 2.56–14.57), consistent with overall increased SB in PTSD. Depression was not significantly different between the PTSD+NM versus PTSD-NM groups (OR=1.43, 95% CI 0.77–2.65).
Conclusion: In a nationally-representative sample, PTSD patients with NM had significantly less SB but not lower depression scores. This previously unreported finding may indicate that NM (possibly through mechanisms associated with REM sleep) have a protective effect against SB.
Support (If Any): None.

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LUCID DREAMING IN VETERANS WITH PTSD: NON-NIGHTMARE DREAMS AND NIGHTMARES

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Introduction: Lucid dreaming (LD) involves awareness, while dreaming, that one is dreaming and metacognitive monitoring of the ongoing dream. Estimates of LD in general population samples are 31–37% with rare (< one per month), and 20–30% with frequent (≥ one per month), LD. The study of LD has important applications for examining the nature of consciousness during sleep and for understanding and treating dream disturbances including posttraumatic nightmares. LD can be assessed tri-dimensionally: dream awareness, dream content control, and control of waking from a dream. We have reported that a group of Veterans with PTSD and recurrent nightmares demonstrated a LD profile characterized by high dream awareness and low dream content control. Here we examined whether the LD profiles of Veterans with PTSD differed between LD in non-nightmare dreams and in nightmares.
Methods: Thirty-two Veterans with current PTSD (mean age = 42, range = 24 - 60; 19% female) were recruited from the Crescenz VAMC Mental Health Clinic. They completed self-report questionnaires including the Nightmare Frequency Questionnaire, the LD subscale of the Iowa Sleep Experiences Scale, and the Lucidity and Consciousness in Dreams Scale. Lucidity in non-nightmare dreams and in nightmares was assessed.
Results: Eighty-eight percent of participants reported at least one nightmare per week (mean = 4.7). Fifty-four percent had frequent awareness of non-nightmare dreams; only 22% had non-nightmare dream content control. Eighty-two percent had frequent awareness of nightmares; only 24% had nightmare content control.
Conclusion: Compared to general population samples, Veterans with PTSD had a higher percentage of frequent lucid dreamers. For non-nightmare dreams, and more prominently for nightmares, they demonstrated a LD profile characterized by high dream awareness and low dream content control. The combination of high conscious awareness of dreaming and inability to control dream content may contribute to the distress of posttraumatic nightmares. These findings can be applied to the development of novel treatments for the nightmare disturbance in PTSD.
Support (If Any): Veterans Integrated Service Network 4 Mental Illness Research Education and Clinical Center

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DAILY MORNING BLUE LIGHT EXPOSURE LEADS TO CHANGES IN FUNCTIONAL BRAIN RESPONSES DURING EMOTIONAL ANTICIPATION IN INDIVIDUALS WITH PTSD

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Introduction: Some of the most common symptoms of post-traumatic stress disorder (PTSD) are sleep difficulties. Morning blue light exposure (BLE) has been used as a way to improve sleep and advance the circadian rhythm. The present study assessed whether six weeks of daily morning BLE can reduce PTSD symptom severity as a result of improved sleep, and affect functional brain responses when anticipating aversive emotional stimuli.

Methods: Fourteen healthy adults (50% female) with a clinical diagnosis of PTSD (according to the Structured Clinical Interview for DSM-5) were randomly assigned to receive either six weeks of morning BLE (active condition, n=9) or amber light (placebo condition, n=5) for 30 minutes each day. Before and after the intervention, participants completed the Clinician Administered PTSD Scale for DSM-5 (CAPS-5) and underwent functional magnetic resonance imaging (fMRI) at 3T while completing an emotional anticipation task. Neuroimaging data were preprocessed and analyzed with SPM12 using standard algorithms. Standard regions of interest (ROIs) were placed bilaterally at the insula, amygdala, and medial prefrontal cortex.
Results: While there was no difference in CAPS-5 symptom scores from pre- to post-light exposure between the two groups ($F(1,12)=.09$, $p=.78$), participants in the BLE group showed a significant increase in activation within the right medial frontal gyrus (22 voxels) and a decrease in activation within the right insula (10 voxels) when anticipating negative versus positive stimuli ($p=.005$, uncorrected).
Conclusion: While we found no evidence for a reduction in PTSD symptoms due to daily morning BLE, these preliminary results suggest that daily BLE may alter responses in brain regions linked to emotion regulation. However, this was a preliminary study and future work with larger sample sizes will examine the possibility that these neuronal changes correspond to individuals' behavioral responses when having to regulate emotions, as well as improved PTSD symptoms and sleep quality.
Support (If Any): This study was supported by a USAMRAA grant.

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ALTERED OVERNIGHT PRODUCTION OF THE PRO-INFLAMMATORY CYTOKINES INTERLEUKIN-6 AND TUMOR NECROSIS FACTOR-A IN POST-TRAUMATIC STRESS DISORDER

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Introduction: Post-traumatic stress disorder (PTSD) is associated with altered levels of pro-inflammatory cytokines, including tumor necrosis factor-α (TNF-α) and interleukin-6 (IL-6). Studies in animals and healthy humans have also shown that pro-inflammatory cytokines can modulate sleep. A better understanding of overnight cytokine production in PTSD might shed light on a potential mechanism of PTSD-related sleep disturbance. Thus, we investigated overnight levels of TNF-α and IL-6 in individuals with and without PTSD.
Methods: Serum samples were collected from otherwise healthy, medication-free participants with chronic PTSD ($n = 44$; 50% female; M age=30.34; $SD = 8.11$) and matched controls ($n= 49$; 53% female; M age=30.53; $SD = 6.57$) during a night of sleep in a laboratory. Levels of TNF-α and IL-6 were measured at hours 0, 2, 4, 6, and 8 after typical sleep onset time using serial serum samples. Plasma cytokine levels were quantified using enzyme-linked immunosorbent assays.
Results: Growth model analysis indicated a significant group by time interaction ($t[247] = -2.92$, $p = .005$) for IL-6 and a significant group by gender by time interaction ($t[275] = 2.02$, $p = .04$) for TNF-α. PTSD positive individuals seemed to have higher cytokine levels at sleep onset, but not at the end of their sleep cycle. Inverted U-shaped profiles of TNF-α for male controls indicated that their TNF-α levels peaked in the middle of the night (hour 4) and decreased towards the end of it consistent with prior literature, while TNF-α of men with PTSD peaked at the end of the sleep cycle (hour 8). There were no significant differences in TNF-α levels overnight between women with and without PTSD.
Conclusion: Overnight IL-6 and TNF-α levels may be altered in individuals with PTSD compared to those without PTSD. Altered overnight TNF-α levels may only be present in men, but not women with PTSD. To our knowledge, this is the first study that examined nocturnal cytokine production in a sample of individuals with and without PTSD. Overall data indicate that the disturbed sleep often observed in PTSD may be accompanied by altered inflammation.
Support (If Any): 5R01MH073978-04, 5R34MH077667-03,UL1 RR024131, KL2 TR000143, K01MH109871

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AN EXAMINATION OF FEAR OF SLEEP IN INDIVIDUALS WITH PTSD AND COMORBID INSOMNIA

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Introduction: Fear of sleep (FOS) may play a role in the development and maintenance of sleep disturbance in posttraumatic stress disorder (PTSD). The aims of the present study were to (1) examine the association between FOS and pre-treatment PTSD symptoms, (2) examine the association between FOS and other pre-treatment sleep disturbance symptoms, and (3) determine whether FOS decreases following cognitive-behavioral therapy for insomnia (CBT-I).
Methods: Forty-five adults with PTSD and comorbid insomnia participated in the study (31 F; age: 37.20 ± 10.47 years). FOS was assessed using the Fear of Sleep Inventory (FOSI); PTSD symptoms were assessed using the Clinician Administered PTSD Scale (CAPS); and sleep disturbance symptoms were assessed using polysomnography (PSG), sleep diaries, and the Pittsburgh Sleep Quality Index Addendum for PTSD (PSQI-A). Participants were randomly assigned to 8 weeks of CBT-I (N=29) or a waitlist control condition (N=16).
Results: Greater FOS was associated with greater nightmare frequency (CAPS; $R=0.34$, $p=0.02$), greater hypervigilance intensity (CAPS; $R=0.30$, $p=0.04$) and greater PTSD symptom severity (CAPS; $R=0.40$, $p<0.01$). FOS was not associated with trauma-type, gender, or civilian vs. veteran status. Greater FOS was associated with reduced total sleep time (PSG; $R=-0.32$, $p=0.04$), less REM sleep (PSG; $R=-0.31$, $p=0.04$), greater disruptive nocturnal behaviors (PSQI-A; $R=0.40$, $p<0.01$), decreased WASO (sleep diaries; $R=-0.43$, $p<0.01$), and fewer REM interruptions (PSG; $R=-0.34$ $p=0.04$). FOS was not associated with any other pre-treatment sleep variable. Following CBT-I, there was a significant reduction in FOS compared to the waitlist condition ($F(2,80) = 8.24$, $p<0.01$). These improvements persisted 6 months later.
Conclusion: Results from this study suggest that FOS is related to sleep disturbances specific to trauma (e.g., nightmares, hypervigilance, disruptive nocturnal behaviors) rather than "classic" insomnia symptoms. Unexpectedly, greater FOS was associated with reduced WASO and REM interruptions. These results may be related to having a truncated sleep period (i.e., reduced TST) and thus, more consolidated sleep. Interestingly, FOS deceased following CBT-I despite FOS not being a specific target for intervention.
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DIFFERENT RELATIONS WITH SLEEP DISTURBANCE ACROSS PTSD SYMPTOM CLUSTERS IN OEF/OIF VETERANS

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Introduction: Disturbed sleep, in the form of insomnia and nightmares, is a prominent feature of posttraumatic stress disorder (PTSD). Broadly, theories suggest that insomnia may be the result of intrusions of anxious arousal, and that re-experiencing in the form of nightmares relates to an inability to fully integrate and process traumatic event-related stimuli. However, the predictive utility of relations between specific PTSD symptom clusters and objective/subjective sleep has not been established. The present study examined how PTSD symptom clusters are differentially related to objective and subjective sleep in Operation Enduring Freedom (OEF)/Operation Iraqi Freedom (OIF) Veterans.

Methods: Thirty subjects (10% female, mean age 38.0, SD=9.4) participated in a study investigating neurobiological factors related to hyperarousal in PTSD. PTSD symptom clusters were assessed using the Clinician-Administered PTSD scale and consisted of re-experiencing, avoidance, and arousal symptoms. Sleep symptomatology was assessed using the Insomnia Severity Index, Nightmare Frequency Questionnaire, and Nightmare Distress Questionnaire. Additionally, polysomnography was conducted to assess for sleep continuity and architecture. To avoid conflation, the PTSD items measuring insomnia and nightmares were excluded from the PTSD re-experiencing and arousal symptom cluster scores as well as the PTSD symptom severity total score.

Results: Greater overall PTSD severity and each symptom cluster were positively associated with nightmare frequency, nightmare distress, and insomnia severity (p's<.001); increased stage N1 sleep (p's<.05) and reduced stage N3 sleep (p's<.05). Adjusting for depression, re-experiencing and arousal symptom clusters predicted number of nightmares (p's<.05) but not the avoidance cluster (p>.10). Also, re-experiencing symptom cluster significantly predicted nightmare distress and reduced stage N3 sleep (p's<.05) but not the avoidance and arousal symptom clusters (p's>.10).

Conclusion: PTSD re-experiencing symptom cluster showed unique relations with nightmare distress and reduced stage N3 sleep. These findings suggest that specific PTSD symptom clusters may be beneficial in differentiating sleep disturbance in OEF/OIF Veterans.

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REPRODUCIBLE EEG SIGNALS DISCRIMINATE COMBAT VETERANS WITH PTSD

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Introduction: Putative quantitative electroencephalography (EEG) markers of post-traumatic stress disorder (PTSD) during sleep show poor inter-night reproducibility. This raises concerns about their clinical utility for diagnosis and personalized treatment. To address this challenge, we investigated approaches to improve inter-night stability and discriminatory power of EEG spectral features.

Methods: We obtained bilateral 10-channel EEG recordings (frontal, central, temporal, parietal, and occipital) from 66 combat veterans (50 with PTSD) during two nights of sleep, separated in most cases by less than 30 days (82%). We computed the absolute EEG spectral power across 10 EEG channels, 5 sleep stages and nocturnal wakefulness, and 6 frequency bands (360 features). We subsequently normalized the features by calculating the spectral power ratios across different sleep stages and nocturnal wakefulness (900 features). For each feature, we computed the correlation coefficient (Spearman's ρ) between nights as a measure of inter-night stability, and the effect size (Hedges' g) as a measure of discriminatory power (PTSD vs. healthy groups).

Results: None of the absolute EEG spectral features yielded $g > 0.5$ across nights, despite g exceeding 0.5 for 5 and 21 features for the first and second nights, respectively. In contrast, 34 power-ratio features yielded $g > 0.5$ and $\rho > 0.5$ across nights. Most of these features exhibited elevated delta (frontal), theta (frontal), alpha (occipital), and beta (frontal and central) powers during slow-wave sleep relative to wakefulness and lighter sleep stages among PTSD subjects compared with healthy subjects.

Conclusion: Normalization of EEG spectral powers across sleep stages yielded a set of features that were both stable and discriminatory across nights. These potential PTSD markers support the hypothesis that both central arousal and sleep pressure remain higher across sleep stages in subjects with PTSD compared to healthy subjects.

Support (If Any): The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the US Army or of the US Department of Defense. This abstract has been approved for public release with unlimited distribution.

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SLOW WAVE ACTIVITY AND SIGMA AS NON-RAPID EYE MOVEMENT SLEEP FEATURES CHARACTERIZING POSTTRAUMATIC STRESS DISORDER SYMPTOM SEVERITY AND COGNITIVE FUNCTIONING IN MILITARY VETERANS

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Introduction: Inadequate sleep is a hallmark of posttraumatic stress disorder (PTSD), and may contribute to poor cognitive functioning. Non-rapid eye movement (NREM) sleep, specifically slow wave activity (SWA; 0.5-4Hz) and sigma (12-16Hz), have been linked to cognition in clinical and healthy populations, but remain understudied in PTSD. This study explored relationships between PTSD, SWA, sigma, and cognitive symptoms in military veterans.

Methods: 129 previously-deployed veterans with (PTSD+; n=100) and without (PTSD-; n=29) PTSD, completed the Clinician Administered PTSD Scale (CAPS) and two consecutive sleep laboratory nights with full polysomnography, where relative delta (a marker of SWA) and sigma power were extracted from C4 channel for whole, second night NREM sleep. Analysis of covariance and partial correlations assessed group differences and magnitude of relationships.

Results: The PTSD+ group demonstrated less SWA [$F_{1, 113}$=5.11, p=.03] than the PTSD- group, but no group differences were observed in sigma. In the PTSD+ group, SWA positively correlated with overall PTSD severity determined by the CAPS (r=.21, p=.05) and sigma negatively correlated with CAPS cognitive items (r=-.21, p=.05). Adjusting for age did not impact the significance of relationships tested. However, age correlated with overall PTSD severity (r=-.50, p< .001) CAPS cognitive items (r=-.26, p=.01) and SWA (r=-.48, p< .001), but not with sigma.
Conclusion: SWA is associated with overall PTSD severity and age, while sigma is related to CAPS cognitive items. Although sigma did not differ between groups, other related features, such as sleep spindles, may be related to cognitive functioning in PTSD, and age may uniquely contribute to relationships involving SWA. More precise and objective measures are necessary to fully assess the relationships between SWA, sigma, PTSD, and cognitive functioning in military veterans.
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TRAUMA EXPOSURE POTENTIATES THE RELATIONSHIP BETWEEN SLEEP AND CHRONIC PAIN IN VETERANS WITH TBI AND PTSD

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Introduction: One of the main sequelae of mild traumatic brain injury (mTBI) is sleep-wake disturbances (e.g., excessive daytime sleepiness, insomnia and circadian rhythm disorders), which is present in 50–70% of civilians and Veterans with mTBI. In addition to sleep-wake disturbances, mTBI is commonly associated with headache and chronic pain. As the relationship between sleep-wake disturbances and chronic pain/headache may be potentiated by the co-existence of trauma, the purpose of this study is to describe the association between sleep-wake disturbances and pain in a large sample of Veterans without trauma exposure, with mTBI, with post-traumatic stress disorder (PTSD), and with co-morbid mTBI+PTSD.
Methods: Veterans without trauma exposure (Control; n=309), with mTBI (n=117), with PTSD (n=130), and with comorbid mTBI and PTSD (mTBI+PTSD; n=96) were consented and enrolled from the VA Portland Health Care System Sleep Disorders Laboratory. Data collected included overnight in-lab polysomnography, self-reported sleep-wake disturbances assessed via the insomnia severity index (ISI), and the presence/severity of headache/pain as assessed via the NIH PROMIS Global Health scale. TBI and PTSD symptom severity was assessed using the Rivermead Post-Concussive Questionnaire (RPQ) and the PTSD Checklist (PCL-5), respectively.
Results: Trauma exposure was associated with worse ISI scores (Control=13±0.3, mTBI=15±0.6, PTSD=18±0.5, and mTBI+PTSD=19±0.5; max=26). ISI was positively correlated with RPQ scores in mTBI Veterans (r=0.65, P<0.0001), and with PCL-5 scores in PTSD Veterans (r=0.31, P<0.0007). The prevalence of headaches increased with trauma exposure (Control=35%, mTBI=50%, PTSD=63%, mTBI+PTSD=72%). Additionally, the frequency of experiencing a headache >25% of days/month increased with trauma exposure (Control=35%, mTBI=69%, PTSD=67%, mTBI+PTSD=73%). Finally, self-reported global pain also increased with trauma exposure (Control=3.3±0.1, mTBI=4.1±0.2, PTSD=4.7±0.2, and mTBI+PTSD=5.4±0.2; max=6).
Conclusion: The present study highlights how trauma exposure potentiates the association between sleep-wake disturbances and headache/pain in a large sample of Veterans with mTBI, PTSD, and co-morbid mTBI+PTSD. Future work will explore novel biomarkers using these subjects' in-lab polysomnography data in association with measures of self-reported and quantitative pain.
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EARLY VS. LATE WAKE THERAPY IMPROVES MOOD IN ANTEPARTUM VS. POSTPARTUM DEPRESSION BY DIFFERENTIALLY ALTERING MELATONIN AND SLEEP TIMING.

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Introduction: Critically-timed wake therapy improves mood in one day in most depressed patients (DP). We tested the hypothesis that early-night wake therapy (EWT: sleep 3:00 - 7:00 am) vs. late-night wake therapy (LWT: sleep 9:00 pm - 01:00 am) improves mood more in antepartum vs. postpartum depression by differentially altering melatonin and sleep timing relationships.
Methods: In 50 women: 26 antepartum (17 healthy comparison (HC) subjects, 9 DP, by DSM-IV criteria) and 24 postpartum (8 HC, 16 DP) initially randomized to a cross-over trial of one night of either EWT or LWT, we measured, pre- and post-treatment, interview-based mood assessments; plasma melatonin (sampled at 30-min intervals from 6:00 pm - 11:00 am); polysomnography (PSG); and melatonin-sleep phase-angle differences (PADs) in relation to ambient day length.
Results: After EWT, mood improved significantly more in antepartum vs. postpartum DP; after LWT, mood improved more in postpartum than in antepartum DP. In antepartum DP after EWT, mood improvement correlated with a normalized later melatonin onset time, an earlier sleep onset and a reduced PAD between melatonin and sleep onset time. In contrast, in postpartum DP after LWT, mood improvement correlated with normalization and increase in total sleep time. Longer day length was associated with later melatonin onset time and enhanced mood improvement in antepartum DP after EWT.
Conclusion: In peripartum depression, one night of non-pharmacological behavioral sleep/wake intervention, targeted to specific underlying circadian rhythm abnormalities, improves mood, offering a treatment strategy to women with a potentially severe illness, consistent with the aims of "precision medicine."
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CBT-I FOR MENOPAUSE RELATED INSOMNIA ALSO REDUCES DEPRESSION SEVERITY

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Introduction: Menopause has been associated with elevated risk of mood disturbances. This relationship has been attributed to a number of factors including alterations in hormone levels, psychosocial factors, and insomnia associated with menopause. While cognitive behavioral therapy for insomnia (CBT-I) has been shown to also reduce depression in the general population, the effectiveness of CBT-I in reducing depression associated with menopause has not been tested.

Methods: 122 females with insomnia concurrent with menopause were randomized into three conditions: CBT-I (N=41), Sleep Restriction Therapy (SRT, N=41) and an Information-only control condition (IC, N=40). Outcome measures included Insomnia Severity Index (ISI), and Beck Depression Inventory (BDI-II; sans sleep items). All measures were conducted pre-, post-treatments, and at 6 months follow-up.

Results: dCBT-I resulted in a robust significant improvement in ISI (-8.2±5.3 points) compared to control (-4.0±4.2 points). The post-treatment remission rate (ISI≤10) was significantly greater in the dCBT-I condition (67.1%) compared to the control group (33.7%; $p<.01$). Similar results were observed for depression symptoms, with the dCBT-I condition exhibiting decreased depression severity (-3.0±4.1 points, from 7.2±4.2 pre-treatment) compared to the control condition (-1.2±3.2 points, from 7.1±3.9 pre-treatment, $p<.01$). Whereas depression rates (QIDS≥10) were comparable between conditions at pre-treatment (control: 28.3%; dCBT-I: 24.0%, $p>.05$), the dCBT-I condition exhibited a significantly lower rate of clinically significant depression at post-treatment (8.2%) compared to the control group (19.0%, $p<.01$). Results stratified by demographics indicated that dCBT-I yielded a near identical and significant decrease in both insomnia and depression symptom severity across all demographic groups.

Conclusion: Findings from this study provide evidence for the effectiveness of CBT-I for insomnia associated with menopause, and also suggest its potential for reducing concurrent depression. Furthermore, gains in depression symptoms appear to be sustained up to 6 months following CBT-I, and may also continue to decrease over time.

Support (If Any): This research is funded by the National Institute of Nursing Research (R01NR013959, PI:Drake).

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QIGONG EXERCISE IMPROVED QUALITY OF SLEEP AND REDUCED INTERLEUKIN-1 BETA AND INTERLEUKIN-6 AMONG PERSONS WITH DEPRESSIVE SYMPTOMS AND SLEEP DISTURBANCES: A RANDOMIZED CONTROLLED TRIAL

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Introduction: Growing evidence has shown that Qigong exercise improves sleep quality and alleviates depressive symptoms. However, the mechanisms underlying the effects of Qigong exercise remain unclear.

Methods: A randomized waitlist-controlled trial was conducted to assess efficacy of Qigong exercise and investigate relationship between pro-inflammatory cytokines and self-reported symptoms among depressed persons with sleep disturbance. 173 participants were screened and recruited from the community. Intervention was eight 3-hour weekly sessions of Qigong training plus 30-minute self-practice at least 3 times per week. Self-reported questionnaires, including Pittsburgh Sleep Quality Index (PSQI), Center for Epidemiologic Studies Depression Scale (CES-D) and perceived stress scale (PSS) and measurement of pro-inflammatory cytokines interleukin (IL)-1β and IL-6 were assessed at baseline (T0), immediate post-intervention (T1) and 3-month post-intervention (T2).

Results: Compared with waitlist control group, independent t-tests showed that Qigong exercise significantly improved sleep quality and reduced depressive symptoms and perceived stress as measured by PSQI (-1.7 vs -0.7, p =.014), CES-D and PSS and lowered IL-6 (-0.21 vs 0.70, P = <.001) and IL-1β (-0.08 vs 0.00, P = .002) at T1. Significant association was found between PSQI change score and reduction in IL-1β level at both T1 and T2 following Qigong exercise, but not with IL-6 level; while reduction in IL-6 was significantly associated with changes in CES-D and PSS scores.

Conclusion: Qigong exercise alleviated sleep disturbance and depressive symptoms, and also reduced the levels of IL-1β and IL-6. Significant associations between reduction in IL-1β and sleep improvement were found following Qigong exercise. This study sheds light on possible underlying mechanism of regulating sleep by lowering the level of IL-1β. Further studies using polysomnography for recording NREM and REM sleep are warranted to confirm our preliminary findings.

Support (If Any): The Centre on Behavioral Health Research Fund of the University of Hong Kong

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HEART RATE SLEEP PROFILE: A NEW BIOMARKER FOR DEPRESSION?

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Introduction: Sleep disturbances may play an important role in the pathophysiology of both depression and cardiovascular dysfunctions. Previous observations suggested atypical patterns of heart rate changes in people with depression, often marked by elevated and unstable heart rate during sleep. This study assessed the validity of novel biomarkers based on heart rate changes across the sleep period to discriminate between individuals with depression and healthy controls.

Methods: Retrospective data was collated in 993 adults: 545 with unipolar depressive syndromes referred to a specialized sleep clinic (74% females, mean±SD: 45±16 years old), and 448 healthy controls (55% females, mean±SD: 40±18 years old). Electrocardiography started before bedtime and extended beyond sleep offset. Sleep-based heart rate profiles were defined by a classification algorithm using a panel of temporal and frequency domain variables designed to distinguish between depression and control cases. A subset of 630 cases (315 depression & 315 controls) was randomly selected for training the machine-learning algorithm, and the remaining 259 cases (125

depression & 134 controls) were used for testing the algorithm. This process was repeated ten times with different subsets to assess classification stability.

Results: After training, the algorithm classified individuals with depressive syndrome and healthy controls with a mean accuracy of 86%. More specifically, 82% of the depression cases were correctly identified by the algorithm (i.e. sensitivity) and, of the cases not classified as depression by the algorithm, 88% were from the control group (i.e. specificity).

Conclusion: The algorithm's ability to distinguish between clinical groups based on heart rate changes across sleep is encouraging for the identification of objective biomarkers of depression. The pathophysiological mechanisms underlying cardiovascular changes across sleep in the context of depression remain to be further investigated. Yet, the present results suggest that heart rate profiles during sleep may be useful as adjunctive assessment measures for depression.

Support (If Any): This study was partly supported by a fellowship from the Canadian Institutes of Health Research.

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SLEEP AND AUTONOMIC STRESS RESPONSE IN ADOLESCENTS WITH BIPOLAR DISORDER

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Introduction: Sleep and circadian disruption contribute to the pathophysiology of bipolar illness, but the mechanisms of this relationship are not yet understood. The aim of the present research was to evaluate whether sleep duration and timing in adolescents with bipolar disorder would prospectively predict parasympathetic nervous system activity to a social stressor, reflecting interference in stress regulatory systems that may confer vulnerability to mood episodes.

Methods: Participants were euthymic or depressed adolescents with bipolar disorder (n=24) and healthy controls (n=27). Sleep duration and timing were measured by actigraphy for a week prior to a laboratory social stress task, and electrocardiography was used to index stress-related high frequency heart rate variability (HRV). Multilevel models were performed to evaluate the effects of study group, sleep characteristics, and their interaction on initial HRV and change in HRV during stress and recovery.

Results: There was a significant interaction between study group and mean sleep duration on initial HRV (Z=-3.22, p=.001) and linear and quadratic change in HRV during the stressor (respectively, Z=2.47, p=.01; Z=2.41, p=.02). Longer sleep durations were associated with lower initial HRV and greater reactivity (slopes) in HRV during the stressor in adolescents with bipolar disorder but not controls. Sleep midpoint did not moderate the effect of group on initial HRV, but there was a significant interaction between group and sleep midpoint on linear and quadratic change in HRV during the stressor (respectively, Z=-2.26, p=.02; Z=2.01, p=.04).

Conclusion: These results suggest that long sleep duration, which is characteristic of both remitted and depressed episodes of bipolar illness, is associated with stress vulnerability in adolescents with bipolar disorder. In the context of research linking insufficient sleep to mood impairment in typical adolescents, these data highlight the differential vulnerability that long sleep duration may import for adolescents with bipolar illness.

Support (If Any): This research was supported by grants from The Pittsburgh Foundation (Emmerling Fund to Drs. Franzen and Goldstein) and the National Institutes of Health (K01-MH103511 to Dr. Casement).

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THE LONGITUDINAL NEUROENDOCRINE, IMMUNE, AND CARDIOVASCULAR IMPACT OF A MINDFULNESS-BASED SLEEP INTERVENTION FOR AT-RISK ADOLESCENTS

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Introduction: Anxiety, depression, and sleep disturbance have been shown to affect biological health by dysregulating the hypothalamic-pituitary-adrenal (HPA) axis, immune system, and vasculature of the heart, which may worsen psychological health and medical issues. Previous research has shown that sleep may serve as a mediating factor between psychological and medical disease, suggesting that treatment for sleep may reverse or even prevent future adverse psychobiological health outcomes. This project is the first to investigate the neuroendocrine, immune, and cardiovascular benefits of sleep among an at-risk for depression adolescent sample within a longitudinal, randomized control trial investigating the effectiveness of a 7-week mindfulness-based sleep intervention.

Methods: Participants (n = 144) were adolescents aged 12–18 who endorsed sleep and anxiety issues, known risk factors for depression onset. Participants were randomized into either a 7-week mindfulness-based sleep intervention or a 7-week study skills (active control) intervention. At both pre-intervention (T1) and two-year post-intervention follow-up (T2) time points (currently ongoing until January 2017), participants provided 6 saliva samples across two days to measure salivary biomarkers of stress and inflammation including cortisol and C-Reactive Protein (CRP), and were assessed via a cardiovascular health test measuring blood pressure, heart rate variance, and endothelial functioning, objective and subjective measures of sleep including Actigraphy and the Pittsburgh Sleep Quality Index (PSQI) as well as other mood questionnaires, and a semi-structured diagnostic clinical diagnostic interview.

Results: We expect a series of independent samples t-tests and ANOVA results will show an improvement among participants in the sleep intervention group from T1 to T2 in neuroendocrine, immune, and cardiovascular measures as compared to their baseline levels, as well as to participants in the control group, and that these improvements will be mediated by the degree of improvement across objective and subjective measures of sleep.

Conclusion: This research will improve our understanding of the biologically protective nature of sleep, inform clinical treatment decisions, and serve as an accessible sleep treatment option for at-risk adolescents while simultaneously improving psychobiological health and possibly preventing future medical complications.

Support (If Any): The project is supported by a National Health and Medical Research Council (NHMRC)-funded grant (APP1027076).

1091

YOUTH'S BEDTIME REGULARITY MEDIATES THE ASSOCIATION OF DEPRESSION AND ANXIETY WITH NEGATIVE ATTENTION BIAS

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Introduction: Attention biases towards negative information and sleep problems are core clinical features in anxiety and depressive disorders. We studied if sleep patterns, which were readily malleable, were associated with such biases among depressed and anxious individuals.
Methods: A youth sample recruited from local universities (n=188, age ranged from 17–24) were administered the Structured Clinical Interview for DSM-IV disorders, (47% have a lifetime history of depressive and/or anxiety disorder). All participants wore an actiwatch and completed a sleep diary for 5 days and then completed an affective go/no-go task (AGNG) and other neurocognitive assessment on the 6th day. Their sleep difficulty (e.g. sleep latency), and regularity of sleep timing (e.g. standard deviation of 5-day bedtime) were coded as indicator of sleep-wake behaviors with the discrimination index (*d*') in the AGNG as indicator of attention bias.
Results: Depressed and anxious individuals had a lower *d*' in the AGNG, $F(1,176)=6.280$, $p=.013$, $I^2=.038$ than healthy participants. There was a significant correlation between *d*' on the AGNG with regularity of bedtime, $r(168)=.225$, $p=.024$. Structural equation model with depression and anxiety as predictor, bedtime regularity as mediator and *d*' on AGNG as dependent variable achieved a very good fit, CFI=1.000, RMSEA<0.001, SRNR<.001. There was no significant direct effect ($B=.032$, Standard Error=.211, $p=.880$) but a significant indirect effect of depression and anxiety status in predicting *d*' on AGNG through its effect on bedtime regularity. $B=.180$, Standard Error=.127, $p=.031$.
Conclusion: Our findings support the mediating role of sleep of the associations between depressive and anxiety disorder with attention bias. Given the high prevalence of depressive and anxiety disorders and sleep problems among youth and the prevalence of attention bias in psychopathology, further longitudinal studies are warranted in investigating the causal interrelationships among these variables.
Support (If Any): Funder: General Research Fund (#18619616), Research Grant Council, HKSAR

1092

THE EFFECT OF REM SLEEP ON EMOTIONAL MEMORY CONSOLIDATION IS MODULATED BY DEPRESSION

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Introduction: Negative emotional memory bias is thought to play a causal role in the onset and maintenance of Major Depressive Disorder (MDD). Accumulating research demonstrates a relationship between REM sleep and the consolidation of negative emotional memories. Accordingly, it is believed that REM sleep may influence MDD vulnerability via its effects on emotional memory consolidation. This study aimed to compare the relationship between REM sleep and emotional memory consolidation in healthy participants relative to a subclinical group of participants exhibiting mild-to-moderate depressive symptoms.
Methods: Twenty-three participants were selected from a pre-screen of 77 student volunteers based on their Beck Depression Inventory-II (BDI-II) scores, and assigned to either the subclinical (BDI-II range = 14–27; n = 11) or control (BDI-II range = 0–6; n = 12) group. Using a within-subjects split-night design, we measured recognition performance for positive, neural and negative images before and after a three-hour retention interval rich in either Slow-Wave Sleep (SWS) or REM sleep.
Results: We found a significant three-way 2 (sleep condition: SWS, REM sleep) x 2 (participant group: subclinical, control) x 3 (image valence: positive, neutral, negative) interaction on memory consolidation (post-sleep d' − pre-sleep d'; $F(2, 42) = 3.28$, $p = .047$). Post hoc analysis on the participant groups separately showed a significant two-way sleep condition x image valence interaction on memory consolidation in the subclinical group ($F(2, 20) = 4.73$, $p = .021$), but not in the control group ($F(2, 22) = 0.17$, $p = .845$).
Conclusion: Our findings confirm the role of REM sleep in the selective consolidation of negative emotional material. However, this effect was only exhibited by our subclinical participants. These results suggest that REM sleep- related emotional memory consolidation may be greater in individuals suffering with depressive symptoms.
Support (If Any): University of Lincoln

1093

TREATING DEPRESSION IN INSOMNIA: DISTINCTIVE PATTERNS OF DEPRESSIVE SYMPTOM CHANGE TRAJECTORIES AND THEIR CORRELATES, A REPORT FROM THE TRIAD STUDY

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Introduction: We have previously reported that cognitive behavioural therapy for insomnia (CBT-I) was more efficacious than control therapy for insomnia among patients with comorbid depression, but did not lead to differential depression outcomes. This study explored the heterogeneity in the course of depression severity by identifying classes of change trajectories and examining their sleep correlates.
Methods: 148 adults (age $M \pm SD = 46.6 \pm 12.6$, 73.0% female) with insomnia and major depressive disorders received antidepressant pharmacotherapy, and were randomized to 7-session CBT-I or control interventions over 16 weeks with 2-year follow-up. The Hamilton Rating Scale of Depression (HRSD) and Insomnia Severity Index (ISI) were administered at baseline, bi-weekly during, and every 4 months after treatment. Dysfunctional Beliefs and Attitudes about Sleep (DBAS) and Glasgow Sleep Effort Scale (GSES) were collected at baseline, mid-, and end-intervention.
Results: Growth mixture models revealed three trajectories: (1) Partial-Responders (68.9%) had moderate symptom reduction during the first half of the intervention (p-value < .001), but continued to report mild depression severity throughout the remaining assessments. (2) Initial-Pronounced-Responders (17.6%) had significant symptom reduction during the intervention (p-values < .001), with low depression severity at post-treatment; their HRSD scores, however,

increased over follow-up (p-value < .001) to levels comparable to the Partial-Responders. (3) Optimal-Pronounced-Responders (13.5%) achieved most gains during the first half of the intervention (p-value < .001), and continued to improve (p-value < .01) while maintaining low HRSD scores during follow-up. The classes did not differ significantly on baseline measures (demographics, ISI, DBAS, or GSES) or intervention received. They differed significantly on ISI, DBAS, and GSES after treatment began (p-values < .05); Optimal-Pronounced-Responders consistently scored the lowest on all three measures.
Conclusion: In patients with comorbid insomnia and major depression, depressive symptom change trajectories during and after antidepressant treatment are heterogeneous, and linked to insomnia and sleep-related constructs after commencing treatment. Trajectories were not associated with intervention type. Early changes in insomnia symptoms may be useful for predicting longer-term outcomes in patients with depression.
Support (If Any): MH078924, MH078961, MH079256

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META-ANALYSIS OF THE ANTIDEPRESSANT EFFECTS OF THERAPEUTIC SLEEP DEPRIVATION

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Introduction: Acute sleep deprivation (SD), either total or partial, is a well-known non-pharmacologic treatment for depression that produces clinical improvement in depression symptoms within a single 24-hour period and, as such, is one of the most rapid antidepressant interventions known. Studies of SD typically report a 40% to 60% response rate, however antidepressant response to SD has not been quantitatively analyzed since 1990 despite the addition of over 75 studies to the literature. The present study examined the overall efficacy of SD in depressed samples, and examined how the antidepressant response may be affected by the type of SD performed (total/partial), the nature of the sample (depressed/bipolar), medication status, and the definition of "response" used in each study.
Methods: A total of 66 studies met inclusion criteria, meaning they were studies of experimental SD that provided data on the proportion of the sample that responded to the intervention, the definition of response, and did not simultaneously combine the intervention with other therapies (e.g., chronotherapeutics). Data were analyzed with meta-analysis of proportions and Poisson mixed-effects regression model.
Results: The overall response rate to SD was 45% among randomized controlled trials of SD, and 50% among studies that did not randomize to SD vs. control groups. The response to SD was not affected by type of SD performed, the nature of the clinical sample, medication status, the definition of response, or by age or gender.
Conclusion: Findings support a significant effect of SD that is robust across patient characteristics and suggest the need for future studies on the phenotypic nature of the antidepressant response to SD, neurobiological mechanisms of action, and moderators of the SD treatment response in depression.
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1095

A CASE-CONTROL STUDY OF FREQUENT NIGHTMARES IN PATIENTS WITH MAJOR DEPRESSIVE DISORDER (MDD)

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Introduction: Nightmare disturbance is a common yet often neglected sleep complaint in patients with major depressive disorder (MDD). The aims of the present study were to establish the clinical, psychosocial, and polysomnographic profiles of the depressed patients with frequent nightmares through a case-control study.
Methods: Three groups of participants were recruited from the psychiatric outpatient clinic of a regional hospital and the local community in Hong Kong: 1) depressed patients with an active complaint of frequent nightmares, which were defined as having nightmares at least once per week as confirmed by both the retrospective questionnaire assessment and prospective daily mood and dream diary (n=35), 2) age- and gender-matched depressed patients without frequent nightmares (n=35), 3) age- and gender-matched healthy normal controls (n=35). All recruited depressed patients had no comorbid posttraumatic stress disorder (PTSD). Comprehensive in-depth assessments were conducted, including a clinical interview by Mini International Neuropsychiatric Interview (MINI), a battery of questionnaires (Beck Depression Inventory, BDI; Hospital Anxiety and Depression Scale, HADS; Insomnia Severity Index, ISI; Revised-Impact of Event Scale, R-IES; and Beck's Scale for Suicidal Ideation, BSSI), and one overnight polysomnographic and 7-day of actigraphic sleep assessments.
Results: Depressed patients with frequent nightmares were more likely to show melancholic features (p<.05), more severe insomnia symptoms (p<.001), increased anxiety (p<.001) and depressive symptoms (p<.001) as well as a heightened level of suicidal risk (p<.001). They also scored significantly higher on R-IES intrusion (p<.001), avoidance (p<.001), and hyperarousal (p<.001). In addition, depressed patients with frequent nightmares exhibited higher REM density (p<.05), longer REM latency (p<.05) and less REM sleep periods (p<.05) as compared to healthy controls. Whilst there were no significant differences in average sleep parameters as measured by actigraphy, depressed patients with frequent nightmares showed a greater night-to-night variability in wake-after-sleep onset (p<.01), % of wake time (p<.01), % of mobile time (p<.01) and fragmentation index (p<.05).
Conclusion: Frequent nightmares represent a distressing sleep problem associated with a more severe clinical presentation and increased suicidality in patients with MDD. Enhanced clinical attention and targeted sleep treatment should be directed to address nightmare complaint in depressed patients.
Support (If Any): N/A

1096

EXPERIENTIAL AVOIDANCE PREDICTS DEPRESSION THROUGH PERCEIVED STRESS, PRE-SLEEP AROUSAL, AND POOR SLEEP QUALITY

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Introduction: The link between maladaptive emotion regulation, such as experiential avoidance (EA), sleep health, and depression is not well

understood. It is suggested that EA exacerbates depression due to the impact that avoidance strategies have on an individual's experience of emotion, which is strongly associated with perceived stress. Perceived stress may increase pre-sleep arousal, which is disruptive to sleep, thus increasing risk for depression through the established association between sleep disruption and depression risk. However, these relationships have not been examined simultaneously. The current study investigated the association between EA and depression, through which perceived stress, pre-sleep arousal and poor sleep quality may play a role.

Methods: 347 participants were recruited through Amazon MTURK. Participants completed an online survey containing validated measures of EA, perceived stress and reactivity, sleep quality (SQ), and depression symptoms. Of this sample, 47 were missing data on at least one variable of interest and were excluded from final analyses (n = 300).

Results: The PROCESS macro for SPSS was used to run a serial mediation model using EA as the independent variable, depression symptoms as the dependent variable, and perceived stress, pre-sleep arousal, and SQ as serial mediators. The model was significant, $F[4, 295] = 101.61$, $R^2 = .58$, $p < .001$. There was a significant reduction in the direct effect of EA on depression ($\beta = .65$, $t = 14.84$, $p < .001$), indicating a significant partial indirect effect through perceived stress, pre-sleep arousal, and sleep quality ($\beta = .35$, $t = 6.78$, $p < .001$).

Conclusion: The findings replicate previous research suggesting EA predicts depression symptoms; however, the relationship partially functions through the effect that EA has on perceived stress. The increase in perceived stress appears to increase pre-sleep arousal ultimately impacting SQ. Poor sleep quality is subsequently related to depression symptom severity. Overall, the findings may suggest that addressing maladaptive strategies related to emotional reactivity may reduce arousal at bedtime and improve sleep quality, potentially reducing depression symptom severity and risk for depression.

Support (If Any):

1097

EFFICACY OF COGNITIVE BEHAVIORAL THERAPY FOR INSOMNIA IN PATIENTS WITH INSOMNIA COMORBID WITH MAJOR DEPRESSION.

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Introduction: Insomnia is a highly frequent comorbidity of Major Depressive Disorder (MDD). Although benzodiazepine receptor agonists are usually used, there are concerns about their long-term safety. On the other hand, Cognitive Behavioral Therapy for Insomnia (CBT-I) has demonstrated its efficacy on primary insomnia, but evidence is scarce in insomnia comorbid with MDD. In addition, these few studies do not reflect common clinical practices, where combination of drug treatments is frequently used. On this basis, the aim of this study was to evaluate the efficacy of adding CBT-I in patients with insomnia and MDD when receiving pharmacological Treatment as Usual (TAU).

Methods: Outpatients with MDD and insomnia who were receiving TAU were recruited. They were randomly assigned to receive CBT-I (four weekly sessions including sleep education, sleep hygiene, stimulus control, sleep restriction and cognitive therapy) or being put on a waiting list (WL) where subjects only received sleep hygiene education. A follow-up evaluation with Insomnia Severity Index and Hamilton Depression Rating Scale was carried out at the end of the 4-week CBT-I program and one month after the basal evaluation in the WL group.

Results: Twenty and 15 patients were assigned to CBT-I and WL groups, respectively. There were no significant differences in demographic, clinical, and pharmacological treatment between groups. In comparison to the control group (pre 16.2 ± 4.8, post 13.8 ± 7.8), adding CBT-I to TAU (pre 18.2 ± 3.8, post 10.6 ± 4.4) resulted in a significant reduction of insomnia symptoms ($F=6.8$, $p=.003$). No significant differences were found in depression scores ($F=1.7$, $p=.19$) between CBT-I group (pre 20.0 ± 6.4 post 9.1 ± 6.1) and the WL group (pre 23.6 ± 5.8 post 16.1 ± 9.1).

Conclusion: Results of this study suggest that adding CBT-I to TAU produces significant improvement of insomnia in adult outpatients with MDD under usual pharmacological treatment.

Support (If Any): None

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IMPROVEMENTS IN SUBJECTIVE SLEEP AND DEPRESSION ALONG THE COURSE OF ADJUNCTIVE PHOTOTHERAPY

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Introduction: Depression is often associated with disrupted sleep. Sleep onset difficulties and sleep quality have been suspected to play an important role in the pathogenesis of depression. Phototherapy has the potential to restore sleep dysfunctions, which in turn may alleviate mood. This study examined the relationship between changes in sleep and depressive symptoms alongside adjunctive phototherapy.

Methods: Twenty-two young individuals with depression (21.3 ± 5.2 years old; 76% female) were recruited from early-intervention mental health services in Sydney and Ottawa. Phototherapy was self-administered with green-blue light-emitting glasses for 60 minutes upon awakening for two weeks as an adjunct to standard clinical care. Prior to starting phototherapy (baseline), participants completed the Leeds Sleep Evaluation Questionnaire (LSEQ) and the Beck Depression Inventory-II (BDI-II). Following the two weeks of phototherapy, participants were asked to fill out the LSEQ and BDI-II once again (follow-up).

Results: After two weeks of adjunctive phototherapy, there was a marked reduction in depressive symptoms severity for 28% of participants, as defined by a shift to a lower depression severity category on the BDI-II. Overall, the 'Getting To Sleep' index of the LSEQ significantly improved from baseline to follow-up ($t(20) = -2.192$, $p = .040$). Additionally, improvements on the 'Getting To Sleep' ($r = -.601$, $p = .004$) and 'Quality Of Sleep' ($r = -.511$, $p = .018$) indexes both positively correlated with the improvement of depression severity. No significant correlations between the changes in BDI-II and changes in any other LSEQ subscales were found.

Conclusion: These preliminary findings indicate that the antidepressant effects of bright light are associated with the degree of sleep improvement. Larger placebo-controlled trials are still required to a have a better understanding of the potential role of sleep restoration for mood enhancement following phototherapy.

Support (If Any): This work was partially funded by the Centre for Integrated Research and Understanding of Sleep (CIRUS), the Fonds de recherche du Québec - Santé (FRQS), and the Canadian Institutes of Health Research (CIHR).

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RELATIONSHIPS OF MUSCULOSKELETAL DISORDERS, SLEEP DISTURBANCES, AND DEPRESSION AMONG HOSPITAL NURSES OF MUSCULOSKELETAL DISORDERS, SLEEP DISTURBANCES, AND DEPRESSION AMONG HOSPITAL NURSES

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Introduction: Musculoskeletal disorders (MSDs) are the leading cause of pain and disability among healthcare workers, and are frequently accompanied by comorbid symptoms, such as depression. Sleep plays an integral part in mental wellness with sleep disturbances contributing to mental disorders such as depression. However, the relationships among MSDs, sleep disturbances, and depression haven't been well studied.
Methods: Questionnaires were administered to registered nurses and licensed practical nurses at a community hospital in Northeast US. MSDs were assessed for six body regions: low back, shoulder, neck, wrist/forearm, knee, and ankle/feet; and were defined as "yes" for participants reporting moderate, severe, or extreme pain in any region. Depression and sleep disturbances were measured with the Center for Epidemiology Studies Depression Scale, and the PROMIS Sleep Disturbance Short Form. Work factors assessed included shift work, physical demands, psychological demands, decision authority, social support, and work-family conflict. Baron and Kenny's method (1986) was used to assess the mediating and moderating effects.
Results: Among 397 nurses (95% female; age 43 ± 12 y), 47.4% reported MSDs, 11.4% reported moderate to severe sleep disturbances, and 24.4% reported depression. Multivariate robust Poisson regressions found that MSDs (PR=1.49, $p<0.05$) and moderate to severe sleep disturbances (PR=2.00, $p<0.01$) were associated with increased risk of depression, after adjustment for age, gender, race, BMI, regular exercise, shift work, and other work factors. However, moderate to severe sleep disturbances did not mediate or moderate the association between MSDs and depression.
Conclusion: Both MSDs and sleep disturbances were associated with depression, and therefore need to be considered in future interventions to promote mental well-being of nurses. Longitudinal studies are needed to explore the causal relationships among these factors. Future studies with a larger sample size should re-examine the role of sleep disturbances in the association between MSDs and depression.
Support (If Any): This study was supported by a University of Massachusetts Lowell Faculty Start-up Award to YZ. JFD is supported by R01 AG044416.

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DAYTIME FUNCTION IN MIND-BODY TREATMENT OF COCURRENT SLEEP AND MOOD DISTURBANCES

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Introduction: Both sleep disturbances and depressive mood are closely associated with wide-range daytime dysfunctions. Yet limited study closely investigates daytime functioning variables after treatments for sleep disturbances either coexisting with or without depressive mood
Methods: Participants Participants were 185 individual with co-existing sleep and mood disturbances (92 in I-BMS; 93 in WLC). Daytime functioning variables were measured by items from Pittsburg Sleep Quality Index (PSQI-day) indicating daytime dysfunctions, Somatic subscale from Somatic Symptom Inventory (SSI), Anxiety subscale from Hospital Anxiety Depression Scale (HADS) and 12-Item Short Form Health Survey (SF-12) represented by Mental and Physical Component scores (MCS and PCS). Data were collected at baseline, post-treatment (8 weeks) and three-month follow-up. Multiple imputations were firstly conducted to evaluate effect size of each daytime variables after treatments. Then, regression analyses were used to reveal associations between daytime variables at follow-up and previous changes in nighttime sleep qualities (PSQI-Night) and mood (Center for Epidemiological Studies Depression after minus sleep item- CESD-M) at post-treatment respectively. At last, path analyses were used to understand interplays among daytime functioning, sleep and mood.
Results: We found that there was a small to large between-group effect size (0.20–0.70) on daytime functioning and a medium to large within-group effect size (0.53–0.89) in the I-BMS group. After adjusting for group and baseline scores, CESD-M was the most important predictor of daytime functioning. PSQI-day was associated with both PSQI-nightand CESD-M. Path analyses indicated that PSQI-day bridged PSQI-night and CESD-M in a 2-way direction (X^2=12.36, p=0.34, *df*=11, X^2/df=1.1; RMSEA=0.026; CFI=0.989; TLI=0.980; X^2=12.10, p=0.36, df=11, X^2/df=1.1; RMSEA=0.023; CFI=0.991; TLI=0.983).
Conclusion: Among subjects with co-existing sleep and depressive symptoms, improvement in daytime functioning was predominantly related to improvement in depressive symptoms. Nighttime sleep only related to daytime dysfunction that was specific to sleep disturbances. The phenomenon could be regarded as a primary link. More works are required to understand "sleep-specific" daytime impairments and their roles in the course of concurrent sleep and mood disturbances.
Support (If Any): NA

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EMOTION REGULATION AND AFFECT MEDIATE THE RELATIONSHIP BETWEEN INSOMNIA SYMPTOM SEVERITY AND MENTAL HEALTH IN A NON CLINICAL POPULATION

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Introduction: The effects of insomnia symptoms on mental health have been well documented. Although multiple studies have further supported the relationship between sleep and negative psychological outcomes, fewer studies have examined what affects this relationship. Research has investigated the link between insomnia symptoms and emotion-related factors such as negative affect and emotion regulation difficulties, but it is not yet known how these emotion-related factors play a role in the relationship between insomnia and mental health.
Methods: Participants were 68 healthy adults (65.7% female; mean age =22.26, range = 18–40) recruited from a mid-size university in the northwestern United States. Participants completed cross-sectional self-report measures of insomnia symptom severity (Insomnia Severity Index), emotional vulnerabilities (Difficulties in Emotional Regulation Scale, Positive and Negative Affective Scale), and mental health difficulties (Patient Health Questionnaire-9, Generalized Anxiety Disorder-7).
Results: Multiple regression analyses were conducted to evaluate whether positive affect, negative affect, or emotion regulation

difficulties mediated the relationship between insomnia symptoms and depressive and anxious symptoms. Difficulties in emotion regulation (β = .560, p<.001) and negative affect (β = .715, p< .001) significantly mediated the relationship between insomnia symptoms and anxiety symptoms. Additionally, difficulties in emotion regulation (β = .488, p<.001) and negative affect (β = .570, p<.001) significantly mediated the relationship between insomnia symptoms and depressive symptoms. However, positive affect was not a significant mediator for sleep and anxious symptoms (β = -.046) or depressive symptoms (β = -.062, all ps>.05).

Conclusion: Emotion regulation and negative affect both play significant roles in the relationship between insomnia symptoms and mental health. Results highlight the potential importance of emotional functioning in understanding insomnia and psychological disorders. Potential clinical implications for insomnia are discussed.

Support (If Any):

1102

THE RELATIONSHIP BETWEEN SLEEP DISTURBANCE, NEGATIVE AFFECT, AND EMOTION REGULATION

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Introduction: Although sleep disturbance is often anecdotally associated with increased negative affect, there has been relatively little research that has directly examined this relationship, in either healthy or depressed populations. Therefore, this study aimed to examine the relationship between sleep disturbance, negative affect, including anger and irritability, and emotion regulation in a sample of healthy (HC) and depressed (MDD) active service members of the US Army.

Methods: Data for this study came from the survey of the All-Army Study (AAS), a component of the Army Study to Assess Risk and Resilience in Service Members (Army STARRS), a representative sample of active duty Army personnel (N=19,506). Diagnosis of MDD was based on the Composite International Diagnostic Interview Screening Scales. Sleep disturbance was coded as absent or present utilizing one survey item. One item was also used to assess frequency of irritability, while composite scores were created and used to assess both frequency of anger and the frequency of utilizing healthy emotion regulation strategies (i.e., "Try new approaches if old ones don't work").

Results: Results from Multivariate ANOVA revealed a significant sleep disturbance by group (HC, MDD) interaction for irritability, $F(1,19502) = 7.437$, $p<.01$, and emotion regulation, $F(1,19502) = 4.282$, $p<.05$, but not anger. Post-hoc tests revealed that having sleep disturbance was associated with more irritability and anger, and poorer emotion regulation in healthy controls, however this pattern did not hold for those with MDD. In MDD, sleep disturbance was associated with increased anger, but was not associated with differences in emotion regulation skills. Irritability was associated with sleep disturbance, but to a lesser extent than in HC.

Conclusion: The results of this study support the anecdotal evidence that sleep disturbance is associated with greater negative affect in addition to lower utilization of healthy emotion regulation strategies. However, these findings were only true of healthy controls. In those with MDD, increases in sleep disturbance may not play as pivotal a role in increasing emotional dysregulation.

Support (If Any): None

1103

PREGNANCY AND POSTPARTUM ANTIDEPRESSANT USE MODERATES THE EFFECTS OF SLEEP QUALITY ON DEPRESSION SEVERITY

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Introduction: This study examined the course of antidepressant use, sleep quality and depression severity from pregnancy through 6-months postpartum in women with and without a depressive disorder during pregnancy.

Methods: Women (N=215) were interviewed during pregnancy, 1-month and 6-months postpartum. Mixed linear models were used to examine the longitudinal course and inter-relationships for the time-varying variables of antidepressant use, subjective sleep quality and depression severity.

Results: Pregnant women with a depressive disorder who did not use antidepressants had more variable depression severity over time with improvements in depression severity by 6-months postpartum. In contrast, the depression severity of their medicated counterparts remained stable and high throughout. Pregnant women without a depressive disorder had worse sleep quality when using antidepressants compared with when they were not. Antidepressant use significantly strengthened the magnitude of the effect of sleep quality on depression severity in women with a depressive disorder during pregnancy.

Conclusion: When prenatally depressed women use antidepressants, their sleep disturbance is more highly linked to depression severity than when they do not. Furthermore, antidepressants are not adequately treating the sleep disturbance of these women or their remitted counterparts, leaving both groups vulnerable to significant negative mental and physical health outcomes.

Support (If Any): This work was supported by The National Institutes of Health, grant R01MH078033 (PI: Amy Salisbury, PhD).

1104

MATERNAL DEPRESSION AND SLEEP QUALITY IN EARLY POSTPARTUM: DO MATERNAL SLEEP-RELATED COGNITIONS AND NIGHTTIME BEHAVIOURS MEDIATE THE RELATIONSHIP?

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Introduction: While postpartum depression has been linked to poorer maternal sleep quality, the pathways underlining this relationship are not well known. This study aimed to investigate the links between maternal postpartum depression, cognitions regarding infant sleep, nighttime behaviours and reported sleep quality. We propose a model linking postpartum depression and maternal sleep quality through maternal cognitions and ensuing maternal behaviours.

Methods: Using a prospective cohort study design, nulliparous women with a singleton pregnancy completed questionnaires at 18, 28, 36 weeks gestation and 5 weeks postpartum. A sample of 452 women participated in this study. Measures included the Edinburgh Postnatal Depression Scale, three subscales from the Maternal Cognitions

about Infant Sleep Questionnaire (Anger, Limits and Doubt) and the Pittsburgh Sleep Quality Index. Maternal nighttime behaviours, including infant settling methods, checking, and sleep location, were assessed by a questionnaire. Path analysis was undertaken using Mplus version 7 and mediators were tested using the Indirect approach. Model fit was assessed using a variety of standard fit indices.
Results: Depression is associated with maternal cognitions (Limits b=.20; p=.001; Anger b=.40, p<.001; Doubt b=.40; p<.001) and poorer sleep quality (b=.34; p<.001). Anger and doubt are associated with infant checking. Doubt is associated with sleep location (bed sharing coefficient =.03; p=.007; separate room coefficient = -.05; p<.001) and was found to mediate the relationship between depression and problematic nighttime behaviours. Both doubt and checking were found to mediate the relationship between depression and sleep quality (indirect effect = 0.01; p=.031).
Conclusion: Some evidence substantiating the proposed maternal sleep model was found, especially pathways linking depression and sleep quality through doubt and checking behaviours. Further investigation of this model is warranted, especially in the context of developing interventions to improve maternal sleep quality during the postpartum period.
Support (If Any): Funding from Canadian Institutes of Health Research (CIHR)

1105

AN OPEN-LABEL PILOT STUDY OF A WEARABLE HOME MORNING LIGHT THERAPY FOR POSTPARTUM DEPRESSION

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Introduction: Postpartum depression is a common and debilitating condition; unfortunately, many women with postpartum depression remain symptomatic under current treatment paradigms. We investigated the preliminary efficacy of a wearable home morning light therapy (Re-Timer®), for depression in postpartum women in an open-label pilot trial. We also examined changes in sleep and circadian timing (dim light melatonin onset, DLMO) from pre- to post-treatment.
Methods: Participants were 10 women (32.3 ± 3.3 years) who were within 9 months postpartum, met DSM-V criteria for major depressive disorder, and scored ≥ 20 on the Hamilton Rating Scale for Depression-Seasonal Affective Disorders version (SIGH-SAD). Participants used a wearable home morning light therapy for 60 minutes every morning for 5 weeks. Saliva was collected in participants' homes at baseline and post-treatment to estimate the DLMO, with a validated home saliva collection kit. Pre- and post-treatment assessments included mood (SIGH-SAD and the Edinburgh Postnatal Depression Scale; EPDS) and sleep (daily sleep diaries and the Pittsburgh Sleep Quality Index; PSQI).
Results: One participant discontinued participation during the baseline DLMO, and one participant discontinued light therapy after 3 weeks due to headaches and irritability. Paired-sample t-tests showed significant post-treatment improvements in mood for the EPDS (13.57 ± 3.78 to 8.86 ± 7.36, p = 0.046) and SIGH-SAD (24.43 ± 5.13 to 13.86 ± 7.36, p = 0.002). Sleep quality, as measured by the PSQI global score, also improved (11.29 ± 3.04 to 7.71 ± 2.81, p = 0.023). Daily sleep diaries showed a trend for improved sleep efficiency in the final week of treatment (76% ± 10.32 to 81% ± 12.26, p = 0.054).
Conclusion: In this open-label pilot study, 5 weeks of a wearable home morning light therapy was associated with mood and sleep improvements. The decrease in EPDS was clinically meaningful, suggesting that a wearable home morning light therapy should be further explored as a potential standalone or adjunctive treatment for postpartum depression.
Support (If Any): Gilmore Fund for Sleep Research and Education; NIH K23 HL122461

1106

SUBJECTIVE AND OBJECTIVE SLEEP QUALITY INDICATORS AND THE RELATIONSHIP TO POSTPARTUM DEPRESSION

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Introduction: Relationships between subjective, but not objective sleep outcomes, and postpartum depression have been observed in small, cross-sectional samples. The purpose of this study was to examine these relationships using a large sample followed prospectively from birth through 6 and 12 weeks postpartum.
Methods: Data from a RCT of a behavioural sleep intervention with 217 first-time mothers were subjected to secondary analysis. Objective sleep variables (nocturnal sleep, night awakenings, daytime sleep) were measured by actigraphy at 6 and 12 weeks. Subjective sleep quality was measured by the General Sleep Disturbance Scale (GSDS) and mothers' reports of their sleep as a "small", "big" or "no" problem. Depressive symptoms were measured with the Edinburgh Postnatal Depression Scale (EPDS). Control variables included group allocation, baseline EPDS and social support. Logistic regression was used to estimate the association between subjective and objective sleep variables and the presence of postpartum depression. Separate models estimated the odds of postpartum depression according to each sleep variable.
Results: GSDS scores at baseline were not related to depression; however, GSDS scores at 6 weeks were associated with >3 times the odds of depression (OR=3.56; 95% CI=1.73–7.33). The perception that sleep was a "small" or "big" problem at 6 weeks was associated with >3 (OR=3.40; 95% CI=1.54–7.46) and >8 (OR=8.29; 95% CI=2.41–28.59) times the odds of depression, respectively. There was no association between any objective sleep measures and postpartum depression.
Conclusion: Subjective sleep quality indicators are strongly associated with postpartum depression while objective sleep outcomes are not. Sleep complaints may be an important clinical indicator of low mood. Future intervention studies to improve mood in the postpartum could target women's expectations and appraisal of their sleep via cognitive-behavioural strategies.
Support (If Any): Funded by the Canadian Institutes of Health Research (Grant No MCT 84658)

1107

SLEEP DISTURBANCE AS A RISK FACTOR FOR NON-SUICIDAL SELF INJURY AND SUICIDAL BEHAVIOUR IN YOUTH.

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Introduction: Converging evidence identifies sleep disturbance as an evidence-based risk factor for suicidal behaviour. This relationship has not yet been systematically evaluated in association with a history of non-suicidal self-injury (NSSI). Research is warranted among

adolescents given increased vulnerability to sleep disturbances and high risk of suicide attempts. The current investigation sought to examine sleep disturbances among youth with 1) no history of self-directed violence (SDV) (controls), 2) history of NSSI, or 3) history of a suicide attempt (SA).

Methods: N=1046 high school students (aged 15–17; 53% female) completed self-report surveys of SDV (with and without suicidal intent), depression, and a range of sleep parameters using: The Sleep Condition Indicator (SCI; Insomnia symptoms), Disturbing Dreams and Nightmare Severity Index (DDNSI), Munch Chronotype Questionnaire (MCQ; sleep efficiency (SE), total sleep time (TST), chronotype), and Hospital Anxiety and Depression Scale. Consistent with suicidal ideation findings, sleep disturbance were hypothesized to be greater among both SDV groups relative to those without such a history. ANCOVA analyses (including HADS as a planned covariate) were employed to examine differences between groups.

Results: Youth in groups endorsing past SDV (NSSI=12.2%, SA=5.6%) scored Significantly lower on the SCI ($p<0.001$), indicating greater insomnia severity than controls (82.2%). SE was poorer (school ($p=0.005$) and weekend nights ($p=0.004$)), with shorter school night TST ($p=0.003$) and greater eveningness observed among those reporting NSSI and SA history ($p=0.020$). DDNSI-assessed nightmare severity differed significantly between all three groups ($p<0.001$), with the highest scores observed among those with an SA history. All effects remained when controlling for depression, with the exception of chronotype.

Conclusion: Findings revealed significant differences in sleep disturbance between youth with no history of SDV and those reporting NSSI or SA histories. These findings may inform empirically-driven approaches to risk assessment and interventions to enhance suicide prevention and NSSI.

Support (If Any): This research was supported by a University of Strathclyde studentship.

1108

NIGHTMARES AND EMOTION REGULATION DEFICITS AS PREDICTORS OF RISK FOR SUICIDAL IDEATION AND HISTORY OF SELF-DIRECTED VIOLENCE AMONG MILITARY VETERANS

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Introduction: Nightmares, depression, and emotion regulation (ER) difficulties are implicated in risk for military suicidal behaviors. However, the combination of these risk factors has yet to be investigated in the prediction of risk. We sought to characterize the severity of suicidal ideation (SI) and self-directed violence (SDV) history in relation to these factors, given the prediction of heightened risk.

Methods: Data were collected among N=65 veterans (M age=45.2), screened for inclusion in a military suicide prevention clinical trial. Data were collected during the pretreatment phase of a behavioral insomnia trial, using: The Disturbing Dreams and Nightmare Severity Index (DDNSI), Difficulties in Emotion Regulation Scale (DERS), Beck Depression Inventory (BDI), Beck Suicide Scale (BSS). History of suicide attempts (SA) (actual, interrupted, aborted attempt) was assessed using the Columbia Suicide Severity Rating Scale (CSSRS-Lifetime Version). Hierarchical regression analyses were employed to test associations in prediction of SI and SA history, which were hypothesized to be related to greater ER deficits, depression, and nightmare severity.

Results: Participants demonstrated clinically-significant SI (BSS $M=4.08\pm6.11$), depressive symptomatology (BDI-II $M=21.11\pm11.24$), nightmares (DDNSI $M=10.85\pm9.76$), and ER deficits (DERS $M=95.71\pm20.40$), and 24.2% endorsed lifetime SA history. Higher DERS and BSS symptoms were associated with SA history ($p<.01$, $p<.03$). However, in prediction of current SI, the BDI ($t=3.28$, $B=.37$, $p=.002$) and DDNSI ($t=2.28$, $B=.26$, $p=.026$) outperformed risk in comparison with the DERS ($t=1.23$, $B=.13$, $p=.22$).

Conclusion: Delineating the salient risk factors for SI and SDV is vital to standardized suicide risk assessment. Results underscore the potential importance of nightmares and ER deficits as a risk factor within such frameworks to enhance risk detection and thus prevention.

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1109

DO SLEEP PARAMETERS MEDIATE THE ASSOCIATION BETWEEN CHRONOTYPE AND MENTAL HEALTH?

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Introduction: Chronotype, specifically a preference for eveningness, is a well-established predictor of mental health problems, particularly depression and anxiety. However, research is lacking on whether specific sleep parameters may act as mediators of the correlation between chronotype and depression & anxiety. An understanding of how sleep parameters - including efficiency, sleep onset latency (SOL), total sleep time (TST), wake after sleep onset (WASO), and number of awakenings (NA) - may act as mediators of the correlation between chronotype and depression & anxiety would offer a basis for future longitudinal research on how chronotype specifically affects mental health outcomes.

Methods: Fifty-four participants (age: M=19.58, SD=1.49; 82.7% female) used actigraph watches (Actigraph Corp.) for an average of 7 days to assess their sleep. Actigraphy data were informed by daily sleep diaries, and sleep parameters (including efficiency, SOL, TST, WASO, and NA) were calculated using ActiLife software. Self-report measures were used to assess chronotype (reduced Morningness-Eveningess Questionnaire; rMEQ) and depression & anxiety symptoms (Patient Health Questionnaire; PHQ). Two participants were excluded from analyses due to missing data.

Results: rMEQ scores (range: 7–21) were significantly negatively correlated with depression symptoms ($r = -.282$, $p = .042$), such that greater preference for eveningness was associated with increased depressive symptoms. However, rMEQ scores were not significantly correlated with anxiety symptoms ($r = -.160$, ns). None of the 10 (one sleep index per model times two [depression and anxiety]) correlational mediation models predicting depression and anxiety from rMEQ scores were statistically significant. The effect sizes (Preacher & Kelley's kappa-squared) of the overall mediation models that included efficiency and TST predicting depression (0.02 and 0.05, respectively) and anxiety (0.02 and 0.04, respectively) are in the small-to-medium range.

Conclusion: rMEQ scores correlated with mental health outcomes as expected. None of the correlational indirect effects models were significant, suggesting that the association between chronotype and mental health symptoms might not be mediated by sleep parameters. However, effect sizes of the mediation models of sleep efficiency and TST on depression and anxiety, respectively, point to effects that may bear further investigation with longitudinal designs with more statistical power.

Support (If Any):

1110

A LIFETIME APPROACH TO COMORBIDITY IN SLEEP, MOOD AND ANXIETY DISORDERS. SLEEP DISTURBANCES PLAY A ROLE IN THE NON-REMISSION OF PANIC DISORDERS

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Introduction: Mood, anxiety and sleep disorders have a very complex relationship: it has a negative impact on therapeutic strategies. The aim was to evaluate the effect of mood and sleep deregulation on treatment outcome in Panic Disorder by adopting a dimensional perspective and using the Mood Spectrum Self-Report Questionnaire (MOODS-SR). It has been widely validated, within a project of the University of Pisa, Italy and the University of Pittsburgh, USA, to evaluate a wide range of mood disorders, including mild, sub-threshold and atypical manifestations. Considering sleep disturbances as a part of mood spectrum, the hypothesis of the study was to find them playing a key role in the comorbidity between mood and Panic Disorders.
Methods: Eighty-five patients with a DSM-IV diagnosis of Panic Disorder, and no comorbidity for Major Depression or Bipolar Disorders were included in the study. Patients were evaluate with the Structured Clinical Interview SCID-I, the MOODS-SR both Last Month and Lifetime version and the Panic Disorder Severity Scale (PDSS). Follow-ups were carried out at 1, 3, 6 and 12 months of treatment. Response was defined as a 40% reduction in PDSS score. Remission was defined as a PDSS score < 5.
Results: Forty-three out of 85 patients (50.5%) met the criteria for remission during the follow-up period. 'Remitters' had significantly lower total scores on MOODS-SR lifetime at baseline than 'non remitters' (t = 2.0, p = 0.045). In a logistic regression model, with 'remission' as the dependent variable, the 'sleep disturbances' component of the MOODS-SR Lifetime was the only determinant for non remission (OR=0.79; p=0,045) even controlling for sleep disturbance in the last month. The items accounting for this were: *'Repeated difficulty falling asleep',* (chi-square=4.4; df=1; p=0.036) and *'Repeatedly waking up in the middle of the night'* (chi-square=5.2; df=1; p=0.022).
Conclusion: Lifetime sleep disturbances, as part of a mood spectrum, contributed to the non-remission of Panic Disorders. A dimensional perspective may be useful to a better understanding of the comorbidity of these disorders. In this framework sleep disturbances, experienced in a lifetime, might be considered a 'chain' linking mood and anxiety disorders.
Support (If Any): no support

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INSOMNIA AND SUICIDAL IDEATION AMONG MILITARY PERSONNEL: EXPLORING JOINT SYMPTOM TRAJECTORIES OVER A 12-MONTH PERIOD

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Introduction: Over the past decade, the rate of suicide has doubled among US military personnel. This concerning increase highlights the need to identify and investigate novel risk factors for suicide. One risk factor for suicide that has gained attention is insomnia, though methodological limitations (e.g., cross-sectional designs) in existing studies hinder nuanced understanding of the relationship between these variables. The current study addressed these limitations by utilizing a longitudinal sample of military personnel and applying advanced statistical modeling to investigate the relationship between insomnia and suicidal ideation.
Methods: Participants (N = 788) were non-treatment seeking current and former military service members who endorsed recent suicidal ideation or history of suicide attempt. Participants completed five waves of data collection over the course of a year, including the Insomnia Severity Index (ISI), the Columbia Suicide Severity Rating Scale, and the Patient Health Questionnaire - 9 (depression; PHQ).
Results: Preliminary results of an autoregressive cross-lagged panel analysis modeling suicidal ideation and insomnia simultaneously across the first three waves of data indicated good overall model fit, X^2 = 26.889, p = .003, RMSEA = .047, 90% CI: .026-.068, SRMR = .037. Results of this model indicated that insomnia predicted subsequent increases in suicidal ideation (b = .014, p = .013), but not vice versa (b = -.267, p = .074). Additional, more nuanced latent difference score modeling will also be utilized to investigate whether levels and/or changes in insomnia symptoms drive subsequent changes in suicide ideation, or vice versa, across all waves of data, while controlling for depression.
Conclusion: The current study improves upon limitations in the sleep and suicide literature. Our full results will help clarify the nature of the temporal relationship between insomnia symptoms and suicide ideation, and preliminary findings suggest that this relationship may be best characterized as one that is unidirectional. Results will yield a nuanced understanding of the relationship between insomnia and suicidal behavior among military personnel, which has potential clinical implications, including improved risk assessment, and support for use of clinical interventions for insomnia that could simultaneously lower risk for suicide.
Support (If Any): DoD: W81XWH-13-2-0032 (PI: Stecker)

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ASSOCIATION BETWEEN SLEEP APNEA AND SUICIDAL THOUGHT AND BEHAVIOR

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Introduction: Although previous research supports the relationships among suicidality, generalized sleep disturbance, insomnia, and nightmares, there is limited research assessing the association between sleep apnea and suicidal thought and behavior. The current investigation explored relationships among sleep apnea, suicidal ideation (SI), suicide planning (SP), and suicide attempts (SA).
Methods: Using 2014 National Survey of Drug Use and Health data (N = 41,086), logistic regression analyses were performed with past-year SI, SP, and SA as dependent variables. Sleep apnea was assessed via a single item where participants were asked to report whether their doctor had informed them that they carried a diagnosis of sleep apnea in the past 12 months. Demographics, overall health rating, past-year substance use disorder and past-year depressive episode were included as covariates.
Results: Sleep apnea was reported by 2.9% (n = 1179) of the sample. Prevalence of suicidality among participants with sleep apnea was 9.7% for SI, 3.3% for SP, and 1% for SA compared with 5.2%, 1.5%, and 0.7%, respectively, for those without sleep apnea. Sleep apnea was associated with both SI (OR = 1.56, 95% CI = 1.24–1.97) and suicide planning (OR = 1.59, 95% C I = 1.11–2.28) after controlling for age, sex, ethnicity, past year substance use disorder, self-rated quality of life, and past year depressive episode. Sleep apnea was not significantly associated with SA (OR = 1.19, 95% CI = 0.65–2.18).

Conclusion: To our knowledge, these are the first analyses to report a relationship between sleep apnea and suicidal thought and behavior in a nationally representative sample. Although findings are based on self-report of being diagnosed with sleep apnea SI and SP were significantly higher among those with sleep apnea even after accounting for key covariates. Diagnosis of sleep apnea may represent an early opportunity for healthcare providers to initiate conversations with their patients regarding suicide and mental health.
Support (If Any): This work was supported, in part, by the VA Advanced Fellowship Program in Mental Health Illness Research and Treatment, VISN 2 Center of Excellence for Suicide Prevention at the Canandaigua VAMC.

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THE EFFECTS OF ESZOPICLONE ON SLEEP SPINDLES AND MEMORY CONSOLIDATION IN SCHIZOPHRENIA: A DOUBLE-BLIND RANDOMIZED TRIAL

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Introduction: Patients with schizophrenia (SZ) have a specific deficit in sleep spindles that correlates with impaired memory consolidation and symptom severity. In a small placebo-controlled pilot study we found that eszopiclone, a non-benzodiazepine hypnotic drug that acts on $GABA_A$ receptors in the thalamus where sleep spindles are generated, increased spindles in SZ but its effect on memory consolidation was not significant. Here we employed a more powerful cross-over design and recruited a larger sample to investigate the effects of eszopiclone on spindle activity and sleep-dependent memory consolidation.
Methods: Chronic, medicated patients with SZ (n=26) and demographically-matched healthy controls (n=29) were randomly assigned to either placebo first or 3 mg of eszopiclone first conditions separated by one week. Each condition included two consecutive nights of high-density EEG polysomnography. Consolidation of motor procedural memory was measured by the motor sequence task (MST). Participants were trained before sleep on the second night and tested upon awakening. Spindles were detected by a wavelet-based algorithm and examined in relation to overnight changes in MST performance.
Results: On placebo, patients showed consistent, widespread reductions in spindle density that reached significance in a parietal cluster(p=.04). In both groups, eszopiclone increased spindle density across channels(p<.001) but more for patients than controls in parietal regions(p=.03). Overnight MST improvement correlated significantly with sleep spindle density in both placebo(r=.36, p=.008) and eszopiclone(r=.34, p=.01) conditions and this did not differ by group. While both groups showed significant memory consolidation on placebo, eszopiclone did not increase it in either group.
Conclusion: While eszopiclone significantly increased spindles, and spindles correlated with memory, eszopiclone did not improve memory. This may reflect that memory consolidation relies not only on spindles, but also on their coordination with other NREM oscillations. This hypothesis is supported by recent findings that both spindle density and the coordination of spindles with slow waves predict sleep-dependent memory consolidation in SZ. Thus, interventions to improve memory in SZ may need to both increase spindle density and preserve or enhance their coordination with NREM oscillations.
Support (If Any): This research was supported by 1R01MH092638 to DSM and RS, and NIH-NHLBI 5T32HL007901-17 to BB.

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A FUNCTIONAL HOMOLOGY BETWEEN ADHD AND ACUTE SLEEP DEPRIVATION: AN ALE META-ANALYSIS OF FMRI-MONITORED EXECUTIVE FUNCTION

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Introduction: Sleep disruption is common in attention deficit hyperactivity disorder (ADHD). Likewise, deficits in executive function are a hallmark of sleep deprivation in healthy individuals. Despite this apparent convergence, whether ADHD and sleep deprivation modulate common, or disparate, neural systems is unknown. While no study has utilized fMRI to investigate sleep loss in ADHD, fMRI is commonly used in sleep deprivation and ADHD independently. Thus, we performed a novel, comparative meta-analysis of fMRI-monitored executive function between sleep deprivation and ADHD.
Methods: An initial systematic review of task-based fMRI studies of sleep deprivation vs. rested and ADHD vs. controls yielded 126 articles for an activation-likelihood-estimate (ALE) meta-analysis in GingerALE. fMRI coordinates were extracted for each contrast (i.e., "ADHD vs. Controls", "TSD vs. Rested") and normalized to the Talairach-atlas. Separate ALE analyses ($p < .005$) were performed for ADHD and sleep deprivation. These initial estimates were forwarded to conjunction analyses to identify regions where activation was either overlapping or differing significantly between ADHD and sleep deprivation ($p < .005$; permutation-testing).
Results: Conjunction analyses revealed overlapping deactivations between ADHD and sleep loss in central executive-function-regulating regions: dorsal medial anterior cingulate cortex, precentral gyrus, left inferior parietal lobule, and left inferior frontal gyrus. Compared to sleep loss, ADHD was associated with exaggerated hypoactivations within right dorsolateral prefrontal cortex, right anterior insula, and right temporoparietal junction. In contrast, sleep deprivation was associated with significantly exaggerated hyperactivation in subcortical arousal centers, namely, thalamus and striatum.
Conclusion: Our study indicates that ADHD and acute sleep deprivation may share a common neural signature: hypoactivation of executive function neuroanatomy. ADHD was associated with exaggerated, but not unique, deactivations in the same network. In contrast, sleep loss exhibited unique hyperactivation in subcortical arousal centers, perhaps intimating a compensatory response in sleep loss not present in ADHD. By elucidating shared from distinct patterns of functional neuroanatomy, these data provide novel targets for future experimental investigations of sleep loss in ADHD.
Support (If Any): This work was supported by K01MH109854 and T32MH019927.

1115

PROJECT SLEEP: AN ONLINE MINDFULNESS-BASED INTERVENTION TO IMPROVE COLLEGE STUDENTS' SLEEP HEALTH

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Introduction: Improving sleep health of college students may help prevent the development of insomnia and subsequent mental health disorders. Project Sleep was a 4-week online intervention study designed to

examine whether an abbreviated mindful breathing intervention, versus abbreviated progressive muscle relaxation or self-monitoring, would result in greater reductions in stress and improvements in sleep health.
Methods: Data were collected from a sample of 120 students from a large Midwestern university. Participants who completed the pre- and post-intervention questionnaires were included in the analyses (n=111; 92.5%). Participants were randomized into a mindful breathing (MB), an abbreviated progressive muscle relaxation (APMR), or a self-monitoring (SM) group. Participants were asked to complete the interventions daily for 4-weeks using an online delivery system. In person assessments of sleep quality, insomnia symptoms, stress, and pre-sleep arousal were assessed using validated self-report questionnaires pre- and post- intervention.
Results: Repeated-measures ANOVAs were conducted to examine the effectiveness of the interventions. Results revealed a marginal group X time interaction effect for stress ($F = 2.897$, $p = .059$). There was a main effect of time for pre-sleep somatic arousal ($F = 7.498$, $p = .007$), while there was a group X time interaction for pre-sleep cognitive arousal ($F = 4.518$, $p = .013$). There was a marginal group X time interaction for insomnia symptoms ($F = 2.969$, $p = .055$) and a main effect of time for sleep quality ($F = 13.772$, $p < .001$). Lastly, changes in stress and pre-sleep cognitive arousal were related to changes in insomnia symptoms ($r = -.225$, $p = .054$; $-.244$, $p = .009$, respectively).
Conclusion: The findings suggest pre-sleep somatic arousal and sleep quality improved regardless of group membership. Further, mindful breathing and abbreviated progressive muscle relaxation resulted in (marginal) reductions in stress and cognitive pre-sleep arousal, which were related to improvements in insomnia symptoms. Overall, abbreviated strategies targeting stress and arousal, such as mindful breathing and progressive muscle relaxation, delivered online may be beneficial for college students' reduced stress and subsequent sleep health.
Support (If Any):

1116

NIGHTMARES AND INSOMNIA SYMPTOMS PROSPECTIVELY PREDICT THE DEVELOPMENT OF SUICIDAL IDEATION

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Introduction: Research has demonstrated an association between insomnia symptoms, nightmares, and suicidal ideation even above and beyond symptoms of depression, anxiety, and PTSD. Further, the longer an individual has insomnia or nightmares, the more strongly they are associated with suicide risk. However, there has been little prospective work examining whether sleep disorders prospectively predict the development of suicidal ideation. The present study aimed to examine whether insomnia symptoms and nightmares predict the development of suicidal ideation. We hypothesized that both insomnia symptoms and nightmares would prospectively predict suicidal ideation at one, three, and eleven month post-assessments after controlling for baseline suicidal ideation.
Methods: Amazon's Mechanical Turk was utilized to recruit 706 participants, who then received follow-up requests for participation after one month ($N = 375$), three months ($N = 292$), and eleven months ($N = 220$). The Insomnia Severity Index was used to assess insomnia symptoms, the Disturbing Dreams and Nightmares Severity Index assessed nightmares, and current suicidal ideation was assessed using item 12 on the Quick Inventory of Depressive Symptomology.
Results: Both insomnia symptoms ($\beta = .22$, $t = 5.34$, $p < .01$), and nightmares ($\beta = .13$, $t = 3.17$, $p < .01$), predicted suicidal ideation after one month when controlling for suicidal ideation at baseline. When entered into a model together, insomnia symptoms ($\beta = .21$, $t = 4.31$, $p < .01$) still significantly predicted suicidal ideation after one month, but nightmares failed to independently predict one month suicidal ideation independent of insomnia symptoms and baseline suicidal ideation. Neither nightmares nor insomnia symptoms predicted suicidal ideation at three or eleven months when controlling for baseline suicidal ideation.
Conclusion: The present study demonstrates that both insomnia symptoms and nightmares are proximal, but not distal, risk factors for the development of suicidal ideation. Further, insomnia symptoms are predictive of the proximal development of suicidal ideation independent of nightmares and baseline suicidal ideation. This research is one of the first studies to demonstrate that sleep disorders are prospectively associated with the development of suicidal ideation, and as such it has great clinical relevance.
Support (If Any): None

1117

SLEEP AND SUICIDAL IDEATION: EXAMINATION OF PROSPECTIVE TEMPORAL RELATIONSHIPS

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Introduction: Previous research has indicated that disturbed sleep is associated with suicidal thoughts and behaviors, independent of depression. However, work in this area has predominantly relied on cross-sectional, self-report and retrospective-design studies. The current investigation aims to provide new insight through the examination of the prospective temporal relationships between actigraphy and subjective measures of sleep and suicidal thoughts, across a seven-day period.
Methods: Currently in this ongoing research, 26 adults with poor sleep quality, severe depressive symptoms and suicidal thoughts, have completed a seven-day experience sampling study. Sleep variables were measured daily using both an actigraphy watch and sleep diary. Momentary assessments of suicidal thoughts were collected six times per day.
Results: Multilevel modelling was conducted to examine the relationships between sleep and suicidal thoughts, whilst controlling for severity of depressive symptoms. Preliminary analyses indicated that both actigraphy and subjective measures of poor sleep predict daytime levels of suicidal thoughts (ps <.05). Further analyses will be presented to assess the interaction effects of psychological variables, such as anxiety.
Conclusion: Experience sampling method permitted the examination of the prospective temporal relationships between actigraphy and subjective measures of sleep and suicidal thoughts. The current study makes a novel contribution to the field by providing the first micro-longitudinal data of the sleep/suicide association.
Support (If Any): DLL is supported by doctoral studentship funding from the Medical Research Council (UK) and the University of Manchester Presidential Scholar Award.

1118

DAYTIME SLEEP, SWS SPINDLE ACTIVITY AND ACUTE EMOTION REGULATION IN SOCIAL ANXIETY DISORDER

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Introduction: Sleep promotes emotional memory consolidation. Yet, sleep's impact on acute emotion regulation remains largely unknown.

We explored daytime sleep's impact on affect, anxiety, and sleepiness following an experimental stressor in individuals with Social Anxiety Disorder (SAD; Experiment-1) and healthy controls (HC; Experiment-2).

Methods: Twenty-five SAD and 36 HC subjects completed one (HC) or two (SAD) experimental stressor sessions (SAD: social exposure; HC: viewing highly aversive photographs) followed by a 120-minute PSG-recorded nap (Nap-Condition) or wake (Wake-Condition) opportunity. Positive and Negative Affect Schedule (PANAS+/-), Spielberger State-Trait Anxiety Inventory-State (STAI-S), and Stanford Sleepiness Scale (SSS) were completed pre- and post-session. For SAD, canonical (13.5Hz), fast (15Hz), and slow (11Hz), spindles were detected bilaterally in artifact-free EEG using co-author S.P.'s open source wavelet analysis program (http://zzz.bwh.harvard.edu). Spindle amplitude, density and duration was calculated for detected spindles.

Results: *Experiment 1*: Two (Condition: Nap/Wake) x 2 (Session: 1/2) x 2 (Time-Point: Pre-Session/Post-Session) ANOVAs, performed independently for SSS, PANAS+, PANAS-, and STAI-S scores, revealed main effects of Time-Point for SSS, (Post>Pre; $F(1,24)=12.67, p=0.002$), PANAS+, (Post<Pre; $F(1,24)=47.03, p=0.0001$), PANAS-, (Post<Pre; $F(1,24)=45.28, p=0.0001$), and STAI-S, (Post<Pre; $F(1,24)=15.20$, $p=0.0007$), and Session for PANAS+, (1>2; $F(1,24)=7.17, p=0.013$, and PANAS-, $F(1,24)=7.27, p=0.013$, Time-Point x Condition interactions for PANAS+, $F(1,24)=9.29, p=0.006$, and PANAS-, $F(1,24)=5.42$, $p=0.029$, and a Session x Condition interaction for PANAS+, $F(1,24)=9.53, p=0.005$. Increased post-nap sleepiness correlated with sleep-onset latency ($r=0.69, p=0.03$) and fast N3 sleep spindle density ($r=0.861, p=0.013$) and duration ($r=0.808, p=0.028$), which also correlated with increased post-nap negative affect ($r=0.848, p=0.016$). Finally, increased post-nap positive affect correlated with slow N3 spindle duration ($r=0.756, p=0.049$). *Experiment 2:* Two (Condition: Nap/Wake) x 2 (Time-Point: Pre-Session/Post-Session) ANOVAs, performed independently for PANAS+, PANAS-, and SSS, revealed a main effect of Time-Point for PANAS+, (Post>Pre; $F(1,34)=6.72, p=0.01$), PANAS-, (Post<Pre; $F(1,34)=21.97, p<0.001$), and SSS, (Post<Pre; $F(1,34)=7.68, p=0.009$), suggesting that both napping and wake increased positive affect, decreased negative affect and reduced sleepiness.

Conclusion: Napping dampened positive and negative affect and increased sleepiness in SAD but not HC. For SAD, fast and slow N3 spindle activity differentially impacted emotion regulation and sleepiness. These differing patterns suggest a possible emotion-regulatory deficit of sleep in anxiety disorders.

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1119

ASSOCIATIONS OF NEO-PI-R PERSONALITY DOMAINS WITH SLEEP QUALITY, CHRONOTYPE, AND OUTCOMES IN EXPOSURE THERAPY FOR SOCIAL ANXIETY DISORDER

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Introduction: Prior research demonstrates relationships between the revised NEO personality inventory (NEO-PI-R) "Big 5" personality domains with sleep quality and chronotype. The current study investigates associations between these personality factors, sleep quality, chronotype and therapeutic outcomes of an exposure treatment for Social Anxiety Disorder.

Methods: Thirty-two socially anxious participants aged 18–39 (18 females) with mean Liebowitz Social Anxiety Scale (LSAS) of 85 (SD 19, range 42–111, 97%>60) completed a 5-session, exposure-based, group therapy for social anxiety. Although a post-exposure nap intervention was tested, the current analyses focused on associations of personality factors with treatment outcome, sleep quality and chronotype. Actigraphy and diaries measured sleep onset latency (SOL), sleep efficiency (SE), sleep midpoint (SM), and total sleep time (TST) over the 7-week study period. Subjects completed the NEO-PI-R and Morningness-Eveningness Questionnaire (MEQ) before treatment. NEO-PI-R scores were separated into "high" and "low" based on a median split of scores for each of the five personality domains. Independent t-tests were used to compare sleep variables between subjects high and low in each domain. When t-tests were either significant or a trend, correlations of the domain score with the sleep variables were completed.

Results: Subjects high in Conscientiousness had significantly higher scores on the MEQ ($p<.05$), i.e., greater morningness, (51 ± 6.98) compared to subjects low in Conscientiousness (43.24 ± 12.25). Sleep midpoint also trended later for those low in Conscientiousness ($p<.1$). Significant correlations were found between Conscientiousness and diary SE (positive, $p<.01$) and actiwatch SOL (negative, $p<.05$). Agreeableness positively correlated with actiwatch TST ($p<.05$). Neuroticism negatively correlated with percent improvement in LSAS score over treatment ($p<.05$).

Conclusion: Conscientiousness showed the most significant relationships with MEQ, SE, and SOL. Conscientious individuals' focus on achievement might contribute to healthier lifestyles that make better quality sleep a priority. A larger sample size will be required to validate results.

Support (If Any): R21MH103484

1120

EFFECTS OF POST-EXPOSURE NAPS ON CHANGE IN AUTONOMIC AROUSAL TO A SOCIAL CHALLENGE ACROSS EXPOSURE THERAPY FOR SOCIAL ANXIETY

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Introduction: Sleep promotes memory consolidation and regulates emotion. Sleep may strengthen therapeutic extinction learned during exposure therapy. We investigated effects of post-exposure naps on pre- to post-treatment changes in autonomic arousal during an experimental social stressor in Social Anxiety Disorder.

Methods: Twenty-five participants aged 18–36 (16 females) with mean Liebowitz Social Anxiety Scale scores of 85 (96%>60) completed a five-session group exposure therapy for social anxiety. A modified Tier Social Stress Test (mpTSST) was conducted before and after treatment. Heart rate and skin conductance level (SCL) were measured during the baseline, performance (speech and mental math), and recovery periods of the mpTSST. Heart-rate variability measures including root mean square of successive N-to-N intervals (RMSSD) and ratio of low- to high-frequency HR oscillations (sympathovagal balance) were computed. The third and fourth therapy sessions concluded with a speech exposure followed by either a 120-minute nap opportunity (Nap, 14Ss) or a non-arousing video (Wake, 11Ss).

Results: The Nap group showed greater pre- to post-treatment decrease in SCL during and while recovering from the social stressor: Time (pre-treatment, post-treatment) x Group (Nap, Wake) interaction [$F(1.23)=4.54$, $p=.044$]. The post- compared to pre-treatment

SCL during mpTSST decreased in the nap group (p=0.0298) but not the Wake group. There was a trend toward decrease in RMSSD across treatment [F(1.21)=2.96, p=.099] but no group differences. Although the pre-to-post treatment main effect for sympathovagal balance was not significant, a near trend was seen for the Time x Group interaction [F(1.21)=2.57, p=.12], with sympathovagal balance decreasing in the Nap group and slightly increasing in the wake group—the same pattern that was seen for the other sympathetic activity index, SCL.
Conclusion: Post-exposure naps promoted faster recovery from a social stressor and also lowered sympathetic activation to the stressor. Sleep augmentation of exposure therapy may show benefit in the treatment of Social Anxiety Disorder
Support (If Any): R21MH101567

1121
MORNINGNESS-EVENINGNESS AND SOCIAL ANXIETY: THE INDIRECT EFFECT THROUGH PUNISHMENT SENSITIVITY AND EXPERIENTIAL AVOIDANCE
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Introduction: Chronotype, or the preference to organize daily activities in the morning or evening, has been linked to individual differences in a variety of outcomes, including personality, mood, and anxiety. Specifically, an evening preference, termed eveningness, has demonstrated poorer outcomes across various domains compared to morningness. One such outcome is increased risk for social anxiety (i.e., a fear that others will evaluate or notice their anxiety and become embarrassed or humiliated). Research suggests that evening-types have greater difficulty coping with social demands compared to morning-types and the organization of activities in the evening limits their positive social experiences, both of which have been shown to be important factors underlying social anxiety. Therefore, social encounters may become aversive and subsequently avoided. The current study examined whether eveningness was associated with increased punishment sensitivity and subsequent experiential avoidance, and whether these factors were associated with increased social anxiety.
Methods: Using online survey methodology, 347 participants were recruited through Amazon MTURK. Morningness-eveningness (ME), punishment sensitivity, experiential avoidance and social anxiety were assessed using validated measures.
Results: The PROCESS macro for SPSS was used to run a serial mediation model using 5,000 bootstrapped samples. ME was entered as the predictor variable, social anxiety as the outcome variable, and punishment sensitivity and experiential avoidance as serial mediators. The overall model was significant, $F(3, 297) = 21.99$, $R^2 = .18$, $p < .001$. The direct effect of ME on social anxiety ($\beta = -.12$, $t = -2.14$, $p = .03$) was no longer significant after the serial mediators were added to the model ($\beta = -.00$, $t = -.11$, $p = .92$), indicating a full indirect effect between ME and social anxiety through punishment sensitivity and experiential avoidance.
Conclusion: Results indicate that eveningness is related to social anxiety through increased punishment sensitivity, which is subsequently related to increased experiential avoidance. Eveningness preference, which may foster sensitivity to perceived aversive experiences and increase avoidance of those experiences that subsequently leads to social avoidance/anxiety. Taken together, the findings suggest that increasing acceptance of aversive experiences may reduce avoidance in evening-types and reduce social anxiety.
Support (If Any):

1122
RESTING STATE FUNCTIONAL CONNECTIVITY IN PRIMARY INSOMNIA, GENERALIZED ANXIETY DISORDER AND CONTROLS
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Introduction: Psychiatric disorders are commonly characterized by sleep abnormalities. Conversely, disrupted sleep may contribute to the development of psychiatric conditions. This bidirectional causal relationship suggests common pathophysiological mechanisms in primary sleep and psychiatric disorders that could serve as clinical biomarkers or targets for novel therapeutics.
Methods: Thirteen individuals with primary insomnia were age and sex matched to 13 good sleeping controls and 12 persons with generalized anxiety disorder (GAD). Each completed a 10-min, resting state scan in a 3-T fMRI scanner and completed inventories of state anxiety and neuroticism. Controls and primary insomniacs also recorded sleep for 2 weeks using diaries and actigraphy. Resting state data were preprocessed using standard methods and whole-brain connectivity of 6 fear and extinction-related seeds were compared between the 3 groups.
Results: Significant between-group differences in resting-state functional connectivity were seen between a left amygdala seed and a bilateral cluster in the rostral anterior cingulate cortex. This connectivity was significantly greater in controls than in both primary insomnia and GAD and this difference was greatest in GAD. No other seed regions revealed significant results. Across subjects, mean connectivity for left amygdala to rostral ACC decreased with poorer sleep, greater neuroticism and greater pre-scan state anxiety.
Conclusion: For resting state connectivity in an emotion regulatory circuit, primary insomnia is intermediate between healthy controls and patients with GAD. These differences in connectivity correlate with measures of poor sleep and anxiety. This pattern may contribute to a greater risk of developing an anxiety disorder with preexisting primary insomnia.
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1123
SLEEP QUALITY, PERCEIVED STRESS AND ACADEMIC PERFORMANCE OF UNDERGRADUATE STUDENTS IN A NIGERIAN UNIVERSITY
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Introduction: There is increasing awareness about the association of sleep quality, academic achievement and psychological functioning among university students. However, this relationship has not been explored in Nigeria. This study aimed at assessing the sleep quality of the undergraduate students and its association with perceived stress level and academic performance.
Methods: It was a cross-sectional descriptive study which employed a multistage sampling method to recruit the study participants. A self-administered including a questionnaire on Sociodemographic characteristics, an item of question assessing the Cumulative Grade Point Average (CGPA), Pittsburgh Sleep Quality Index (PSQI), Perceived Stress Scale (PSS) and General Health Questionnaire (GHQ-12) to assess the socio-demographics, academic performance, sleep quality, perceived stress level and risk of psychopathology.

Results: Out of the 310 students who participated in the study, 298 (96.1%) returned an appropriately completed questionnaire (Male-56%). The prevalence of poor sleep quality was 48.0%. A significant majority (77.7%) had moderate to high level of perceived stress and the mean CGPA (SD) was 3.84 (2.03). About one-fourth had a high risk for psychopathology. The global sleep quality score was positively correlated with perceived stress level (R=0.187, p=0.001) and risk of psychopathology (R=0.453, p <0.001). The factors associated with sleep quality and academic performance were explored and identified.
Conclusion: Sleep quality has a potential effect on perceived stress level and academic performances among undergraduate students. Sleep education for them should emphasize the importance of good sleep quality and possible mental health consequences.
Support (If Any): None

1124

ARE SLEEP DISTURBANCES CAUSALLY LINKED TO THE PRESENCE AND SEVERITY OF PSYCHOSIS-LIKE EXPERIENCES IN NON-CLINICAL POPULATIONS? A SYSTEMATIC REVIEW

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Introduction: Sleep disturbance is common within psychosis, and it is found to be predictive of future diagnoses of schizophrenia and bipolar disorder. However, there has been no comprehensive synthesis of non-clinical psychosis-like and hypomanic-like experiences and sleep disturbances. The present review aimed to identify and assess the causal nature of sleep disturbances within non-clinical psychosis-like and hypomanic-like experiences.
Methods: On September 2016, a systematic literature review of MedLine and PsycInfo identified studies in the general population which reported a validated measure of sleep and psychosis-like or hypomanic-like experiences. A total of 5643 manuscripts were identified in the initial search and 45 were retained for this review. Effect sizes were calculated to assess the magnitude of associations between sleep and circadian variables and psychosis-like and hypomanic-like experiences. However, a full meta-analysis was not appropriate given heterogeneity of study designs.
Results: The results showed that insomnia was associated with all individual psychosis-like and hypomania-like experiences reviewed. Parasomnias, nightmare frequency, nightmare distress and individual sleep stages were associated with psychosis-like experiences but there was evidence of variation in magnitude between individual experiences. Sleep manipulation studies highlighted a potential causal link between sleep loss and psychosis-like experiences but limitations in methodology made it hard to draw definite conclusions at this time. Finally, a dysregulation of circadian rhythms was found in the hypomania-like but not psychosis-like experiences. However, gaps in the literature made it difficult to make strong comparisons between these two non-clinical experience clusters.
Conclusion: The review found that sleep disturbances were linked to non-clinical psychosis-like experiences but there are currently gaps in the literature which makes it hard to make direct comparisons between individual psychosis-like experiences.
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1125

COMPARISON OF SPINDLE DENSITY AND PROCEDURAL MEMORY RELIABILITY IN NAP AND OVERNIGHT SLEEP

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Introduction: Sleep spindle density has shown good test-retest reliability in nocturnal sleep and in naps. Additionally, both nocturnal sleep and naps enhance memory consolidation. However, research on the reliability of spindle density and memory enhancement between nocturnal sleep and naps is lacking. If naps provide reliable estimates of nocturnal sleep spindle density and overnight memory consolidation, future studies of spindles and sleep-dependent memory consolidation can be tested using naps rather than more expensive and time-consuming overnight studies.
Methods: 15 patients with schizophrenia (23–43 yrs, M = 32.5, SD = 6.23) and 8 healthy controls (23–42 yrs, M = 31.4, SD = 6.11) trained on the finger tapping motor sequence task (MST) in the evening and were tested after nocturnal sleep. Months later, the participants learned the MST with a different sequence in the afternoon and were tested after a 90-minute nap opportunity. Both overnight and nap sleep were monitored with polysomnography. Spindle density during N2 was measured using the WaveCount spindle detector. Overnight/overnap MST improvement was calculated as the percent increase in correct sequences from the last 3 training trials to the first 3 test trials the following night or nap.
Results: Preliminary results indicate a weak intraclass correlation for MST improvement in the overnight versus nap conditions (r= 0.26, p = 0.099) with n=23. Spindle density for all 23 participants has yet to be calculated; spindle density reliability between conditions will be assessed once records are scored.
Conclusion: Our preliminary investigation indicates weak reliability of MST improvement overnight and over-nap. We will next examine spindle density to determine whether naps can substitute for nocturnal sleep in studies of this type. We will also determine whether schizophrenia patients show different reliability for memory consolidation and spindle density than controls. While we assume that spindle density is a trait, we will assess the effects of the time interval between the night and the nap on reliability.
Support (If Any): This project was supported by NIH 1-K24-MH099421-01 and 1R01MH092638-01A1.

1126

SPINDLE ACTIVITY RELATED TO MOTOR PROCEDURAL LEARNING IN PATIENTS WITH SCHIZOPHRENIA

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Introduction: (EEG) oscillation characteristic of stage 2 non-rapid eye movement sleep (N2), mediate sleep-dependent memory consolidation. Patients with schizophrenia (SZ) have reduced sleep spindle density (spindles per minute) during N2 and a correlated deficit in sleep-dependent motor procedural memory. In this study we examined

whether motor learning leads to regionally specific spindle increases in the motor network in the nap that follows learning, whether local spindle increases correlate with post-nap performance improvement and whether SZ patients differ from controls in spindle changes and memory improvement.

Methods: SZ patients (n=15) and demographically-matched healthy controls (HC, n=12) were trained on the finger tapping motor sequence task (MST) and their performance tested after a 90 minute nap opportunity. We acquired continuous EEG and magnetoencephalographic (MEG) data simultaneously during MST training, the nap and MST testing. We computed the motor evoked responses, time-locked to each finger tap, for each subject during MST training and derived the anatomical constrained current source estimates using the minimum norm estimation method on both the EEG and MEG data.

Results: Preliminary analysis of 4 HC and 4 SZ patients showed that the subjects had sufficient sleep time (63.9±22.7 min) during MEG. Both groups showed significant overnap performance improvement on MST and did not differ in this regard. The SZ group exhibited reduced spindle density over the central and frontal electrodes. This spindle density deficit was also prominent at the MEG sensors. The source localization of the motor evoked responses revealed right lateralized activation of the primary and supplementary motor areas for both groups.

Conclusion: These preliminary findings demonstrate the use of MEG/EEG to localize cortical sources of motor performance. We are presently conducting analyses to test our hypothesis that motor learning leads to specific spindle increases in the motor network that correlate with sleep-dependent memory consolidation in HC but not in SZ patients

Support (If Any): This research was supported by K24 MH099421 (DSM) and Vergottis Postdoctoral Fellowship (DM)

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LEG MOVEMENT ACTIVITY DURING SLEEP IN ADULTS WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

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Introduction: Sleep disturbances are prevalent in Attention Deficit Hyperactivity Disorder (ADHD). The hypothesis that the typical daytime hyperactivity observed in these patients may correspond to an increased motor activity during the night, thus causing sleep disruption, has been studied in children, but rarely in adults. Here we present a first detailed analysis of the nocturnal motor activity in ADHD adults compared to healthy controls, including the time structure of leg movements (LM) during sleep.

Methods: Fifteen ADHD patients and eighteen control subjects underwent four in-lab polysomnographic sleep recordings. The periodic character of LM was evaluated using validated markers of "periodicity", i.e. the periodicity index, inter-movement intervals and time distribution of LM during sleep, in addition to standard parameters, such as the periodic leg movement during sleep index (PLMSI) and periodic leg movement during sleep arousal index (PLMSAI). Sleep quality and the prevalence of insomnia symptoms were assessed with the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI). None of the participants had restless legs syndrome.

Results: Objective sleep parameters from the baseline night did not differ between ADHD and control subjects, with the exception of a longer sleep latency (p=0.007) in the patient group, as well as a slightly higher PLMSI (p=0.044) and PLMS duration (p=0.023), only in REM sleep. The PSQI questionnaire indicated a poor sleep quality and the ISI the prevalence of subclinical insomnia symptoms in ADHD patients.

Conclusion: Leg movement activity during sleep in ADHD adult subjects was neither more frequent than in healthy controls nor did the nocturnal motor events show an increased periodicity. The reduced subjective sleep quality reported by ADHD adults was in contrast to the normal objective polysomnographic parameters, suggesting a sleep-state misperception in these individuals or more subtle sleep abnormalities not picked up by the traditional sleep staging.

Support (If Any): none

1128

LATER BEDTIME IS ASSOCIATED WITH DECREMENTS IN PERCEIVED CONTROL OF OBSESSIONS AND COMPULSIONS

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Introduction: Accumulating evidence links sleep timing disruptions with obsessive-compulsive symptoms and poor treatment response. One theory proposes that impaired response inhibition contributes to the persistence of obsessions and compulsions, and research has similarly suggested that poor inhibitory control may be one cognitive consequence of sleep/circadian disruption. We hypothesize that individuals with disrupted sleep timing may lack the ability to dismiss obsessive thoughts and compulsive behaviors, ultimately resulting in more severe and treatment-resistant symptoms.

Methods: Twenty individuals diagnosed with OCD and ten individuals endorsing subthreshold OCD symptoms participated in one week of sleep and OC symptom monitoring. Participants wore actigraphs and completed sleep diaries and daily ratings of perceived degree of control over obsessive thoughts and ritualized behaviors. Hierarchical Linear Modeling (HLM) was used to investigate the interplay of sleep timing and OCD symptoms over time.

Results: The relation between perceived control of obsessions and previous night's bedtime was significant, t (27) = -3.23, $p < .01$, b = -2.77), indicating that later previous night's bedtime was associated with lower perceived control of obsessive thoughts, when controlling for previous day's perceived control of obsessions. Similarly, the relation between perceived control of compulsions and previous night's bedtime approached significance. Consistent with our directional hypothesis, neither perceived control over obsessions or compulsions significantly predicted changes in bedtime.

Conclusion: These findings are consistent with the inhibitory failure theory of OCD which suggests that deficits in the ability to dismiss intrusions result in clinically significant obsessions, and similarly, and impaired behavioral inhibition gives rise to compulsions. We propose that disrupted sleep timing may be one mechanism which confers risk for such inhibitory deficits. Considering OCD-focused psychotherapy relies on refraining from compulsions, inhibitory control deficits may explain why individuals with comorbid OCD and sleep/circadian disruption have more severe and treatment-refractory symptoms.

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1129

PSYCHIATRIC COMORBIDITIES ASSOCIATED WITH OBSTRUCTIVE SLEEP APNEA: A PRELIMINARY ANALYSIS AND COMPARISON OF BIOMEDICAL AND CLINICAL DATA SOURCES

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Introduction: Obstructive sleep apnea (OSA) is characterized by complete or partial obstruction of the upper airway leading to repetitive cessation or reduction in airflow while sleeping. While there is strong evidence of numerous comorbid conditions (e.g., obesity, diabetes, hypertension), most existing research focuses explicitly on cardiovascular morbidities with limited emphasis on mental or behavioral disorders. The goal of this study was to utilize large datasets to explore relationships between OSA and psychiatric disorders.
Methods: Three data sources were used: (1) MEDLINE/PubMed database including over 26 million citations, (2) Semantic MEDLINE Database (SemMedDB) including semantic predications from PubMed titles/abstracts, and (3) Medical Information Mart for Intensive Care III (MIMIC-III) database including electronic health record data for over 40,000 critical care patients from Beth Israel Deaconess Medical Center. Comorbidity rank (CR) was calculated (based on a formula similar to term frequency-inverse document frequency [TF-IDF]) for ranking psychiatric comorbidities identified from MEDLINE/PubMed articles, SemMedDB predications, and MIMIC-III patients with OSA.
Results: Approximately 300 unique psychiatric comorbidities were identified across the three data sources. Cognitive deficit had the highest CR in both MEDLINE/PubMed and SemMedDB, indicating a strong association between OSA and cognitive deficit. OSA also was associated with post-traumatic stress disorders, depressive disorders, bipolar disorder, anxiety disorders, mood disorders, alcohol and drug abuse, delirium, and dementia. Comparison of comorbidities identified in MIMIC-III and MEDLINE/PubMed resulted in a Cohen's kappa of 0.04 likely due to more specific ICD-9-CM diagnosis codes compared with more general MeSH descriptors respectively. Future work includes grouping these codes using different categorization schemes for more parallel comparisons.
Conclusion: This study highlights the potential of using a multi-source approach for studying psychiatric comorbidities for OSA and complementary perspectives of clinical and biomedical data sources. The preliminary results suggest opportunities for further investigation that may contribute to improving mental health in persons afflicted with OSA.
Support (If Any): This work was supported in part by National Library of Medicine grant R01LM011364.

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FACTORS PREDICTING SLEEP DISTURBANCES IN OPIOID-DEPENDENT SUBJECTS ON BUPRENORPHINE

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Introduction: Sleep disturbances are common in opioid use disorder and can lead to relapse. Buprenorphine is regularly used in the treatment of opioid use disorders with a recent federal mandate to increase its availability for this purpose. However, the prevalence of sleep disorders and factors predicting sleep disturbance in opioid-use disorders on buprenorphine (OUDs) are largely unknown. The aim of this study is to evaluate the sociodemographic and clinical correlates predicting sleep disturbances in OUDs.
Methods: OUDs (n=91) were recruited from a buprenorphine maintenance program in central Pennsylvania. Subjects completed a sociodemographic survey and the Pittsburgh Sleep Quality Index (PSQI). Subjects were divided into two groups based on a PSQI total score of ≤5 (indicating normal sleep quality) or PSQI >5 (indicating poor sleep quality). We used chi-square tests, t-tests, and Mann-Whitney U tests to compare demographics, sleep disturbances, and PSQI composite scores between the groups. Stepwise logistic regression analysis using forward selection evaluated the likelihood that subjects have normal (PSQI ≤ 5) or poor sleep quality (PSQI > 5) as dependent variable and sociodemographic data, depression, anxiety, number of rehab admissions, change in sleep with buprenorphine treatment, and durations of opioid dependence, abstinence, and buprenorphine treatment as independent variables.
Results: PSQI scores > 5 were seen in 71/91 (78%) subjects. The PSQI > 5 group had prolonged sleep latency (SL), decreased total sleep time (TST) and sleep efficiency (SE), and higher PSQI composite scores for SL, TST, SE, sleep quality, sleep disturbance, daytime dysfunction, and sleep medication need. Logistic regression analysis showed that patients with more severe anxiety (OR=2.9), older age (odds ratio=1.1) and fewer rehab admissions (OR=0.8) were more likely to have poor sleep quality.
Conclusion: Specific sleep issues are highly prevalent in ODS, warranting clinical attention. Severity of anxiety, older age and fewer rehab admissions may predict poor sleep quality in OUDs.
Support (If Any): Department of Psychiatry, Penn State College of Medicine.

1131

CHARACTERIZATION OF OBJECTIVE AND SUBJECTIVE SLEEP IN PATIENTS RECEIVING BUPRENORPHINE MAINTENANCE THERAPY FOR OPIOID USE DISORDER

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Introduction: Sleep disturbances associated with opioid use disorder (OUD) are well recognized. Characterization of sleep abnormalities in individuals on buprenorphine maintenance therapy, a partial mu-opioid agonist used for the treatment of OUD, is limited. Our aim was to characterize and compare subjective and objective sleep measurements in this population.
Methods: We assessed sleep as part of a longitudinal naturalistic study of individuals with OUD in opioid maintenance therapy. Participants (N = 26) receiving outpatient-based buprenorphine maintenance therapy completed daily electronic sleep diaries and ambulatory EEG monitoring for one week. Participants also self-reported sleep quality and drug use on electronic diaries.
Results: The majority of patients were male (77%), middle-aged (46 ± 11 years), and African American (77%). 92% of participants were cigarette smokers and 77% of participants reported using other substances. Ambulatory EEG monitoring demonstrated poor sleep in terms of total sleep time (262 ± 73 min), sleep efficiency (.73 ± .11), wake after sleep onset (59 ± 38 min), and sleep latency (27 ± 19 min). However, participants reported relatively high sleep quality (7.1/10 ± 1.6). Patients reported significantly greater total sleep time (370 ± 86 min), sleep efficiency (.92 ± .05), and less wake after sleep

onset (14 ± 16 min) (p's <.001) and less sleep latency (19 ± 14 min, p = .09) in the diary, relative to the EEG estimate.
Conclusion: Individuals in outpatient-based buprenorphine maintenance therapy for OUD have objectively impaired sleep, but perceive their sleep to be of substantially greater duration and quality. Future research is needed to elucidate the effect of buprenorphine on sleep and daytime functioning in this population.
Support (If Any): NIDA ZIA DA000499 09 (PI: Preston)

1132

FEAR OF SLEEP MODERATES THE RELATION BETWEEN INSOMNIA AND CANNABIS USE FREQUENCY AMONG VETERANS

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Introduction: Insomnia has emerged as condition for which individuals are particularly apt to use cannabis. This has been demonstrated among medical cannabis users as well as recreational users with psychological conditions (e.g., anxiety). However, the reasons why certain individuals with insomnia are driven to use cannabis remain unknown. Given the extensive anecdotal and empirical literature pointing to the anxiolytic properties of some cannabis formulations, it is possible that individuals with insomnia use cannabis specifically to manage fear-related sleep processes. To examine this hypothesis, the present study aimed to determine whether fear of sleep serves to moderate the relation between insomnia severity and cannabis use frequency.
Methods: Participants included 51 veterans (M = 46.63, SD = 16.35) with a cannabis use disorder (CUD), insomnia, and co-occurring psychopathology. Insomnia severity was measured with the Insomnia Severity Index (ISI), fear of sleep with the Fear of Sleep Index (FoSI), and cannabis, alcohol, and nicotine use frequency with the Timeline Followback Interview (TLFB).
Results: Fear of sleep was examined as a moderator of the relation between insomnia severity and cannabis use frequency. Covariates included frequency of alcohol and nicotine use. An interaction between fear of sleep and insomnia severity was observed (β = 0.4, p = .01). Conditional effects indicated that insomnia severity was associated with greater cannabis use frequency among those with an elevated fear of sleep (β = 1.30, p = .01), but not those with less fear of sleep (β = -0.24, p = .61).
Conclusion: Veterans with co-occurring insomnia and CUD appear to be at greatest risk for frequent cannabis use if their insomnia is rooted in a fear of sleeping. Findings highlight the importance of addressing (through exposure-based techniques) underlying sleep anxiety and fear as a means of curbing excessive cannabis use among individuals suffering from insomnia.
Support (If Any): This project was funded by a VA Clinical Science Research & Development (CSR&D) Career Development Award-2 (CDA-2; CX001023) award to Dr. Babson.

1133

EVENING LIGHT EXPOSURE IS ASSOCIATED WITH ALCOHOL CONSUMPTION AND REWARD FUNCTION IN LATE ADOLESCENT DRINKERS

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Introduction: Light is the most important cue for circadian rhythms, and light-induced circadian phase shifts have antidepressant effects. Light also appears to directly influence mood-related function independent of effects on the circadian system. However, most extant studies in humans have focused on the effects of light in the context of mood disorders. In the present study, we extend this work by examining associations between light exposure, reward function, and alcohol use in a sample of late adolescent drinkers.
Methods: Participants included 30 late adolescents (18–22 y/o; 18 females) all reporting weekly alcohol use. Participants completed baseline measures including the Inventory of Depressive Symptomatology, Barrett Impulsivity Scale, Chapman Physical and Social Anhedonia Scales, and the Temporal Experience of Pleasure Scale. Participants also completed a ~13-day ecological momentary assessment protocol during which they completed ratings of affect, craving, and alcohol use (6 times/day) and sleep diaries via smartphone and wore wrist actigraphs with light sensors. Mean white light exposure was calculated for the 2-hour periods just prior to (i.e., evening) and following (i.e., morning) the actigraphic rest interval. Photoperiod was examined as a potential covariate.
Results: Photoperiod was unrelated to any of the other variables and thus was not included as a covariate in subsequent bivariate correlations. Greater evening white light exposure was significantly associated with greater alcohol use (r=0.46), greater consummatory pleasure (r=0.41), and less social (r=-0.58) and physical (r=-0.58) anhedonia. Trend-level (p&lt0.10) associations were observed between greater evening light exposure and greater alcohol craving (r=0.34) and lower impulsivity (r=-0.36). No statistically-significant associations were observed between morning white light exposure and alcohol use or reward measures.
Conclusion: Evening, but not morning, light exposure was associated with both alcohol use and measures of reward function at a cross-sectional level. Experimental studies should probe whether the phase-delaying effects of light influence reward function and alcohol consumption.
Support (If Any): This work was supported by grants from the National Institutes of Health, including R21AA023209 (Hasler) and K01DA032557 (Hasler).

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INSOMNIA AND DAYTIME TIREDNESS IN STUDENT ATHLETES ASSOCIATED WITH RISKY BEHAVIORS AND POOR DECISION MAKING WHEN UNDER THE INFLUENCE OF ALCOHOL

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Introduction: Insomnia and daytime tiredness are particularly common among student athletes who are balancing academics with athletics, are often over-scheduled, and frequently travel. Alcohol consumption is also high in this group. The present study examined whether athletes with sleep-related problems are more likely to engage in unhealthy behaviors when drinking.
Methods: Data from the National College Health Assessment (an annual survey of US college/university students conducted by the American College Health Association) was used. Data encompassed survey years 2011–2014 and were restricted to varsity athletes (N=8,683). Participants reported the frequency over the past 7 days of: "had an extremely hard time falling asleep" (insomnia) and "felt tired, dragged out, or sleepy during the day" (tiredness). Responses were dichotomized around ≥3 days/week. Participants were asked whether, in the past 12 months when drinking alcohol, they did

something they regretted, lost memory for the event, got in legal trouble, had sex without providing consent, had sex without others' consent, had unprotected sex, physically injured themselves, physically injured others, and/or seriously considered suicide. Logistic regressions restricted to the 73% who reported drinking examined likelihood of behaviors relative to insomnia and tiredness, adjusted for age, sex, and survey year.

Results: Insomnia was associated with increased likelihood of doing something regretful (OR=1.32,p<0.0001), forgetting (OR=1.26,p<0.0001), legal trouble (OR=1.51,p=0.006), sex without providing consent (OR=1.75,p=0.002), sex without other's consent (OR=3.40,p<0.0001), unprotected sex (OR=1.33,p<0.0001), injuring self (OR=1.56,p<0.0001), injuring other (OR=1.70,p=0.003), and suicide ideation (OR=2.42,p<0.0001). Tiredness was associated with doing something regretful (OR=1.61,p<0.0001), forgetting (OR=1.46,p<0.0001), sex without providing consent (OR=1.50,p=0.03), unprotected sex (OR=1.32,p<0.0001), injuring self (OR=1.56,p<0.0001), and suicide ideation (OR=2.56,p<0.0001). All remained significant in a combined model with both sleep variables (neither mediated the other). These relationships were also not mediated by depression.

Conclusion: Insomnia and daytime tiredness among student athletes both independently predict risky/dangerous behavior and poor decision-making when drinking alcohol. Alternatively, risky behavior may also lead to poor self-care and worse sleep.

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1135

DIFFICULTY SLEEPING ASSOCIATED WITH SUBSTANCE USE AMONG STUDENT ATHLETES

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Introduction: Sleep problems are common among student athletes, who are often over-scheduled while trying to balance academics and athletics. Sleep disturbance may be a risk factor for substance use in this population. The aim of this study was to evaluate the association between sleep disturbance and different psychoactive substances in student athletes.

Methods: Data were collected from the National College Health Assessment, a survey of US colleges/universities. Data from 2011–2014 included N=8,683 student athletes. Participants were asked whether, in the past 12 months, "sleep difficulties" had "been traumatic or very difficult for you to handle" (yes/no). Students were also asked whether they used the following in the past 30 days: cigarettes, hookahs, cigars/cloves, smokeless tobacco, alcohol, marijuana, cocaine, methamphetamine, other amphetamines, sedatives, hallucinogens, steroids, opiates, inhalants, ecstasy, club drugs, or other drugs. They were also asked whether "the typical student at your school" used these substances in the past 30 days. Regression analyses examined whether use of any of these substances was associated with sleep difficulties, adjusted for age, sex, and survey year. Also, discrepancy between student use and perceived typical use (more or less vs typical) and sleep was examined. Depression score was explored as a possible mediator.

Results: Sleep difficulties were associated with increased use of cigarettes (OR=2.51,p<0.0001), hookahs (OR=1.63,p<0.0001), cigars/cloves (OR=1.60,p<0.0001), smokeless tobacco (OR=1.76,p<0.0001), alcohol (OR=1.36,p<0.0001), marijuana (OR=1.66,p<0.0001), cocaine (OR=4.49,p<0.0001), methamphetamine (OR=4.17,p<0.0001), other amphetamines (OR=2.16,p<0.0001), sedatives (OR=4.53,p<0.0001), hallucinogens (OR=4.23,p<0.0001), steroids (OR=2.75,p=0.002), opiates (OR=4.51,p<0.0001), inhalants (OR=3.49,p<0.0001), ecstasy (OR=2.92,p<0.0001), other club drugs (OR=3.09,p=0.001), and other illicit drugs (OR=3.26,p<0.0001). Sleep difficulties were associated with greater than typical use of: cigarettes, alcohol, cocaine, methamphetamine, other amphetamines, sedatives, hallucinogens, steroids, opiates, inhalants, ecstasy, other club drugs, and other illicit drugs. This relationship was not mediated by depression score.

Conclusion: Substance among student athletes are strongly related to sleep disturbances. Sleep-focused interventions should be evaluated to determine whether they decrease use of psychoactive substances.

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SLEEP DURATION AND QUALITY ASSOCIATED WITH MENTAL WELL-BEING IN STUDENT ATHLETES

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Introduction: Sleep difficulties are common among student athletes, who are often over-scheduled and balancing academic with athletics. This group is also at high risk of poor mental health. This study uses validated measures to quantify this relationship.

Methods: Data were collected from N=190 NCAA Division-1 student athletes. Sleep assessments included the Pittsburgh Sleep Quality Index[PSQI] (global score and sleep duration item), Insomnia Severity Index[ISI], and Fatigue Severity Scale[FSS]. Mental well-being was assessed as depression (Centers for Epidemiology Depression Scale[CESD]), anxiety (GAD7 questionnaire), mental health days (days in the past month of poor mental health), social support (Multivariable Scale of Perceived Social Support[MSPSS] subscales for family, friends, and significant-other; friends scale used to generate "teammates" subscale), and stress (Perceived Stress Scale[PSS]). Regression analyses were adjusted for age, sex, and year in school.

Results: Poor sleep quality was associated with depression (B=1.14, p<0.0001), anxiety (B=0.79, p<0.0001), stress (B=1.04, p<0.0001), fewer healthy days (B=1.03, p<0.0001), and less support from family (B=-0.31, p=0.014), friends (B=-0.37, p=0.003), significant-other (B=-0.33, p=0.022), and teammates (B=-0.39, p=0.001). Insomnia was associated with depression (B=0.85, p<0.0001), anxiety (B=0.50, p<0.0001), stress (B=0.78, p<0.0001), fewer healthy days (B=0.60, p<0.0001), and less support from family (B=-0.30, p<0.0001), friends (B=-0.28, p<0.0001), significant-other (B=-0.23, p=0.006), and teammates (B=-0.33, p<0.0001). Fatigue was associated with depression (B=0.31, p<0.0001), anxiety (B=0.17, p<0.0001), stress (B=0.24, p<0.0001), fewer healthy days (B=0.19, p<0.0001), and less support from family (B=-0.08, p=0.018) and teammates (B=-0.10, p=0.003). Longer sleep duration was associated with less depression (B=-1.85, p<0.0001), anxiety (B=-0.78, p=0.006), stress (B=-1.00, p=0.03), and more support from family (B=0.93, p=0.005). To determine whether these relationships were simply explained by stress, PSS score was entered as a covariate. In this case, nearly all relationships remained significant.

Conclusion: Short sleep duration, poor sleep quality, and daytime fatigue in student athletes are all associated with depression, anxiety, stress, poor mental health days, and decreased social support. These associations are not accounted for solely by stress.

Support (If Any): K23HL110216; NCAA Innovation Grant.

1137

COMPARATIVE EFFECTS OF PSYCHOTROPIC MEDICATIONS ON SLEEP ARCHITECTURE: A RETROSPECTIVE REVIEW OF DIAGNOSTIC POLYSOMNOGRAPHY SLEEP PARAMETERS

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Introduction: Psychiatric disorders are common diagnoses among patients presenting for diagnostic polysomnography (PSG). In addition to psychiatric diseases being frequently associated with sleep disturbances, psychotropic medications can adversely affect multiple sleep parameters, including sleep architecture. To the best of our knowledge, the comparative effects of different classes of psychotropic drugs on sleep architecture and sleep-related disorders in terms of polysomnographic data has not been examined in the literature.

Methods: In this retrospective review of 405 consecutive de-identified diagnostic PSGs performed at a hospital-based sleep laboratory from 2007 until 2011, we identified 347 PSGs divided into five groups: Controls, Antidepressants (AD), Antidepressants + Anticonvulsants (ADAC), Antidepressants + Antipsychotics (ADAP), Antidepressants + Anticonvulsants + Antipsychotics (ADACP). The antidepressants included were SSRIs, SNRIs and TCAs. We compared these groups for socio-demographic characteristics, reported medical history, specific medication use and sleep parameters. For pairwise comparisons, we used ANOVA or Kruskal-Wallis tests for continuous variables and Chi-Square tests for dichotomous variables and adjusted for multiple testing. Subsequently, we used multivariate logistic regression to determine the Odds Ratio (OR) of an increase in the Apnea-Hypopnea Index (AHI) and the Periodic Leg Movement Index (PLMI) within each group compared to controls, while controlling for relevant variables.

Results: In pairwise comparisons, there were no significant differences in body mass index and neck circumference between groups. Compared to controls, all medication groups had a significantly higher prevalence of benzodiazepines (χ^2=31.826; p<0.001) and trazodone (Fisher's exact test: p<0.001) use while AD and ADACP had significantly longer REM latency (p<0.001 and p=0.007 respectively) and lower REM percentage of total sleep time (p=0.001 and p=0.009 respectively). ADAP had a significantly lower AHI (p=0.015) compared to controls, but that association was lost in the regression model. Among all medication groups, only AD was associated with a higher PLMI (adjusted OR: 1.025; 95% confidence interval: 1.011–1.039; p<0.001) while no group was associated with a higher AHI compared to controls.

Conclusion: Psychotropic drug intake was not associated with a higher AHI in patients undergoing PSGs. Adjunct anticonvulsants or antipsychotics to antidepressants might have a protective effect against periodic leg movement disorder.

Support (If Any): None.

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HYPOTHALAMIC DYSFUNCTION IS RELATED TO SLEEP IMPAIRMENT AND CEREBROSPINAL-FLUID BIOMARKERS IN ALZHEIMER'S DISEASE

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Introduction: Hypothalamus is a key brain region controlling several essential functions, such as the determination of the sleep-wake cycle. In fact, nuclei regulating the alteration of sleep and wake states sited in the hypothalamus are: suprachiasmatic nucleus (SCN), orexinergic nucleus, tuberomamillary nucleus (TBM). It has been described in post-mortem studies that hypothalamus is affected by the Alzheimer's Disease (AD) pathology. Moreover, orexinergic and SCN dysfunctions have been related to sleep-wake cycle impairment. On these basis, in order to evaluate the possible in vivo alteration of the hypothalamus and its correlation with sleep impairment and cerebrospinal-fluid (CSF) biomarkers changes in AD patient, we investigated the polysomnographic sleep, the CSF AD biomarkers and orexin levels, and the hypothalamic [18F]FDG PET uptake in a population of AD patients compared to non-demented controls.
Methods: We performed lumbar puncture for CSF AD biomarkers and orexin quantification, polysomnography and [18F]FDG PET in a population of AD patients. We compared the AD group to two control groups matched for age and sex with the AD population. The first group underwent PSG and CSF biomarkers and orexin analysis (Control 1), and the second group underwent [18F]FDG PET assessment (Control 2).
Results: We documented the significant reduction of hypothalamic [18F]FDG PET uptake in the AD group (n=18) compared to the Control 2 group (n=18) ($p<0.0.1$). Moreover, we found the increase of CSF orexin levels coupled with the marked alteration of the night-time sleep in the AD group compared to the Control 1 group (n=15) ($p<0.05$). Finally, we observed the significant association between the reduction of sleep efficiency and REM sleep and the reduction of hypothalamic [18F]FDG PET uptake in the AD group. Moreover, [18F]FDG PET hypothalamic uptake correlated with the higher ratio of total-tau/beta-amyloid42 CSF levels (index of marked neurodegeneration). We did not document the correlation between hypothalamic [18F]FDG PET uptake and CSF orexin levels.
Conclusion: We documented the alteration of the hypothalamus and its correlation with both the dysregulation of night-time sleep and the CSF index of marked neurodegeneration in AD patients.
Support (If Any): none

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MIDLIFE SHIFT WORK AND RISK OF INCIDENT DEMENTIA

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Introduction: Research examining the long-term effects of midlife shift work in relation to dementia risk is limited. The aim is to investigate the association between shift work and incident dementia in two population-based cohorts from the Swedish Twin Registry (STR).
Methods: The STR-1973 sample included 13,283 participants who were born 1926–1943 and were at least 30 years old upon receiving a mailed questionnaire in 1973 that included information on status (ever/never) and duration (years) of shift work employment. The Screening Across the Lifespan Twin (SALT) sample included 41,610 participants who were born 1900–1958 and participated in a telephone interview in 1998–2002 that asked about status and duration of night work history. Dementia diagnoses were obtained from Swedish national health registers. Cox regression models were used to estimate hazard ratios (HR) with 95% confidence intervals (CI). Restricted cubic spline functions were incorporated into models for dose-response analyses. Potential confounding factors such as age, sex, education, cardiovascular disease and diabetes were included in adjusted models.
Results: A total of 983 (7.4%) and 2,033 (5.0%) dementia cases were identified after a median of 41.2 and 14.1 years follow-up from the STR-1973 and SALT sample, respectively. History of any-type shift work (HR=1.40, 95% CI=1.19–1.65) and night work (HR=1.13, 95% CI=1.02–1.25) were associated with higher dementia incidence in separate multivariable-adjusted models. Sensitivity analysis on the SALT sample restricted to persons born 1926 or after yielded a slightly amplified HR of 1.17 (95% CI=1.03–1.32). Spline models indicated modest dose-response relationships, where longer duration of shift work and night work predicted greater dementia risk.
Conclusion: Findings suggest that having any type of shift work or night shift work is associated with increased dementia risk in later life. The association persists after multivariable adjustment for potential confounders, which suggests that the association may be causal.
Support (If Any): This work was supported by the National Institute on Aging and the Swedish Research Council for Health, Working Life and Welfare.

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ACTIGRAPHIC SLEEP AND BRAIN VOLUMES IN COMMUNITY-DWELLING OLDER ADULTS

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Introduction: Aging is associated with increases in the prevalence of sleep disturbance, which has been tied to cognitive impairment and decline. Disturbed sleep may lead to cognitive decline by promoting neurodegeneration. Thus, we investigated the association of objectively measured sleep with neuroimaging measures of brain volume in community-dwelling older adults.
Methods: Participants were 183 older adults without dementia enrolled in the Baltimore Longitudinal Study of Aging who completed 3-T magnetic resonance imaging scans and wrist actigraphy. Total gray matter, white matter, ventricular, and hippocampal volumes were quantified using a multi-atlas approach to parcellation (MUSE software) and were our outcomes. Predictors were actigraphic sleep parameters averaged across nights, including total sleep time (TST), average wake bout length (WBL), % wake (% of sleep interval scored as wake), and sleep onset latency (SOL).
Results: Participants had a mean ±SD age of 76.6 ± 8.8 years; 42.6% were male, 24% were non-White, and 84% had 16+ years of education. On average, they completed 6.8 ± 0.8 nights of actigraphy and had a TST of 394.5 ± 65.8 min, wake bout length of 2.5 ± 0.8 min, %

wake of 11.7±4.9, and SOL of 11.5±14.5 min. After adjusting for age, sex, race, education, and intracranial volume, each SD increase in WBL was associated with a 3.52 unit increase in ventricular volume (B = 3.52, 95% confidence interval (CI) 0.80, 6.24, p = 0.012). In addition, each SD increase in % wake was associated with a 0.091 unit decrease in hippocampal volume (B = -0.091, 95% CI -0.18, -0.002, p = 0.045). There were no associations between TST or SOL and brain volumes.

Conclusion: Greater objectively measured wakefulness is associated with indices of brain atrophy in community-dwelling older adults. Longitudinal research using actigraphy and neuroimaging is needed to better understand whether sleep has a role in the prevention of neurodegeneration.

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EXCESSIVE DAYTIME SLEEPINESS, NAPPING, AND BRAIN AMYLOID IN OLDER ADULTS

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Introduction: Excessive daytime sleepiness (EDS) and napping are related and both have been linked to poor cognitive outcomes. However, little is known about their association with Alzheimer's disease pathology. We determined the association of EDS and napping with β-amyloid (Aβ) deposition in community-dwelling older adults.

Methods: We studied 124 participants in the Baltimore Longitudinal Study of Aging (mean age ±SD = 60.1 years ±9.8; education = 16.7±2.2 years; 50.8% women; 21.8% non-White) with measures of EDS and/or napping who completed Pittsburgh Compound B positron emission tomography 15.7±3.4 years later. Participants reported whether they often become drowsy and fall asleep when they want to be awake and frequency of napping. Those responding "yes" to the former were considered to have EDS, and those napping more than "never" were considered nappers. PET cortical distribution volume ratios >1.06 were considered Aβ-positive (Aβ+).

Results: Of the 124 participants, 30 (24.4%) reported EDS, 35 (28.5%) reported napping, and 43 (34.7%) were Aβ+. In unadjusted analyses, participants with EDS had over three times the odds of being Aβ+ (odds ratio (OR) = 3.37, 95% confidence interval (CI) 1.44, 7.90, $p = 0.005$), compared to those without. This remained significant after adjustment for age, body mass index, and education (OR = 2.58, 95% CI 1.03, 6.45, $p = 0.043$). Nappers had twice the odds of being Aβ+, but this did not reach significance in unadjusted (OR = 2.01, 95% CI 0.90, 4.50, $p = 0.091$) or adjusted (OR = 1.84, 95% CI 0.76, 4.47, $p = 0.18$) analyses.

Conclusion: EDS is associated with an increased odds of amyloid deposition more than a decade later. Prospective studies with polysomnography and repeated measures of Aβ will clarify whether sleep-disordered breathing or another factor drives this association, or if EDS is a marker of preclinical Alzheimer's disease.

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1142

CIRCADIAN REST-ACTIVITY RHYTHMS AND COGNITIVE FUNCTION IN PARKINSON'S DISEASE

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Introduction: There is accruing evidence that circadian rhythms are disrupted in Parkinson's disease (PD). Because circadian function is associated with cognition in the general population, we hypothesized that circadian disruption is a mechanism for cognitive impairment in PD.

Methods: We used nonparametric circadian rhythm analysis (NPCRA) to compare actigraphy-derived rest-activity circadian function, over the course of 7 days, in 35 non-demented individuals with idiopathic PD and 15 matched healthy control participants. Within the PD group, we then examined the separate contributions of circadian robustness and sleep efficiency to cognition as measured with standard neuropsychological tests.

Results: The PD participants exhibited a lower relative amplitude in their daily/circadian rest-activity patterns than the control group. For the PD group, less stable day-to-day rest-activity patterns predicted poorer executive and visuospatial functioning and slower psychomotor speed. Hierarchical regressions showed that circadian stability significantly contributed to variance in each of these cognitive domains above and beyond the contributions of objective sleep quality. Whereas sleep efficiency predicted executive function (accounting for 18.3% of the variance) but did not predict psychomotor or visuospatial performance, circadian stability significantly predicted performance in all three domains, uniquely accounting for 14.4% to 17.4% of the variance.

Conclusion: Our findings indicate that rest-activity circadian rhythms are disrupted in PD relative to matched healthy adults, and that circadian dysfunction is a potential mechanism for cognitive impairment in PD.

Support (If Any): The data for this study were originally collected with the support of a Ruth L. Kirschstein National Research Service Award from the National Institute of Neurological Disorders and Stroke (1F31NS061555; K.S.), and of NINDS grant R01 NS050446 (A.C.G.). K.H. was partially supported by R00-HL102241, R01AG048108-01A1 and P01AG009975.

1143

SHORT WAVELENGTH LIGHT THERAPY FACILITATES RECOVERY FROM MILD TRAUMATIC BRAIN INJURY

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Introduction: Mild traumatic brain injury (mTBI) or "concussion" is often associated with persistent problems with sleep and fatigue in up to 50% of those injured. We hypothesized that regular morning blue light exposure therapy may re-entrain the circadian rhythm and improve overall sleep quality, potentially enhancing brain repair, thereby improving brain functioning, symptom expression, and neurocognitive problems.

Methods: Twenty-eight individuals (15 female; aged 18–48 years) who experienced an mTBI during the preceding 18 months underwent a comprehensive neuropsychological assessment and multi-modal neuroimaging. In a double-blind design, participants were randomly

assigned to complete daily morning exposure with a light device fitted with an array of light emitting diodes in the blue (n=14) or amber wavelength (placebo; n=14). Participants used the device for 6-weeks at home (30-minutes daily, prior to 11:00am), and returned for follow-up assessment and imaging.

Results: Blue light exposure led to an earlier bedtime and rise time, lower daytime sleepiness, and improved balance stability compared to placebo light (p<.05). Structural magnetic resonance imaging (MRI) showed that active blue-light treatment was associated with increased volume of the pulvinar nucleus bilaterally (p<.05, FWE corrected), while no difference was observed for the amber placebo condition. Blue light was also associated with increased functional connectivity and greater integrity of white matter axonal pathways connecting the pulvinar to parietal regions compared to placebo (p<.05, FWE corrected). Changes in functional and structural connectivity correlated with improved neurocognitive performance.

Conclusion: Daily morning exposure to blue-wavelength light for 6-weeks led to improved sleep and associated alterations in thalamo-cortical structure, connectivity, and function compared to amber placebo light exposure. Findings are consistent with recent evidence that light exposure may improve fatigue in this population. These preliminary findings raise the possibility that blue-light treatment may provide a novel method for improving recovery from some aspects of mTBI.

Support (If Any): This study was supported by USAMRAA grant W81XWH-11-1-0056 to WDSK.

1144

PRESENCE OF MELATONIN RHYTHM IN ACUTE MODERATE-SEVERE TRAUMATIC BRAIN INJURY DESPITE SEVERE SLEEP-WAKE DISTURBANCES

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Introduction: Sleep-wake disturbances (SWD) are present in the acute phase of moderate-severe traumatic brain injury (TBI), and could be related to circadian disturbances caused by the brain injury. The goal of this study was to 1) compare the rest-activity and melatonin rhythms of moderate-severe TBI patients to that of patients with severe orthopedic and/or spinal cord injuries (OSCI); and 2) evaluate the association between melatonin and the sleep-wake cycle in TBI patients.

Methods: Seventeen moderate-severe TBI patients (Glasgow Coma Scale score: 6.8±3.3; 30.3±13.3yo; 14 men) and sixteen OSCI patients (30.9±13.2yo; 13 men) were recruited in intensive care. Urine was collected from their urinary catheter every hour for 25 hours starting 18.7±12.3 days post-injury, and concentration of 6-sulfatoxymelatonin was calculated to obtain area under the curve (AUC)(ng). A cosinor analysis was also carried out to obtain amplitude (ng/ml) and acrophase (h). Patients wore wrist actigraphs for 9.4±4.2 days, starting 19.3±12.6 days post-injury. Average nighttime (22:00-6:59) sleep duration and fragmentation index were calculated. The daytime activity ratio was used to quantify rest-activity cycle consolidation. We compared groups on actigraphy and melatonin variables using Student's t-tests. Among TBI patients, we investigated associations between melatonin and actigraphy variables using Pearson's correlations. Statistical significance was set at p<0.01.

Results: TBI patients had shorter nighttime sleep duration (TBI: 345.8±101.2mins; OSCI: 449.0±54.4mins, t(30)=-3.52, p<0.01), higher fragmentation index (TBI: 80.5±34.0; OSCI: 52.6±23.3, t(30)=2.68, p=0.012), and poorer rest-activity cycle consolidation (TBI: 75.8±9.3%; OSCI: 86.1±4.8%, t(30)=-3.87, p<0.001). A melatonin rhythm was present in TBI patients, and no group differences were found for AUC (TBI: 249.5±165.6ng; OSCI: 162.3±88.9ng), amplitude (TBI: 12.0±7.5ng/ml; OSCI: 7.7±4.8ng/ml), and acrophase (TBI: 5:08±2:14; OSCI: 5:59±3:16)(p-values>0.05). No associations were found between melatonin and actigraphy variables in TBI patients (p-values>0.01).

Conclusion: This study shows that despite having more severe SWD, moderate-severe TBI patients have a melatonin rhythm similar to other trauma patients without a brain injury. Moreover, SWD do not seem to be associated to melatonin rhythm. This suggests that neural mechanisms other than the circadian system may be responsible for post-TBI SWD.

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1145

LONG-TERM SEIZURE CONTROL IN EPILEPTIC PATIENTS WITH OBSTRUCTIVE SLEEP APNEA USING POSITIVE AIRWAY PRESSURE THERAPY

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Introduction: Obstructive sleep apnea (OSA) is a highly prevalent, often overlooked, comorbidity in people with epilepsy (PWE). Positive airway pressure (PAP) therapy improved seizure control in retrospective series with short follow-up.

Methods: We investigated the effect of PAP therapy on long-term seizure outcomes in adults with epilepsy who underwent polysomnography (PSG) at Cleveland Clinic (1997–2016). Seizure outcomes were compared from baseline to 1, 3 and 5 year post diagnostic PSG in patients without OSA (apnea-hypopnea index [AHI]<5), PAP-treated OSA and untreated OSA. PAP adherence (≥4 hr use ≥70% nights) was ascertained by device download. Seizure outcomes included mean % seizure reduction, ≥50% seizure reduction from baseline (%, responder rate), and ≥ 50% seizure reduction or seizure free at both baseline and follow up (%, successful outcome). Seizure data were obtained from an electronic data entry system for patients and providers. Treatment groups were compared univariably and multivariably using logistic regression adjusting for factors associated with seizure outcome.

Results: 208 subjects (age 45±15 years, 57% female, monthly seizure frequency 0[0.00, 1.4], 54% seizure free at baseline) were included. Mean follow-up was 5.3±3.9 years and 40% were followed for 5 years. 132 (63%) subjects had OSA including 81 (61%) on PAP therapy (83% adherent) and 51 (39%) untreated. No OSA subjects were younger (38 years vs. 48/49), more likely to be female (78% vs. 42/49), and had lower BMI (27.5 vs. 34.2/31) than PAP-treated and Untreated OSA (p=0.001). Responder rate at 1 year was greater in PAP-treated (64%; p<0.001) and No OSA (45%; p=0.009) than Untreated OSA (14%). Successful outcome was achieved more often in PAP-treated (84%) than Untreated OSA (57%; p=0.002) or No OSA (66%; p=0.009) groups. After adjusting for baseline seizure freedom and AED standardized dose, PAP-treated OSA remained more likely to

be successful than Untreated OSA (p<0.001) and No OSA (p=0.016). No significant differences were found at other time points.
Conclusion: This largest-to-date series found better 1-year seizure outcomes in PWE and PAP-treated OSA compared with Untreated OSA and No OSA, expanding existing literature supporting the impact of sleep therapies on seizure control in PWE.
Support (If Any):

1146

OBSTRUCTIVE SLEEP APNEA IS ASSOCIATED WITH BETTER INPATIENT OUTCOMES IN PATIENTS WITH ISCHEMIC STROKE

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Introduction: Hypoxic preconditioning induces stroke tolerance in mice. Patients with OSA often have intermittent hypoxia during sleep. As this could be a form of hypoxic preconditioning, it may lead to improved outcomes in patients with IS. The aim of this study was to compare the outcomes of death and discharge status among patients with ischemic stroke (IS), with or without the comorbidity of obstructive sleep apnea (OSA).
Methods: We investigated the 2007 to 2009 inpatient administrative database of the Healthcare Cost and Utilization Project (HCUP) that uses ICD-9 codes to define diagnoses. We applied unadjusted and adjusted logistic regression to analyze the relationship between OSA and the outcome measures of death and discharge status. We defined good discharge status as a discharge to acute rehabilitation facility or home. Poor discharge status was defined as a discharge to an intermediate care facility, skilled nursing facility, another kind of facility, home health, leaving against medical advice, or death.
Results: We identified 134,399 patients with IS, of whom 1,960 patients had OSA. In an unadjusted model, patients with OSA were found to have lower odds of death [OR(95%CI) 0.52(0.41–0.65)]. After adjusting for insurance, gender, age, race, obesity, hypertension, diabetes mellitus (DM) and tobacco use disorder, OSA was still associated with lower odds of death [OR(95%CI) 0.68(0.53–0.86)]. In an unadjusted model, we found that OSA was associated with lower odds of poor discharge status [OR(95%CI) 0.62 (0.54–0.71)]. Furthermore, after adjusting for age, gender, race, insurance status, obesity, hypertension, DM and tobacco use disorder, OSA was still associated with lower odds of poor discharge status [OR(95%CI) 0.84(0.73–0.98)].
Conclusion: In this study of patients with IS, OSA was associated with lower odds of poor discharge status and death. Hypoxic preconditioning in patients with OSA could be a potential mechanism responsible for the better inpatient outcomes following IS.
Support (If Any):

1147

OBSTRUCTIVE SLEEP APNEA IS ASSOCIATED WITH BETTER INPATIENT OUTCOMES IN PATIENTS WITH NON-TRAUMATIC SUBARACHNOID HEMORRHAGE

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Introduction: Hypoxic preconditioning attenuates SAH-induced vasospasm in mice. Patients with diagnosis of OSA have intermittent hypoxia. As this could be a form of hypoxic preconditioning, it may lead to improved outcomes of non-traumatic SAH. This study aims to compare the outcomes of death and discharge status among patients with non-traumatic subarachnoid hemorrhage (SAH), with or without the comorbidity of obstructive sleep apnea (OSA).
Methods: We investigated the 2007 to 2009 inpatient administrative database of the Healthcare Cost and Utilization Project that uses ICD-9 codes to define diagnoses. We applied unadjusted and adjusted logistic regression to analyze the relationship between OSA and the outcome measures of death and discharge status. We defined good discharge status as a discharge to an acute rehabilitation facility or to home. Poor discharge status was defined as a discharge to an intermediate care facility, skilled nursing facility, another kind of facility, home health, leaving against medical advice, or death.
Results: We identified 11,393 patients as having had non-traumatic SAH, among whom 132 patients had the diagnosis of OSA. In an unadjusted model, patients with OSA were found to have lower odds of death [OR(95%CI) 0.62(0.38–0.99)]. After adjusting for insurance, gender, age, race, alcohol abuse, tobacco use disorder, and hypertension, OSA was still associated with lower odds of death [OR(95%CI) 0.60(0.36–0.99)]. In an unadjusted model, we found OSA to be associated with lower odds of poor discharge status [OR(95%CI) 0.52(0.31–0.88)]. Furthermore, after adjusting for insurance, race, age, gender, alcohol abuse, tobacco use disorder, and hypertension, we found that OSA was still associated with lower odds of poor discharge status [OR (95%CI) 0.47(0.27–0.82)].
Conclusion: In this study of patients with non-traumatic SAH, we found that OSA was associated with lower odds of both poor discharge status and death. Hypoxic preconditioning among patients with OSA could be a potential mechanism responsible for the better inpatient outcomes following non-traumatic SAH.
Support (If Any):

1148

OBESITY, GENDER AND SLEEP DISORDERED BREATHING IN CEREBROVASCULAR DISEASE

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Introduction: The relationship between obesity, male gender and sleep disordered breathing (SDB) is well known. So also is the association between SDB and cerebrovascular disease (CVD). In a population of patients followed in the stroke clinic, we assessed the association between obesity and severity of SDB as determined by Apnea Hypopnea Index (AHI). We also aimed to assess the relationship between gender and presence of SDB.
Methods: This is a retrospective data review of 50 patients with ischemic or hemorrhagic stroke or transient ischemic attack referred from our stroke clinic from June 2014 to May 2016 who endorsed SDB symptoms and underwent nocturnal polysomnography according to AASM guidelines at the TIRR-Memorial Hermann Hospital Sleep Center. Those with SDB diagnosed within 24 months of stroke or TIA were included. Body Mass Index (BMI) was defined as body weight divided by square of body height (kg/m^2).
Results: Of the 50 patients, 29 (58%) were male and 21 (42%) female. Among participants, 40 (80%) had SDB; 20/29 (68.9%) males and 18/21 (85.7%) females. Mean BMI was 31.75 ± 6.55, and 5 of 9 patients with normal BMI (≤ 25) had SDB. Mean body mass index was 31.75 ± 6.55. 40 patients (80%) had obstructive sleep apnea (OSA). Two patients had central sleep apnea along with OSA. Mean AHI was 22.97. With BMI as the independent variable and AHI as dependent, correlation analysis was performed. Pearson correlation co-efficient was 0.15.

Conclusion: In this sample of stroke patients, there was no significant correlation between BMI and severity of SDB. Also, 55% of patients with BMI less than 25 were diagnosed with SDB. A large proportion of female stroke patients also had SDB. Body weight and male gender do not appear to predict presence or absence of SDB or severity of SDB in those with stroke. Pre-existing anatomical and neuromuscular mechanics consequent to stroke may play a role in respiratory obstruction in this group.
Support (If Any): None

1149

SLEEP APNEA IS A SIGNIFICANT CO-MORBIDITY ONE MONTH FOLLOWING STROKE

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Introduction: Obstructive sleep apnea (OSA) is a risk factor for new stroke, and affects over half of acute ischemic stroke patients. Preliminary data indicate that OSA may contribute to functional impairment following an acute stroke. Persistent OSA may also be a risk factor for the occurrence of recurrent stroke. However, the prevalence of OSA in the non-acute setting following stroke has not been well explored. We hypothesized that the risk for stroke would remain high in the non-acute post-stroke setting.
Methods: Clinical data was gathered on 92 consecutive post-stroke outpatients at a specialty stroke clinic in an urban academic center between January and September 2016. The follow up dates were scheduled approximately 1 month after the initial admission for stroke. Patients completed the STOP-BANG OSA risk assessment tool at the time of visit. We also collected data on demographics, comorbidities, length of hospital stay, and type and severity of stoke.
Results: Average age of the patients was 64.18 years. 51% of patients were male. The mean NIH stroke scale was 8.4. 70 patients (76.1%) were screened positive in the Stop-bang questionnaire. There were more males who were STOP-BANG positive (61% vs 18%) and they had a higher BMI (32.22 vs 26.27, p-0.003). The average age was similar (65.58 vs 59.72 years, p-value 0.07). Comorbidities including incidence of hypertension (78.6% vs 54.5%, p-0.05), diabetes (32.8% vs 22.7%, p-0.43), atrial fibrillation (18.5% vs 13.6%, p- 0.75), h/o smoking (48.6% vs 50%, p-1.00), heart failure (12.8% vs 4.5%, p-0.44) and h/o previous stroke (28.6% vs 9.1% p-value 0.08) were identical in both the groups. The severity of stroke (average NIH stroke scale 9.39 vs 5.4, p-0.42), length of stay (average 4.375 vs 2.94 days p-0.1194) and place of discharge (9 vs 6, patients were discharged to rehab p-1.00) were comparable. The incidence of embolic and hemorrhagic stroke was similar (27% vs 22% and 8% vs 4% respectively).
Conclusion: The risk of OSA, remains high at one month following discharge from hospitalization for acute stroke. In this pilot study, only BMI and gender were independently associated with risk of having OSA.
Support (If Any):

1150

SLEEP IMPACTS QUALITY OF LIFE AND NEUROCOGNITIVE CHARACTERISTICS OF BLACK AND HISPANIC STROKE SURVIVORS

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Introduction: Evidence suggesting that poor sleep is linked to compromised neurocognitive function and poorer quality of life, as well as evidence that stroke survivors suffer from poor sleep have laid the groundwork for the current study. This study investigated the association between sleep and quality of life and neurocognitive characteristics among Blacks and Hispanic stroke survivors.
Methods: Using a sample of twenty-three Black and Hispanic stroke survivors, we analyzed associations of sleep parameters (which included sleep duration, sleep quality, insomnia symptoms, being tired, and daytime sleepiness) with quality of life (as measured by the Stroke Specific Quality of Life [SSQOL]) and neurocognitive factors (e.g. working and episodic memory, attention and control, executive function, and processing speed). Additionally, we ascertained whether sleep parameters were associated with SSQOL total score and neurocognitive domains, after adjusting for effects of age and gender.
Results: The mean age of the sample was 57 yrs. (S.D.=10.73); 54.5% were female, 59.1% were born in the U.S., 72.7% were primary English speakers, 68.2% were unemployed, 85.7% had at least a Bachelor's degree, 54.5% reported trouble sleeping, and the mean self-reported sleep duration was 6.55 hrs. (S.D.=2.11). Bivariate correlational analyses indicated that individuals who reported "trouble sleeping" ($r= -0.47$, $p<.05$), or "being tired" ($r= -0.43$, $p<.05$), had lower scores on a Working Memory. Additionally, sleep quality ($r= -.61$, $p<.01$) and insomnia ($r= -0.49$, $p<.05$) were negatively associated with quality of life. Linear regression analysis indicated that sleep quality was inversely associated with Total SSQOL score ($B= -18.84$, $S.E.= 8.45$, $p<.05$), adjusting for age and gender.
Conclusion: We found that sleep quality was associated with poor functional outcomes (quality of life and working memory). Future studies should investigate the long-term consequences of poor sleep on quality of life and neurocognition among stroke survivors.
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1151

UNDER-RECOGNITION OF SLEEP APNEA IN PATIENTS HOSPITALIZED FOR ACUTE ISCHEMIC STROKE

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Introduction: There is a bidirectional association between sleep apnea (SA) and acute ischemic stroke (AIS). Previously estimated prevalence of SA in patients with AIS ranged 60%-80%. We hypothesized that the routine clinical recognition of SA in patients with AIS is below reported range.
Methods: We retrospectively analyzed all patients with AIS admitted to Mayo Clinic hospital in Jacksonville, FL between 2008 and 2014. We abstracted the demographic data, pertinent clinical variables, known or suspected diagnosis of SA and compliance with the treatment. We assessed the hospital mortality and the need for mechanical ventilation (MV).
Results: There were 994 individual patients admitted with AIS within the study period. Majority were white (87%), female (52%), median BMI was 26 (23, 31) and median age was 75 years (IQR 64, 84). Median NIH Stroke Scale was 5 (IQR 2, 10), and median Glasgow Coma Scale was 15 (IQR 13, 15). Only 190 (19%) patients were considered of having SA (known diagnosis or documented clinical suspicion), of which only 42 (23%) received any treatment for SA in the hospital. Based on the limited and frequently extrapolated records of compliance, 47 patients were previously compliant with the home therapy for SA. The hospital mortality was 5%. In univariate analysis, only NIHSS, GCS, SA and congestive heart failure were significantly associated with mortality. More patients without known SA died compared to those with SA (5.6% vs. 1%, p=0.004). After adjusting in

multivariate logistic regression, only NIHSS and GCS retained independent statistical significance. Compared to patients without SA, those with SA had lower NIHSS (p=0.009) and higher GCS (p=0.008). The patients compliant with home therapy had lower NIHSS than the noncompliant ones (p=0.011). More patients without SA required MV (10.9%) compared to those with SA (4.7%, p=0.009).
Conclusion: The low prevalence of SA in patients with AIS is likely related to under-recognition. This is supported by the fact that the patients with recognized SA had better clinical outcomes, at least in part because of administered therapy for SA. However, only independent predictors of mortality were well established severity scales NIHSS and GCS.
Support (If Any): Mayo Foundation

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OBSTRUCTIVE SLEEP APNEA AND THE RISK OF ALZHEIMER'S DISEASE: A SYSTEMATIC REVIEW OF STUDIES PUBLISHED IN THE PAST 10 YEARS

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Introduction: Obstructive Sleep Apnea (OSA) and Alzheimer's disease (AD) are both chronic disease conditions that are highly prevalent, cause significant morbidity and mortality to those afflicted, and have an enormous socio-economic impact. Mounting evidence implicates OSA as one of the risk factors for AD. We systematically reviewed all available studies examining any association or relationship between OSA and AD in the past 10 years, and evaluated the evidence for a causal association.
Methods: PubMed, Embase, Web of Science, and Cochrane library (i.e., the Cochrane Central Register of Controlled Trials) were searched for related peer reviewed scientific publications from January 1, 2006 until and including October 30, 2016. The terms Alzheimer, Mild Cognitive Impairment, Obstructive Sleep Apnea, and Sleep Disordered Breathing were identified as MeSH terms. Other MeSH search headings related to OSA and various study types including cross-sectional, case control, cohort (retrospective and prospective), Randomized Clinical Trials (RCTs) were also identified. Articles identified from the search were first screened using titles and abstracts of the publications and eligible articles for this review had to meet certain inclusion and exclusion criteria.
Results: Twenty-three publications (8 cross-sectional analyses, 3 prospective studies; 7 RCTs that examined cognitive effects of treating OSA in AD; and 5 experimental studies that examined the associations between sleep and AD pathology and/or AD biomarkers) were identified by the literature search. Altogether there is substantial evidence providing support that OSA is associated with cognitive decline and/or AD/AD pathology. Prospective studies provide support that OSA possibly precedes the onset of cognitive impairment, including AD, and experimental studies provide the most compelling evidence of the plausibility of causal associations between OSA and AD pathology or biomarkers.
Conclusion: There is growing experimental and epidemiological evidence for a causal relationship between OSA and AD. Mechanisms underlying this relationship are possibly related to hypoxia, sleep fragmentation and sleep duration measures. OSA may also be sex-dependent, race-dependent and education-dependent risk factor for AD. However, long-term longitudinal studies are needed to determine whether OSA actually precedes AD onset.
Support (If Any): None

1153

DISTURBED SLEEP IS ASSOCIATED WITH CHANGES IN ALZHEIMER'S DISEASE (AD) BIOMARKERS PREDICTIVE OF PERSONS THAT ULTIMATELY DEVELOP AD: FINDINGS FROM SUBGROUP META-ANALYSIS ON SLEEP AND ALZHEIMER'S DISEASE

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Introduction: In a recent meta-analysis, we confirmed the association between sleep and cognitive impairment or Alzheimer's Disease (AD), and, for the first time, consolidated the evidence to provide an "average" magnitude of effect. To examine whether disturbed sleep is associated with changes in AD biomarkers predictive of persons that ultimately develop AD, further subgroup analyses were conducted examining disturbed sleep and the risks of cognitive impairment; preclinical AD and symptomatic AD respectively.
Methods: Original published literature assessing any association of sleep problems or disorders with cognitive impairment or AD was identified by searching PubMed, Embase, Web of Science, and the Cochrane library. Our outcome measures included the use of cognitive tests by studies examining sleep and the risks of cognitive impairment; the use of AD biomarkers or abnormal proteins by studies examining sleep and the risk of preclinical AD; and the use of ICD9/DSMIV diagnoses of AD by studies examining the risk of sleep and symptomatic AD respectively. Effect estimates of individual studies were pooled and relative risks (RR) and 95% confidence intervals (CI) were calculated using random effects models. Meta-regression analyses examining the effect of potential influencing factors was also conducted.
Results: Subgroup meta-analytic findings from 27 studies showed a RR increase inverse to diagnostic confidence (e.g., 1.60, 1.70 and 3.80 for AD, Cognitive Impairment and preclinical AD, *P-value* <.001 for all). The RR of 3.80 finding suggests that disturbed sleep is associated with changes in Alzheimer's Disease biomarkers predictive of persons that ultimately develop AD and may reflect the use of more objective diagnostic measures to identify individuals with sleep problems and preclinical AD among studies that examined this association. Meta-regression results suggested that sample size may have significantly influenced the effect size such that larger sample size studies tended to result in smaller risk and vice versa.
Conclusion: Overall our results highlight potential mechanistic relationships suggesting that sleep is not only associated with cognitive impairment, or symptomatic AD but is also associated with changes in AD biomarkers predictive of persons that ultimately develop AD. These findings are vital for potential prevention of AD.
Support (If Any): None

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THE EFFECTS OF CPAP ON COGNITIVE AND FUNCTIONAL MEASURES IN PATIENTS WITH MILD COGNITIVE IMPAIRMENT AND ALZHEIMER'S DEMENTIA

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Introduction: Untreated OSA may worsen cognitive and functional impairment in patients with mild cognitive impairment (MCI) and

Alzheimer's dementia (AD). It is unclear whether CPAP provides prolonged cognitive and functional improvement in these patients. We examined the effects of CPAP on cognitive and functional outcomes over one year in patients with MCI and AD.

Methods: Twenty-nine patients with MCI or AD with clinical features of OSA underwent overnight polysomnography. CPAP compliance was defined as nightly CPAP use ≥ 4 hours for ≥70% of the nights. Mini-Mental Status Examination (MMSE), Epworth Sleepiness Scale (ESS), Record of Independent Living (ROIL), Geriatric Depression Scale (GDS), and a 10-point Quality of Life (QOL) scale were obtained at baseline, 1-, 6- and 12-month follow-up. The primary analysis was performed using last observation carried forward method to account for incomplete follow-up. In addition, changes in the aforementioned measures from baseline to each follow-up visit were evalauted. Two-sided non-parametric statistics were utilized with p-values < 0.05 being considered statistically significant.

Results: Eighteen patients with MCI (Clinical Dementia Rating [CDR] 0.5) and 11 patients with AD (CDR 1.0) with a median age of 73 years (interquartile range [IQR] 62–76) were included in the study. The median apnea-hypopnea index was 10.0 (IQR 7.0–22.5). Fourteen patients were compliant with CPAP use. No differences were found in sleep apnea severity or CPAP compliance between patients with MCI and AD. Baseline MMSE, ESS, ROIL, GDS and QOL did not differ between CPAP compliant and non-compliant patients. The primary analysis revealed that the ability to manage complex activities of daily living (based on the ROIL) significantly improved in CPAP compliant patients (p=0.026), although MMSE, ESS, GDS and QOL did not change over time. The subanalysis demonstrated improved MMSE in patients who were CPAP-compliant for 12 months (p=0.036), although the rest of the measures did not change.

Conclusion: Treatment of OSA with CPAP may improve functional activities of daily living in patients with MCI and AD.

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1155

LONGITUDINAL CHANGES OF FRACTAL ACTIVITY REGULATION WITH AGING: PRELIMINARY RESULTS FROM THE RUSH MEMORY AND AGING PROJECT

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Introduction: Human physical activity possesses fractal fluctuations with similar temporal structure at different time scales from minutes to hours. Cross sectional studies suggest that such fractal regulation (FR) is robust in healthy young subjects but is degraded with age and cognitive impairment. Here we aimed to characterize the longitudinal change in FR among community-based older persons and to examine the associations of the change with demographics and cognitive status.

Methods: We examined physical activity recordings of 991 participants (59–100 years old; Mean=81) in the Rush Memory and Aging Project who had 2–11 assessments (Mean=5). 42 Subjects were diagnosed with AD at baseline. Physical activity was continuously monitored with an actigraph on the wrist (Actical) for up to 10 days. Cognitive function was based on a previously validated summary score for 19 cognitive tests. To assess FR, temporal correlations in activity fluctuations at both smaller (~0.1–1.5h) and larger (2-12h) time scales were quantified and were indicated by two exponents, alpha1 and apha2, respectively. Linear mixed models were used to examine the associations of demographics and baseline cognitive status with annual rate of change in activity correlations.

Results: Activity correlations in both time-scale regions decreased over time with an annual decline of 0.003 ± 0.0005(SE) in alpha1 ($p<0.0001$) and a faster decline in alpha2 (0.010 ± 0.0008[SE], $p<0.0001$). Faster declines in alpha1 were associated with older age ($p<0.0001$) and worse baseline cognitive function (p=0.0008). The associations of the decline in alpha2 with age and baseline cognitive function were weaker and didn't reach statistical significance (age: p=0.076; cognition: p=0.189). Consistently, AD at baseline doubled the decline in alpha1 (p=0.01) and no significant association with alpha2 was observed (p=0.61). These changes/associations were independent of sex and years of education.

Conclusion: Fractal regulation of physical activity in old adults declines and is accelerated by poorer cognition and AD.

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INFLAMMATION IS ASSOCIATED WITH INCREASED DAYTIME AND NIGHTTIME SLEEP IN PATIENTS WITH DEMENTIA

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Introduction: It has been shown that inflammatory markers are elevated in patients with cognitive impairment and are also associated with excessive daytime sleepiness (EDS). In addition, we have previously shown that patients with Dementia sleep longer. The aim of this study was to test the hypothesis that objective nighttime and daytime sleep is associated with inflammation among patients with Dementia.

Methods: A sub-sample of 53 patients with Dementia, were recruited from a large, population-based cohort in the island of Crete, Greece of 3140 older adults (>60yrs). The overall goal of this study was to assess the prevalence and risk factors associated with cognitive impairment. All participants underwent medical history/physical examination, extensive neuropsychiatric and neuropsychological evaluation, 3-day 24-h actigraphy and a single morning IL-6 and TNFa plasma level. Associations between inflammatory markers and sleep variables, were assessed using Linear Regression Analysis controlling for gender, age, BMI and depressive symptoms.

Results: Mean age of our participants was 80.3 (SD = 5.71) years and 34% were male. Peripheral levels of IL-6 (mean ± SD) and TNFa in patients with Dementia were 1.49 ± 0.95 (pgr/ml) and 1.30 ± 0.58 (pgr/ml), respectively. Regression analyses revealed associations between IL-6 and daytime Sleep Efficiency (r=0.427, p=0.019), daytime Total Time in Bed (r=0.327, p=0.078), nighttime Sleep Latency (r=-0.312, p=0.018), and day and night Total Sleep Time (r=0.223, p=0.096).

Conclusion: These data indicate that prolonged nighttime and daytime sleep is associated with increased levels of sleep-inducing

pro-inflammatory cytokine IL-6 in patients with dementia. Furthermore, extended sleep and sleepiness is a marker of generalized inflammation in demented patients and may be an adverse prognostic sign of coarse of the disease. Finally, from a clinical standpoint, sedative psychotropics to control common symptoms in this population, such as sleep disturbances, agitation, hallucinations, should be used with caution.

Support (If Any): Thales, University of Crete, A multi-disciplinary network for the study of the Alzheimer's disease National Strategic Reference Framework (ESPA) 2007–2013

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INFLAMMATION IS ASSOCIATED WITH EXCESSIVE DAYTIME SLEEPINESS AND IMPAIRED COGNITIVE PERFORMANCE IN PATIENTS WITH MILD COGNITIVE IMPAIRMENT (MCI)

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Introduction: It has been shown that inflammatory markers are elevated in patients with cognitive impairment and are associated with excessive daytime sleepiness (EDS). Furthermore, we have previously shown that extended sleep/sleepiness in patients with Mild Cognitive Impairment (MCI) is associated with impaired cognitive performance. The aim of this study was to assess the associations between inflammation, objective sleep, and cognition among patients with MCI.

Methods: A sub-sample of 119 patients with MCI were recruited from a large, population-based cohort in the island of Crete, Greece of 3140 older adults (>60yrs). The goal of this study was to assess the prevalence and risk factors associated with cognitive impairment. All participants underwent medical history/physical examination, extensive neuropsychiatric and neuropsychological evaluation, 3-day 24-h actigraphy and a single morning IL-6 and TNFa plasma level. Associations between (a) inflammatory markers and sleep variables and (b) inflammatory markers and cognition, were assessed using Linear Regression Analysis controlling for gender, age, BMI and depression for the former, and age, gender, and education, for the later.

Results: Peripheral levels of IL-6 were 1.2 ± 0.83 pgr/ml(mean ±SD), and TNFa were 1.18 ± 0.57pgr/ml. Regression analysis found a borderline significant association between IL-6 and daytime Total Sleep Time (r=0.186,p=0.07). Furthermore, regression analyses revealed significant associations between IL-6 and a number of episodic memory indices including immediate (β = -0.279, p = 0.003) and delayed word list recall (β = -0.25, p = .013), delayed complex figure reproduction (β = -0.26, p =0 .010), and autobiographic memory (β = -0.25, p =0 .009), and between TNFa and delayed word list recall (β= -0.217, p = -0.028).

Conclusion: These data indicate that in patients with MCI, EDS and cognitive impairment are associated with inflammation. It appears that improvement of inflammation through pharmacologic and/or behavioral i.e. exercise, interventions may improve the prognosis in patients with MCI.

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REDUCED SLEEP SPINDLE ACTIVITY IN PARKINSON'S DISEASE IS ASSOCIATED WITH NEUROPSYCHOLOGICAL IMPAIRMENT

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Introduction: Sleep disturbances and cognitive impairment are salient non-motor features of Parkinson's disease (PD). Using quantitative EEG (qEEG) measures we investigated whether slow wave and spindle activity during NREM sleep, which are thought to be involved in cognitive processing, differed between Parkinson's disease patients and healthy age-matched controls. Further aims were to consider the effect of dopaminergic medication and REM behaviour disorder (RBD) status and explore the relationship between sleep qEEG and cognitive task performance in PD.

Methods: Thirty-two patients with Parkinson's disease (10 female; mean age 63.5) and fourteen healthy controls (8 female; mean age 65) underwent overnight polysomnography, neurological and neuropsychological assessment. Spectral power and spindle algorithm analysis during NREM sleep at frontal, central, parietal and occipital sites were compared between the groups. We also evaluated the effect of dopaminergic medication and RBD status and tested associations between qEEG profiles and cognitive performance in PD.

Results: Patients with Parkinson's disease showed reduced fast and slow spindle activity in centro-parietal EEG during NREM sleep compared to controls. In PD, reduced spindle activity across the cortex was moderately correlated (Rho 0.35–0.64) with poorer performance on cognitive tasks. Neither treatment with dopaminergic medication or diagnosis of RBD altered EEG microstructure significantly.

Conclusion: Sleep spindle activity is reduced in Parkinson's disease and is generally associated with neuropsychological impairment. Spindle activity may be a biomarker of cognitive decline and could provide a prospective marker in the evolution of dementia in PD.

Support (If Any): None

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SLEEP-RELATED RESPIRATORY ABNORMALITIES DURING SEIZURES

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Introduction: Epilepsy patients have more than twentyfold greater risk of death when compared to the general population and it often occur at night or in relation to sleep. Prior studies have found that specific cardiorespiratory abnormalities occurred more preferentially during sleep as compared to wakefulness in adult epilepsy patients. Whether nocturnal seizures are more likely to be associated with higher oxygen desaturation drop is uncertain. Therefore, we examined the temporal pattern of oxygen saturation before, during, and after seizures occurring either during sleep or wakefulness.
Methods: Respiratory measures were retrospectively examined in 40 recorded seizures from 20 adult patients with epilepsy (11 female; 22–53 years old) admitted for long-term video-EEG monitoring at the Brigham and Women's Hospital. Oxygen saturation levels were analyzed at 4 time-points: 1) Preictally (10-s before seizure onset), 2) ictally (during a seizure), 3) immediately postictally (10-s after a seizure), and 4) 5-min postictally (5 minutes after a seizure).
Results: Seventeen (43%) seizures occurred during sleep and 23 (58%) during wakefulness. Seizure duration did not differ between sleep and wake states. Seizures from sleep were associated with lower nadir oxygen saturation as compared to seizures from wakefulness, both during a seizure and immediately after a seizure ($ps < 0.05$). Seizures from sleep were also associated with a significantly larger desaturation drop as compared to seizures from wakefulness across all time-points (-7.6 ± 4.6 and -2.9 ± 1.8, respectively; $p < 0.05$).
Conclusion: Despite comparable oxygen saturation levels at baseline (preictally), our results show that seizures occurring during sleep are associated with larger oxygen desaturation drop as compared to wakefulness. Moreover, during nocturnal seizures, oxygen saturation levels remain significantly lower, even few seconds after seizure termination. These findings suggest that nocturnal seizures are more likely to be associated with more severe and longer hypoxemia events, which might have some implication for sudden death in epilepsy patients.
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EFFECTS OF CLOBAZAM ON SLEEP AND DAYTIME FUNCTION IN PATIENTS WITH EPILEPSY
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Introduction: Sleep complaints are widely reported from patients with epilepsy, and antiepileptic medications (AED) may affect sleep. While some of the AED effects on sleep have been more extensively studied, to date there are no reports of the effects of clobazam, a novel AED with benzodiazepine properties. We tested the hypothesis that patients with epilepsy will have longer, more consolidated sleep after treatment with clobazam.
Methods: In this prospective study, we included epilepsy patients (≥18 years old) who were being considered for treatment of epilepsy with clobazam. Patients with known untreated moderate/severe sleep apnea, or with major circadian rhythm disorders were excluded. Nine patients who started clobazam treatment were tested with a set of subjective sleep measures: Pittsburgh Sleep Quality Inventory (PSQI), Epworth Sleepiness Scale (ESS), Karolinska Sleepiness Scale (KSS), Insomnia Severity Index (ISI), and Quality of Life in Epilepsy (QOLIE) prior to starting the treatment, as well as after achieving a stable clobazam dose. They also completed a week of supportive objective assessment of sleep (actigraphy) before starting therapy and one week after achieving stable dose.
Results: Treatment with clonazepam slightly improved sleep quality (PSQI before, 7.3 ± 4.1 vs after, 6.4 ± 2.2) and wake after sleep onset (WASO before, 47.7 ± 18.2 vs after, 46.5 ± 17.0), although these did not reach statistical significance. Nevertheless, a trend was observed for increased total sleep time after treatment (before, 435.5 ± 148.9 minutes vs after, 490.0 ± 80.4; p=0.09). Surprisingly, quality of life, insomnia, and sleepiness measures revealed worse outcomes after treatment (QOLIE before, 25.6 ± 5.7 vs after, 24.8 ± 6.2; ESS before, 6.3 ± 3.7 vs after, 8.9 ± 5.2; KSS before, 5.0 ± 1.6 vs after, 5.4 ± 1.8; ISI before, 10.1 ± 6.2 vs after, 11.2 ± 4.4), although again, these did not reach significance.
Conclusion: Preliminary analyses suggest that clobazam may be beneficial for sleep in patients with epilepsy, primarily by increasing total sleep time. However, further analyses in a larger group are needed to clarify the impact of clobazam on daytime sleepiness and well being.
Support (If Any): Lundbeck

1161
MIGRAINE AND SLEEP: A BI-DIRECTIONAL ASSOCIATION
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Introduction: One of the factors that has been considered to trigger migraine attacks is poor sleep. Research has shown that both the lack of sleep, and excessive sleep can provoke migraine. Alternatively, headache and migraine itself may cause sleep disturbances. The aim of the current study was to gain more insight in this bi-directional relationship between migraine and sleep.
Methods: Dutch university students were recruited to participate in an online survey on general health. To assess possible migraine complaints, the Migraine Screen Questionnaire (MS-Q) was completed. The MS-Q consists of 5 questions, assessing frequency and characteristics of headache. Perceived sleep quality was rated from 0 (very poor) to 10 (excellent), and total sleep time and number of nightly awakenings were recorded. Further the subscales on insomnia, narcolepsy, and circadian rhythm disorder of the SLEEP-50 questionnaire were completed. Nonparametric Spearman correlations were computed to examine the relationship between MS-Q scores and the sleep outcomes.
Results: N=1566 subjects completed the MS-Q and SLEEP-50 subscales. The total MS-Q score correlated significantly with the SLEEP-50 subscales on insomnia (r=0.178; p=0.000), circadian rhythm disorder (r=0.068; p=0.007), and narcolepsy (r=0.148; p=0.000), as well as the number of nightly awakenings (r=0.124; p=0.000) and perceived sleep quality (r=-0.153; p=0.000). total sleep time was not significantly associated with MS-Q scores.
Conclusion: Albeit modest, significant correlations were observed between migraine scores and sleep outcomes. Migraine is associated with poor sleep quality, which is illustrated by the significantly increased number of nightly awakenings with higher migraine scores. It must be examined to what extent poor sleep is a cause or a consequence of migraine, or both. Future research should also address how improved sleep hygiene and adequate sleep habits may reduce the chances of having migraine attacks.
Support (If Any): The study was funded by Utrecht University.

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VALIDATION OF AMBULATORY ACTIVITY MONITORS FOR SLEEP MEASUREMENT IN HUNTINGTON'S DISEASE GENE CARRIERS

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Introduction: Sleep disturbance is one of the earliest symptoms of Huntington's disease (HD), starting up to 10 years prior to diagnosis, and might have an influence on the speed of neurodegeneration and other symptoms. Elucidation of the etiology and the progression of these problems requires longitudinal study designs, which are hampered by the absence of a valid ambulatory objective sleep measurement tool in HD.
Methods: Sleep of seven Huntington's gene carriers (age=54±6.4, 1M) was simultaneously assessed using polysomnography (PSG), actigraphy (Actiwatch Spectrum Pro) and Jawbone UP2 (JB) during an overnight laboratory sleep study. The ambulatory activity monitors were compared to PSG on the measurement of total sleep time (TST), sleep efficiency (SE), sleep latency (SL) and wake after sleep onset (WASO). Epoch-by-epoch comparisons determined sensitivity, specificity, accuracy, and agreement using prevalence and bias adjusted kappa (PABAK).
Results: Compared to PSG, actigraphy and JB overestimated TST by 74.0±54.4min and 78.7±51.2min, and SE by 14.8±11.0% and 16.3±10.1%, respectively. Similarly, the monitors underestimated SL by 23.0±26.4min and 19.3±28.8min, and WASO by 20.0±32.2min and 36.0±28.2min, respectively. These differences were significant for TST and SE for both monitors, and for WASO for JB. Actigraphy and JB showed high sensitivity (0.97, 0.99), low specificity (0.31, 0.34), good accuracy (0.80, 0.83), and substantial agreement (PABAK = 0.62, 0.65).
Conclusion: In assessing sleep in HD gene carriers, both ambulatory monitors showed good ability to recognize sleep, but poor ability to identify wake. Substantial agreement between PSG and the monitors indicates a possible skew in the sensitivity and specificity values due to the high prevalence of sleep overnight. While unfit to replace PSG, actigraphy and JB might still be suitable for longitudinal research in HD, providing investigators are aware of the inaccuracies in the measurement of sleep indices. Clinical utility with circadian rhythm disorders remains to be tested.
Support (If Any):

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USING WRIST-WORN ACTIGRAPHIC DEVICES TO MEASURE SLEEP IN PEOPLE WITH HUNTINGTON'S DISEASE

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Introduction: Sleep disturbances are an early symptom of Huntington's disease (HD), and may be linked to the cognitive, motor and psychiatric symptoms of HD. Long-term collection of HD ambulatory sleep data can show the impact of sleep disturbances as HD symptoms progress. Actigraphy provides an objective measure of sleep well suited to long-term ambulatory data collection, but is cost prohibitive for large-scale studies. Commercial actigraphy devices may be a good alternative. This study aimed to validate research and commercial actigrapy in people with HD.
Methods: Seven people with the gene for Huntington's disease (Age=54.1±6.4, 6F) completed an overnight sleep study using polysomnography, research-grade (Actiwatch Spectrum Pro), and consumer-grade (Fitbit One) actigraphy to measure sleep. For each actigraph, sensitivity and specificity compared to polysomnography were calculated. Intraclass correlations (ICCs) and Bland-Altman analyses (BAA) were used to compare the actigraphs to polysomnography on total sleep time (TST), sleep efficiency (SE), sleep latency (SL), and wake after sleep onset (WASO).
Results: The sensitivity of the research-grade and consumer-grade actigraphs were 97.13% and 98.90% respectively, and specificities were 31.32% and 27.05% respectively. The only significant ICC was the correspondence between the consumer-grade actigraph and polysomnography for TST (r=0.52, p=.03). Using BAA, both actigraphs overestimated TST (Research-grade - Avg.dif=74.3±54.1min; Consumer-grade - Avg.dif=94.3±50.2min) and SE (Research-grade - Avg.dif=14.8±11.0%; Consumer-grade - Avg.dif=17.5±9.8%), and showed good agreement for SL (Research-grade - Avg.dif=-27.9±28.0min; Consumer-grade - Avg.dif=-22.0±24.7min). The research-grade actigraph showed good agreement with polysomnography on WASO (Avg.dif=-20.0±32.2min), whilst the consumer-grade actigraph underestimated WASO (Avg.dif=-39.0±29.1min).
Conclusion: In people with HD, neither actigraph showed sufficient agreement with polysomnography to be a suitable replacement for ambulatory sleep measurement, particularly considering the very low specificity values. Our research-grade actigraphy performed notably worse than what is typically seen in patient populations. The development of a HD specific actigraphy algorithm would greatly improve the agreement between actigraphy and polysomnography.
Support (If Any): None.

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THE USE OF CHEMICAL NEURO STIMULATION TO MINIMIZE SLEEP DISTURBANCE ASSOCIATED WITH MUSCLE CRAMPING AND SPASTICITY

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Introduction: Muscle cramps are common in neurological disorders such as ALS, Charcot Marie Tooth neuropathy, multiple sclerosis, cramp fasciculation syndrome and Parkinson's disease. Muscle cramping and, in the case of certain neurological disorders, associated spasticity disturb sleep impacting quality of life. FLX-787, a synthetically-prepared co-activator of TRPV1 and TRPA1, has been demonstrated to activate sensory neurons in the oropharynx and esophagus to decrease muscle cramp intensity. Chemical Neuro Stimulation of TRPV1 and TRPA1 is thought to stimulate brainstem relays to activate descending spinal pathways and ultimately inhibitory interneurons at the segmental level. Because muscle cramping stems from hyperexcitability of alpha motor neurons, activation of inhibitory interneurons in the spinal cord could decrease hyperexcitability and afford cramp relief. We sought to understand the prevalence and timing of nocturnal leg cramps during sleep and if Chemical Neuro Stimulation could limit nocturnal leg cramp frequency and severity to improve sleep quality.
Methods: Two, randomized, blinded, placebo-controlled cross-over studies in healthy volunteers with a history of nocturnal leg cramps (n=50) were conducted to monitor the safety and efficacy of TRPV1 and TRPA1 co-activation. Additionally, a survey-based assessment (n=84) to monitor the duration of cramp relief after dosing was also performed.
Results: TRPV1 and TRPA1 co-activation either by natural TRP activators or FLX-787 led to an increase in cramp free nights/period and improvements in sleep quality and reduction in associated pain. Across studies, muscle cramping was observed throughout the night with slightly higher frequency during the latter portion of the night (6–8 h). Cramp inhibition by TRPV1 and TRPA1 co-activation was most prominent during the first four hours after dosing with noted decreases in cramp frequency during this time. The cramp survey results agreed with these findings with 56% of respondents experiencing relief in the first 4 hours after dosing.

Conclusion: The results suggest that Chemical Neuro Stimulation is effective at increasing the number of cramp free nights which may lead to improved sleep and decreased pain. Chemical Neuro Stimulation may be a useful strategy to improve sleep quality in individuals suffering from cramps and spasticity associated with neurological disease.
Support (If Any): not applicable

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SLEEP DIFFICULTIES IN AUTISM SPECTRUM DISORDER: A META-ANALYSIS

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Introduction: Although not part of the diagnostic criteria for autism spectrum disorder (ASD), sleep difficulties have a high prevalence in this population (45–86% vs. 25–40% in typically developing matched controls, TD). So far, sleep difficulties in individuals with ASD have been mostly assessed via questionnaires completed by caregivers or self-reported in the case of high-functioning (HF-ASD) adults. In contrast, objective measures of sleep (i.e., actigraphy, polysomnography) have been rarely assessed, given the economic and personal costs involved with the procedures. The few direct comparisons of questionnaires and objective measures of sleep in ASD have produced inconsistent evidence. Here, we evaluate whether sleep questionnaires developed for the general population provide trustworthy inferences with respect to sleep difficulties in ASD and do not simply reflect false positive, publication bias, or underpowered studies.
Methods: We performed a systematic review of the literature and we applied to the suitable findings a quantitative technique called p-curve, to evaluate the existence of evidence. To evaluate the strength of such evidence, we also computed Cohen's ds.
Results: We included 9 studies comparing ASD vs. TD individuals by means of validated and standardized sleep questionnaires. P-curve analyses showed significant right skewness (power 97–99%), proving that ASD individuals have more sleep difficulties compared to TD. These sleep problems in ASD emerge as a robust effect (d=0.9), chiefly with respect to reduced sleep duration and parasomnias. Nevertheless, our results do not exclude the possibility that parents tend to over-report these sleep difficulties in children with ASD or that HF-ASD tends to perceive sleep problems as stemming from their awareness of the disorder.
Conclusion: All in all, reliable standardized questionnaires developed for the general population are also suitable to screen sleep difficulties in ASD, and may favor timely access to intervention with positive consequences for individuals' well-being and quality of life.
Support (If Any): N/A

1166

POOR SLEEP IS ASSOCIATED WITH MORNING HIGH SYMPATHETIC ACTIVITY AND LOW PARASYMPATHETIC ACTIVITY IN RESTING NEUROTYPICAL AND AUTISTIC ADULTS

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Introduction: Individuals with autistic spectrum disorder (ASD) display higher sympathetic activity during wakefulness. In typically developing individuals (TD) higher sympathetic activity is observed in the morning compared to evening levels. The main objectives of this study were to compare autonomic nervous system (ANS) activity during wakefulness in the evening and in the morning in a group of adults with ASD and a group of TD adults, as well as to explore the association between ANS activity and self-reported sleep measures.
Methods: The electrocardiogram of 33 adults (16 ASD; 17 TD) was recorded during wakefulness, before and after a night of sleep. The following heart rate variability (HRV) parameters were measured: low (LF) frequencies, high frequencies (HF) and total spectral power. Values were compared between groups using two-way ANOVAs (ASD vs TD) and one repeated measure (Evening vs Morning). Pearson correlations coefficients between self-reported sleep measure and morning HRV parameters were calculated.
Results: Compared to the TD group, the ASD group displayed significantly lower morning HF values (34.98 ± 20.55 vs. 53.35 ± 22.17) and higher LF/HF ratios (1.52 ± 2.22 vs. 3.02 ± 2.28) compared to the TD group. No group differences were observed in the evening. When all participants were pooled together, longer nocturnal awakenings and lower sleep efficiency were correlated with higher sympathetic activity (respectively $r = 0.52$; $p<0.01$ and $r = -0.43$; $p=0.04$) and lower parasympathetic activity (respectively $r= -0.54$; $p<0.01$ and $r = 0.42$; $p = 0.04$) in the morning.
Conclusion: 1) A higher morning sympathovagal balance prevails in ASD compared to TD individuals; 2) This is associated with self-reported markers of poor sleep.
Support (If Any): Canadian Institutes of Health Research and "Fonds de la recherche du Québec en santé".

1167

DO SLEEP DYNAMICS AFFECT COGNITIVE FUNCTION IN PATIENTS WITH MULTIPLE SCLEROSIS?

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Introduction: Cognitive dysfunction is one of the most common and consequential symptoms of multiple sclerosis (MS), but identification of treatment strategies requires a better understanding of underlying causes. Sleep disorders may be important, treatable contributors. However, relationships between cognition in MS and sleep architecture, beyond traditional polysomnographic summaries of sleep-wake stages, have never been explored. Sleep dynamics and in particular, the mean length of uninterrupted bouts of sleep stages, have provided novel insight among patients with other conditions.
Methods: MS patients (n=64) underwent in-laboratory polysomnography and cognitive assessments with the Minimal Assessment of Cognitive Function in MS, a validated battery that assesses processing speed/working memory, learning, executive function, visual-spatial processing, and language function. Sleep stage bout durations (in minutes) were computed based on AASM Scoring (2013–2015) rules.
Results: Average scores for mean stage 1, 2, 3, and R sleep bout lengths were 1.04, 5.37, 3.24 and 9.37 minutes, respectively. In linear regression models adjusted for apnea-hypopnea index and disability level, mean stage 2 sleep bout length was associated with the California Verbal Learning Test-II (CVLT-II) total score, an age- and education-adjusted composite of verbal memory (beta=1.74, p=0.004). Significant associations were noted with mean stage 2 bout length

and both immediate and delayed verbal memory CVLT-II subscores (beta=0.11–0.19, p=0.004–0.03). Mean stage 3 bout length was also associated with delayed verbal memory subscores (beta=0.07–0.14, p=0.075-0.002). Standard sleep stage percentages showed no association with CVLT-II total score, and fewer associations with CVLT-II subscores..

Conclusion: Although associations cannot prove causation, our results suggest that disruptions in sleep stage continuity may impair verbal memory in MS. More broadly, sleep dynamics and other quantitative approaches beyond standard entire-night summaries of sleep stage percentages used in clinical polysomnography could help to explain cognitive dysfunction in MS.

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1168

CHARACTERIZATION OF CHRONIC SLEEP-WAKE DISTURBANCES OCCURRING AFTER MODERATE TO SEVERE TRAUMATIC BRAIN INJURY

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Introduction: Sleep-wake disturbances (SWD) are among the most prevalent and disabling consequences reported after a moderate-to-severe traumatic brain injury (TBI), but remain poorly understood. Our aim was to better characterize post-TBI SWD using a combination of subjective and objective measures. Moreover, we aimed to verify whether specific types of SWD were associated with markers of TBI severity.

Methods: Thirty-five individuals with moderate to severe TBI (24M/11F; aged: 27.6 ± 9.6 years; Glasgow Coma Scale (GSC) score at hospital admission: 8.6 ± 3.3) were evaluated between 1–3 years post-injury. SWD were assessed using questionnaires (e.g. Epworth Sleepiness Scale, Pittsburgh Sleep Quality Index and Fatigue Severity Scale), as well as with a 7-day sleep diary and simultaneous actigraphy. We also used the Beck Depression Inventory and Beck Anxiety Inventory, as mood fluctuations have been associated with SWD in this population. Scores on questionnaires and actigraphy variables (sleep efficiency, total sleep time and number of naps) were entered into a principal component analysis (PCA) to extract non-correlated SWD and mood components. We performed correlations between each of these components and clinical variables representing TBI severity (e.g., duration of post-traumatic amnesia and GCS score).

Results: The rotated PCA produced four non-correlated components, namely 1) Fatigue/Mood fluctuation, 2) Daytime sleepiness, 3) Increased sleep duration and 4) Sleep efficiency, which explained 75% of the variance on questionnaires and actigraphic measures. The component "Fatigue/Mood fluctuation" was positively correlated with more prolonged post-traumatic amnesia ($r=0.44$ $p<0.01$). However, the other three components were not associated with markers of TBI severity.

Conclusion: Our results suggest that SWD after moderate-to-severe TBI are highly heterogeneous, but they can be conceptualized into two wakefulness and two sleep non-correlated components. Interestingly, daytime disturbances were not associated with sleep disturbances, which suggest that the injured brain deregulates wakefulness mechanisms independently of sleep.

Support (If Any):

1169

POST-CONCUSSION SEVERITY IS ASSOCIATED WITH SLEEP PROBLEMS AND NEUROPSYCHOLOGICAL STATUS

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Introduction: Mild traumatic brain injury (mTBI) is often associated with sleep problems. However, little is known about the relationship between sleep problems, post-concussion symptom severity, and common cognitive deficits such as difficulties with verbal fluency when given a category. We investigated whether post-concussive symptom severity was associated with sleep problems and deficits in verbal fluency in a sample of recent concussion survivors.

Methods: 26 adults (11 males; 18–45 years old) with a documented history of mTBI within the preceding 12 months underwent a comprehensive neuropsychological test battery including the Rivermead Post Concussion Symptom Questionnaires (RPCSQ) and the verbal fluency subtest from the Delis-Kaplan Executive Function System (D-KEFS) to assess post-concussive symptom severity and word retrieval skills, respectively. A questionnaire was also administered to collect information about sleep habits, details of brain injury, and demographics.

Results: Post-concussion symptom severity (RPCSQ) was associated with more severe self-reported sleep problems after the injury ($r=.62$, $p=.001$). In particular, symptom severity was associated with greater feelings of drowsiness when trying to concentrate ($r=.65$, $p<.001$), greater sleepiness during the day ($r=.66$, $p<.001$), feeling restless ($r=.42$, $p=.035$), and more frequent awakening throughout the night ($r=.429$, $p=.032$). Higher RPCSQ scores were also correlated with lower category fluency scores ($r=-.415$, $p=.039$). The deficits in category fluency were related to greater sleepiness during the day ($r=-.410$, $p=.037$).

Conclusion: These results suggest that post-concussive symptom severity is directly associated with greater severity of self-perceived sleep difficulties and poorer verbal category fluency. Notably, the sleep problems were also associated with the severity of word retrieval problems, raising the possibility that some cognitive deficits following concussion may be secondary to sleep-related issues. Future work will explore the mediating role of sleep between concussion severity and neuropsychological performance.

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1170

DISRUPTIVE NOCTURNAL BEHAVIOR AND ELEVATED EMG TONE DURING SLEEP IN VETERANS WITH TBI AND PTSD

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Introduction: Sleep disturbances are highly prevalent in traumatic brain injury (TBI) and post-traumatic stress disorder (PTSD), especially in the Veteran population. The term "trauma-associated sleep disorder", or TSD, may represent a new sleep disorder in this population characterized by nightmares, disruptive nocturnal behaviors and REM sleep without atonia (RSWA). The prevalence and characteristic physiology of TSD in Veterans is unknown.

Methods: A large cohort of Veterans (n=670) were enrolled at the time of their clinical in-lab polysomnography. Several questionnaires including the Rivermead Post-concussive Questionnaire (RPQ), PTSD Checklist (PCL-5), and questions about dream enactment and nightmares were administered. Veterans were categorized into TBI, PTSD,

TBI+PTSD, or Neither. Sleep was staged by two individuals blinded to group according to AASM criteria. EMG tone was classified as low (50% below median EMG tone), medium (50 to 80%) or high (EMG values 80% and above) and analyzed within each sleep stage. Group and individual differences were analyzed using chi-square and one-way ANOVA.

Results: A surprisingly high number of Veterans self-reported a high rate of dream enactment and nightmares: 37% TBI, 63% PTSD, 76% TBI+PTSD, 27% controls for dream enactment ($p<0.001$; $X^2=57.9$), and 26% TBI, 78% PTSD, 81% TBI+PTSD, 14% controls for nightmares ($p<0.001$; $X^2=247$). The percentage of epochs classified with high EMG tone during REM sleep was 3.0% in TBI, 5.6% in PTSD, 7.8% in TBI+PTSD, and 4.2% in controls ($p=0.049$; $F_{(3,284)}=2.64$). Veterans with TBI spend significantly more time in N3 sleep ($p=0.087$ & 0.015) than controls and have a trend towards more restless sleep than subjects without TBI ($p=0.085$; $t=-1.72$), as measured by body position transitions. Otherwise, sleep staging did not differ between groups.

Conclusion: Veterans exposed to trauma have a high rate of dream enactment behavior, nightmares, and elevated EMG tone during REM sleep. Further analysis is underway to determine whether EMG data meets clinical criteria for RSWA and REM behavior disorder, which may have important implications for long-term neurodegeneration.

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1171

SHORT-WAVELENGTH LIGHT THERAPY AS A WAY OF IMPROVING SLEEP, COGNITION, AND FUNCTIONAL CONNECTIVITY FOLLOWING A MILD TRAUMATIC BRAIN INJURY

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Introduction: Mild traumatic brain injury (mTBI) has been associated with disruptions in sleep, limbic function, and increases in symptoms related to anxiety as a consequence of the injury. Evidence suggests that there is a relationship between improvements in neurobehavioral impairments and more regulated sleep architecture, but this relationship is not well understood. We hypothesized that among patients recovering from an mTBI, daily morning blue light therapy (BLT) would yield improvement in brain function, as evidenced by greater post-treatment functional connectivity between the medial prefrontal cortex (MPFC) and amygdala, and this would be associated with improvements in sleep and anxiety.

Methods: Twenty-six adults (12 male; M age: 21.6±3.9) with self-reported sleep disturbances subsequent to a documented mTBI within the preceding 18 months were recruited to receive either BLT or a placebo amber light therapy (ALT) for 30-minutes each morning over a six-week period. Participants underwent a six-minute resting state functional magnetic resonance imaging (fMRI) scan at 3T and completed neurocognitive testing at baseline and again at the conclusion of treatment. Regions of interest were placed in the amygdala (bilateral) and MPFC. Functional connectivity was analyzed utilizing the CONN toolbox with SPM12, p<.05, FDR corrected.

Results: BLT was associated with significant increases in functional connectivity between the left amygdala and MPFC, whereas no change was observed for ALT. The increase in connectivity for BLT was associated with significant decreases in sleep onset latency, state anxiety, and perceived invincibility from baseline to post treatment.

Conclusion: A six-week period of BLT produced improvements in sleep onset latency and anxiety that were associated with increased functional connectivity between the left amygdala and MPFC. BLT may provide an effective method for regulating the sleep wake cycle and improving cognition and emotion among individuals recovering from mTBI. Better sleep may serve to strengthen mPFC to amygdala connectivity, thereby improving emotional functioning.

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1172

EFFECT OF BRIGHT LIGHT THERAPY ON BRAIN AND BEHAVIORAL ABNORMALITIES FOLLOWING A MILD TRAUMATIC BRAIN INJURY

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Introduction: Mild traumatic brain injury (mTBI) can lead to alterations in sleep, circadian function, and cognition. Evidence suggests that blue wavelength light can alter circadian timing and fatigue in patients with mTBI, but no studies have examined the structural brain correlates of these effects. Here, we explored the impact of morning bright (amber/blue) light exposure therapy (ALT/BLT) on white matter structure and its neurocognitive correlates.

Methods: 28 mTBI survivors underwent diffusion tensor imaging (DTI) before and after six weeks of either ALT or BLT. 39 healthy-controls (HCs) were used as a normal comparison group. First, for both groups, raw quantitative anisotropy (QA) and normalized QA (NQA) were estimated for 11 regions of interest (ROIs): the dorsal-lateral prefrontal cortex (DLPFC), genu, splenium and body of the corpus callosum (CC), the left/right uncinate fasciculus (UF), the left/right superior longitudinal fasciculus, the left/right anterior corona radiata (ACR) and the thalamus. Finally, impact of light on changes in diffusion parameters of these ROIs was analyzed among those with mTBI.

Results: At baseline, all 11 ROIs had significantly higher QA ($p<0.05$) for mTBI than HCs. There was no significant improvement in NQA for any ROI following ALT. Following BLT, four ROIs (the body of CC, the L/R UF and the left ACR) showed significant decreases in NQA ($p<0.05$). For ALT, pre-post changes in these ROIs were associated with worsening neurocognitive and mood scores, while changes were generally associated with improvements for those in the BLT group, potentially reflecting a positive impact of BLT on brain and behavior.

Conclusion: Compared to ALT, BLT led to improve structural integrity, neurocognition, and mood of mTBI survivors. Given the known role of light in the entrainment of the circadian rhythm, our findings suggest that BLT may be a useful approach for improving circadian function to facilitate brain recovery from concussion.

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1173

FATIGUE AND SLEEP SLOW OSCILLATIONS ARE ASSOCIATED WITH WHITE MATTER INTEGRITY FOLLOWING MODERATE TO SEVERE TRAUMATIC BRAIN INJURY

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Introduction: Chronic sleep-wake disturbances are among the most invalidating and frequently reported symptoms following a traumatic brain injury (TBI), but their pathophysiological mechanisms are still poorly understood. We aimed to explore potential mechanisms by which anatomical damage due to TBI, more specifically white matter damage, can cause the reported symptoms.

Methods: Twenty-three subjects (17M/6F; age: 31 ± 11 years) were tested 23 ± 9 months following a moderate to severe TBI (Glasgow Coma Scale Score at hospital admission: 8.1 ± 2.9); twenty-seven age- and sex-matched healthy controls were also tested. Magnetic resonance imaging (3T) including a diffusion weighted sequence, 1-night polysomnography, and sleep questionnaires (Pittsburgh Sleep Quality Index, Fatigue Severity Scale and Epworth Sleepiness Scale) were used. Voxelwise t-tests and correlations were carried out with FSL, using tract-based spatial statistics and the Randomise tool.
Results: Extensive white matter damage (i.e. increased diffusivity and reduced anisotropy) was observed for most cerebral tracks in TBI subjects compared to controls. TBI subjects also had lower slow wave frequency (F=6.9; p=0.01), longer negative and positive phase durations (F=4.0–8.0; p=0.05-0.007), and reduced slope (F=4.8; p=0.03). In TBI participants, lower white matter integrity was associated with higher slow wave amplitude (r=0.46–0.79; p<0.05), longer positive and negative phase durations (r=0.69, p<0.05; r=0.55–0.67, p<0.05, respectively), as well as with higher subjective fatigue (r=0.06–0.08; p<0.05).
Conclusion: These results suggest that TBI subjects with greater damage in white matter track integrity report more fatigue symptoms and have larger and elongated sleep slow waves. These slow waves may represent a mechanism that compensates for a possible higher mental effort exerted to accomplish tasks during the day. Our results bring new elements to explain the pathophysiology of post-TBI fatigue and sleep disturbances.
Support (If Any): Canadian Institutes of Health Research (CIHR), Fonds de Recherche Santé-Québec (FRSQ)

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SLEEP ARCHITECTURE FOLLOWING TRAUMATIC BRAIN INJURY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Sleep architecture alterations are present soon after traumatic brain injury (TBI), but what remains less clear is whether these alterations persist chronically (long-term) after injury. It is important to identify whether sleep architecture differs after chronic TBI, as sleep may serve as both a marker of recovery and a point of intervention. We sought to address this question using the Meta-analysis of Observational Studies in Epidemiology technique.
Methods: We performed two independent searches (MEDLINE and EMBASE) and identified 5556 potentially relevant studies. Fifteen of these studies assessed sleep with at least one night of PSG in both a TBI and a control group. Statistical analyses were performed using Comprehensive Meta-Analysis software using standard mean differences (SMD). Data were pooled using inverse variance weighting and random effects model.
Results: Overall, the TBI group had significantly more SWS than controls (SMD: .44; CI: .06, .82). There were no significant differences in N1, N2 or REM between TBIs and controls. Injury severity was included as a moderator (comparing mild TBI and moderate-severe TBI to controls). The moderate-severe group had significantly more SWS than controls (SMD: .65; CI: .08, 1.2). On the other hand, the mild TBI group had significantly less REM than controls (SMD = -.38; CI: -.72, -.04). There were no differences in N1 or N2 between groups. The use of an adaptation night was also included as a moderator. The TBI adaptation night group had significantly more N1 (SMD: .57; CI: .34, .79) and more REM than controls (SMD: -.40; CI: -.74, -.06). Lastly, the non-adaptation TBI group had significantly more SWS than controls (SMD: .87; CI: -.26, .61). No differences in N2 were observed.
Conclusion: Post-TBI sleep staging is impacted by injury severity and the use of an adaptation night prior to data collection. These data unify the findings of previous investigations that had found differing sleep staging in chronic TBI. These data also provide guidelines for future work on sleep following chronic TBI.
Support (If Any): NRC Research Associateship Program.

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SLEEP-WAKE CYCLE AND EARLY NEUROLOGICAL RECOVERY AFTER MODERATE TO SEVERE TRAUMATIC BRAIN INJURY

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Introduction: We recently demonstrated that the sleep-wake cycle is severely altered in the acute stage of moderate to severe traumatic brain injuries (TBI). In general, these patients have short sleep and wake bouts dispersed over the 24 h. This study aimed to explore whether early markers of TBI severity predict acute sleep-wake cycle disturbances. Moreover, it aimed to verify the relationship between the sleep-wake cycle and the acute cognitive recovery.
Methods: We included 37 non-sedated patients (age 30 ± 14 yo, 25 males) hospitalized for moderate to severe TBI. We used two severity markers that are available in the first hours following TBI, namely the initial Glasgow Coma Scale (GCS) score and the delay to recover the ability to sustain visual fixation. Once patients had reached medical stability, we used continuous actigraphy to document the sleep-wake cycle, and a consolidated sleep-wake cycle was defined by a daytime activity ratio > 80%. A short neuropsychological assessment was performed in a subsample of 13 patients. Correlation analyses were conducted between sleep-wake variables, TBI severity markers and performance on neuropsychological tests.
Results: Patients had a median GCS score of 7 (range 3–13) and spent 6 ± 6 days without visual fixation in the intensive care unit. Once patient had reached medical stability, they had 5 ± 4 days of non-consolidated sleep-wake cycle. The number of days without sleep-wake cycle consolidation correlated with the initial GCS score (ρ=0.35; p=0.04) and the delay before recovering visual fixation (r=0.45; p<0.01). Moreover, more altered sleep-wake cycle was associated with poorer performance on cognitive screening, episodic memory, language and logical reasoning tests carried before hospital discharge (r varying from -0.5 to -0.7, p<0.05, n=13).
Conclusion: Our results support emerging evidence showing that early markers of TBI severity gathered in the first few hours after TBI can predict acute sleep-wake cycle alterations. The reappearance of consolidated sleep-wake cycle was associated with better cognitive recovery; still the directionality (or bidirectionality) of this relationship needs to be further investigated.
Support (If Any): The research was supported by the Canadian Institutes of Health Research (CIHR) and by the Fonds pour la recherche du Québec, Santé (FRQS)

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FATIGUE RISK MANAGEMENT PROGRAM INCREASES SLEEP AND ALERTNESS IN FIREFIGHTERS

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Introduction: Firefighters work challenging schedules under highly stressful and demanding conditions. Extended-duration (greater than or equal to 24h) work shifts are common. Obtaining adequate sleep and maintaining alertness throughout overnight shifts is challenging. We conducted a station-level, randomized trial of a fatigue risk management program (FRMP) in an urban fire department which included policies designed to maximize sleep opportunities.

Methods: Thirty-four fire stations, including more than 500 firefighters, were paired and one station from each pair randomized to receive the FRMP intervention. Sleep health education and screening for common sleep disorders was provided for firefighters assigned to FRMP fire stations. Additionally, FRMP stations were outfitted with blackout shades for windows in sleep quarters and a policy to permit and encourage napping during the late afternoon, if not required to work, was instituted. Control and FRMP firefighters completed baseline and follow-up surveys approximately one year later.

Results: More than three-quarters of firefighters assigned to a FRMP station reported sleeping in a room where the blackout shades were installed. Whereas 63.5% of firefighters reported that light negatively impacted their sleep on the baseline survey, 81% of those firefighters reported that the blackout shades improved their sleep. Additionally, 79% of firefighters in the FRMP group reported taking advantage of the rest policy.Firefighters in the FRMP group reported significantly improved sleep quality as compared to firefighters in the control group ($p<0.001$). Only 23% of firefighters in the control group reported increasing their sleep duration overall. In the FRMP group, 49% of firefighters reported increased sleep at the fire station. At follow-up, firefighters in the FRMP group reported feeling less sleepy ($p<0.001$). Firefighters in the FRMP group reported that the FRMP was important and helpful and they recommended it to other fire departments.

Conclusion: This project provides evidence for improved sleep associated with a fatigue risk management program. Sleep management approaches that are practical and readily deployable in occupational settings should be rapidly expanded.

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INCREASED RISK OF ADVERSE SAFETY OUTCOMES IN PGY1 RESIDENTS WORKING LONG WORK WEEKS AND ≥16-HOUR SHIFTS

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Introduction: Adverse safety outcomes are associated with extended-duration (≥ 24 hour) shifts worked by resident physicians. In 2011 the Accreditation Council for Graduate Medical Education (ACGME) implemented an 80-hour work week (averaged over 4 weeks) and a 16-hour limit on the number of consecutive hours that resident physicians may be scheduled to work in their first postgraduate year (PGY1). We sought to determine if long work weeks and shifts of 16 hours or greater was associated with adverse safety outcomes in PGY1 resident physicians.

Methods: Graduating medical students who registered for the National Residency Matching Program were invited to participate in a nationwide survey. From July 2014 to May 2016, residents completed online monthly surveys reporting their work hours, shift lengths, near-crashes and percutaneous injuries. We used linear and generalized linear regression models to estimate the risk of adverse safety outcomes associated with work hours (≤80 and >80 hours/week) and number of shifts that were at least 16 hours (16h; none, 1–4, >4). Age, gender, and BMI were controlled as covariates.

Results: 7,345 PGY1 residents completed 46,871 monthly surveys. Compared to those PGY1 residents working ≤80 hours per week with no 16-hour shifts, PGY1 residents working ≤ 80 hours with 1–4 16h shifts had an increased risk of near-crashes (adjusted odds ratio 1.45, 95% CI 1.29–1.61). Residents working ≤ 80 hours with >4 16h shifts had an increased risk of near crashes (1.72, 1.42–2.08). Residents working > 80 hours with 1–4 and > 4 16h shifts had an increased risk of near-crashes (1.89, 1.47–2.42; 2.50, 1.91–3.27) and percutaneous injuries (2.71, 1.79–4.10; 2.49, 1.61–3.86), respectively.

Conclusion: PGY1 resident safety is negatively affected by shifts of 16 or more hours, as well as by working >80 hours per week. The ACGME's current proposal to eliminate the 16-hour consecutive work limit for PGY1 residents could significantly increase the occurrence of adverse safety outcomes in this vulnerable population, and is inconsistent with the ACGME's stated commitment to the well-being of residents.

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PAP THERAPY AND HEALTH CARE UTILIZATION

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Introduction: We sought to determine if treatment for sleep apnea with positive airway pressure (PAP) therapy was associated with reduced healthcare utilization in a large, integrated health system.

Methods: Electronic health records were used to identify participants with sleep apnea and PAP therapy (cases) and those without either (non-cases). Acute care hospital days and dispensed medications supply were compared among cases and non-cases. Negative binomial regression was used to estimate utilization with 95% confidence interval (CI) for five years before to seven years after PAP dispensation or a randomly selected index date in non-cases. Adjustment was made for time-varying comorbidities and mortality after the index date. Analyses were repeated using a propensity score matched cohorts drawn from cases and non-cases.

Results: There were 50,179 patients with sleep apnea and PAP and 249,995 randomly selected non-cases; ta subgroup of 13,271 cases were propensity score matched to an equal number of non-cases. Cases had greater acute care and less medication utilization before the start of PAP compared to non-cases. We observed a 6.2% decline in acute care utilization following PAP dispensation (from 1.077 to 1.011 events/person-year, P&lt0.05). A non-significant 3.1% increase in medication

utilization was observed (from 0.999 to 1.031 medications per day/person-year). Non-cases had no appreciable change in trend over time. The propensity matched group demonstrated similar findings with a 10.2% decline in acute care utilization (P&lt0.05) and a 1.1% increase in medication utilization (P&lt0.05).
Conclusion: PAP therapy for sleep apnea resulted in a clear reduction in the rate of rise in acute healthcare utilization. A smaller increase in utilization was observed for medications. Given the health and cost implications of acute care hospital stays, these findings suggest that PAP reduces morbidity and that cost-conscious payers have little to fear from wider screening of populations for sleep apnea.
Support (If Any): The ResMed Foundation.

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MULTIMODAL AMBULATORY SLEEP DETECTION USING RECURRENT NEURAL NETWORKS
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Introduction: While polysomnography (PSG) is currently the gold standard for sleep-wake scoring, existing PSG technologies are impractical for long-term home use. Meanwhile, semi-automatic scoring from sleep diaries and actigraphy are commonly used in ambulatory sleep studies, but significant effort is required by users to maintain accurate diaries, and for researchers to check their entries for anomalies. There is thus a need for tools to enable accurate long-term evaluation of sleep timing and duration in daily life with less burden on users and researchers. To meet this need, we developed a system that analyzes large-scale physiological and behavioral data collected from smartphones and wearables using deep neural networks, and compared it to actigraphy and sleep diaries.
Methods: We collected 5580 days of multimodal data (3-axis acceleration; skin conductance and skin temperature from a wrist sensor; location and timing of calls, short message service, and screen-on from an Android phone application) from 186 undergraduate students. A deep neural network model (bidirectional long short-term memory recurrent neural networks, commonly used for speech recognition and machine translation) was applied to the collected modalities for sleep/wake classification on each 1-min epoch and for sleep episode on/offset detection. Sleep diaries and actigraphy data were also collected and examined by a human expert who (i) classified every epoch as sleep or wake and (ii) identified sleep episode onset and offset times, as labels for training and testing our model.
Results: The deep learning computer algorithm achieved a best sleep/wake classification accuracy of 96.5%, and sleep episode on/offset detection F1 scores (measuring detection exactness and completeness) of 0.86 and 0.84 with mean errors of 5.0 and 5.5 min respectively, when compared to the labels based on human scored actigraphy with sleep diaries. Among all modalities, a combination of acceleration, skin temperature and time data gave the best overall average performance.
Conclusion: The results indicate that long-term ambulatory sleep/wake records from large populations can be measured unobtrusively and accurately by exploiting the ubiquity of smartphones and wearable sensors and the power of deep learning.
Support (If Any): NIH (R01GM105018/P01AG009975/R01HL114088/R00HL119618/F32DK107146/R21HD086392), NSBRI (HFP02802/HFP00006/HFP04201), Samsung Electronics, and MIT Media Lab Consortium.

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SURVEY OF SLEEP EDUCATION OFFERED BY U.S. NEUROLOGY TRAINING PROGRAMS
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Introduction: Despite prior development of core competencies for sleep education by Dement and colleagues, limited data suggests that there is continued lack of sleep education in U.S. medical residencies. This study updates previously reported 2010 data on the current state of sleep medicine educational resources and training offered by U.S. Neurology residencies. Current amount of sleep medicine education, including physiology, sleep disorders, method of teaching, research opportunities, and number of trainees pursuing an academic career in sleep medicine were assessed.
Methods: Surveys were sent via "Survey Monkey" email link to program directors. The survey tool is based on a previously reported survey (Sleep Education Survey [SES]), which investigated resources available and amount of sleep education offered for Neurology residents. The SES was created by a task force from American Academy of Neurology (AAN) Sleep Section and peer-reviewed by AAN Residency Education subcommittee. Our survey is comprised of 16 questions focusing on sleep education resources available; topics included in survey were determined from review of sleep education curriculum described for other subspecialties.
Results: Forty-five of 134 (33.6%) programs responded. Eighty-three percent (83%) of programs reported having at least one sleep-specialized faculty; 84.8% of programs reported having an institution-affiliated sleep clinic and/or laboratory. Sixty-three percent (63%) of programs reported having sleep medicine fellowship at their institution; 16% of programs reported having a required 1–4 week sleep medicine rotation; and 91.3% of programs reported offering a sleep medicine elective. Forty-one percent (41%) of programs reported having trainees participate in sleep research projects in the last five years, and a third resulted in a publication. Two programs reported having any trainee in the last five years applying for grants in sleep research. Fifty-seven percent (57%) of programs reported recent trainees pursuing a formal sleep medicine fellowship.
Conclusion: This is a follow-up survey providing an analysis of the current state of sleep medicine training in U.S. Neurology residency programs. Both availability of formal sleep medicine rotations and residents choosing a formal sleep medicine fellowship have increased since previous report from 2010.
Support (If Any): Research is supported by a grant from American Sleep Medicine Foundation.

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SURVEY OF SLEEP EDUCATION OFFERED BY U.S. PSYCHIATRY SUBSPECIALTY FELLOWSHIP PROGRAMS
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Introduction: Core competencies for sleep education in U.S. medical schools were developed by Dement and colleagues in 1988 and updated in 2003, however nothing similar exists for US medical residencies or fellowships. Sleep medicine exposure in Child and Geriatric Psychiatry fellowships, which serve populations with prevalent comorbid sleep complaints, has not been well-studied. This study assesses

the degree to which these fellowships provided structured sleep medicine education.

Methods: We conducted an online survey among ACGME Child and Geriatric Psychiatry fellowship programs. The survey was based on the Sleep Education Survey (SES), a peer reviewed, published survey created by the American Academy of Neurology (AAN) Sleep Section. The survey received minor modifications to reflect the respondent group and whether an ACGME sleep medicine fellowship or accredited sleep practice existed at the respondent's institution. The final 17-question survey was emailed via Survey Monkey per previously published methods to each program for a total of 5 requests approximately one month apart between June and November 2016 using ERAS contact information.

Results: Overall, 12 of 56 (21.4%) Geriatric programs and 31 of 129 (24%) Child/Adolescent programs responded. Taken together, 34 (77.3%) reported no sleep-specialized faculty; with 5 (11%) programs having 1 or 2 sleep specialized faculty; 10 (27.7%) reported having no institution-affiliated sleep clinic or lab. One program reported having a required sleep medicine rotation, and thirteen (28.9%) programs reported having a sleep medicine elective available, the majority for 4 weeks (9, 69.2%). Three programs (8.6%) reported no sleep medicine didactics offered, while the majority (77.1%) offered 1–5 hours of didactics; no program reported more than 15 hours of sleep medicine didactics. Lecture format (vs. clinic or case review) was the most common teaching format. Two programs had at least one fellow from the last 5 years participate in sleep-related research, though none reported having fellows from this period apply for grants for sleep-related research.

Conclusion: There is modest exposure to sleep medicine training among fellows specializing in Child or Geriatric Psychiatry.

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WORK HOUR POLICIES ARE ASSOCIATED WITH MEDICAL RESIDENT SLEEP, HEALTH AND WELLNESS

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Introduction: Little is known about how policies enacted in 2011 by the Accreditation Council for Graduate Medical Education (ACGME), which limited the number of extended-duration shifts for first-year medical residents, have affected the lifestyle of resident physicians in the United States. We sought to test whether measures of sleep, health, and wellness changed for first-year residents following implementation of these guidelines.

Methods: Graduating medical students were invited to participate in the completion of online monthly surveys to provide data on work hours, safety, and health outcomes. The extended duration shift cohort includes data from residents who completed monthly surveys from 2002–2007. Responses from the extended duration cohort were compared to data from our current 16-hour shift cohort, which has collected data from 2014-present. We tested for differences using generalized linear models.

Results: Monthly surveys were prospectively completed by 6,059 first-year resident physicians from 2002–2007 (40,227 resident-months) and 7,345 (46,871 resident-months) from July 2014-May 2016. Average weekly work hours decreased from 74.1 (95% CI 73.8-71.4) to 60.8 hours (60.5–61.0). Nightly hours of sleep increased from 6.59 (6.57–6.61) to 6.80 (6.78–6.82) hours per night on average. Despite this increase, the proportion of respondents obtaining sufficient sleep to feel rested is slightly lower, with sufficient sleep reported for 22.5% of person-months (SD 0.4) in the extended duration shift cohort and 20.1% (SD 0.4) in the 16-hour shift cohort. There has been a 25% reduction in days per month with a respiratory illness (2.2 (2.1–2.2) vs. 1.6 (1.6–1.7)). The 16-hour shift cohort has reported 2.4 (2.3–2.4) weekly hours of exercise on average, an increase of 20 minutes compared to the extended duration cohort (2.1 (2.0–2.1), and they are significantly more likely to meet the CDC recommendation of 2.5 hours of physical activity weekly (OR 1.32; 1.25–1.40).

Conclusion: The 2011 ACGME work hour policy was followed by improved sleep, health, and health behaviors among resident physicians. These findings highlight the importance of work hour limitations to resident well-being.

Support (If Any): National Institute for Occupational Safety and Health R01OH07567 and R01OH010300; National Heart, Lung and Blood Institute U01 HL111478, 5T32HL007901, and 1F32HL134249.

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WORK HOUR POLICIES ARE ASSOCIATED WITH IMPROVED SAFETY AMONG MEDICAL RESIDENTS

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Introduction: In 2011, the Accreditation Council for Graduate Medical Education instituted a 16-hour limit on the number of consecutive hours that resident physicians may be scheduled to work in their first postgraduate year. We sought to examine the effect of these work hour limitations on resident safety, patient safety, and resident education.

Methods: Graduating medical students were invited by email to participate in a prospective cohort study. Participants were asked to complete monthly surveys for the duration of their medical residency. Cohorts were active from 2002–2007 and 2014-present. Work hours, including the number of extended duration shifts, safety outcomes, including motor vehicle crashes and medical errors, and educational outcomes, including nodding off during lectures were reported. The incidence of each outcome was compared between the extended duration shift cohort and the ongoing, 16-hour cohort. Hypotheses were tested using generalized linear models.

Results: Monthly surveys were prospectively completed by 6,059 first-year resident physicians from 2002–2007 (40,227 resident-months) and 7,345 (46,871 resident-months) from July 2014-May 2016. Comparing the extended duration shift cohort to the 16-hour shift cohort, the mean number of extended duration shifts per month decreased from 3.79 to 0.25. The risk of a motor vehicle crash decreased 25% (RR 0.75; 0.67–0.83), while the rate of near-crash events decreased 40% (IRR 0.60; 0.56–0.64). The risk of percutaneous injury decreased 77% (RR 0.23; 0.21–0.25). The rate of self-reported medical errors decreased 13% (IRR 0.87; 0.79–0.95), while the subset of errors attributed to fatigue decreased 15% (IRR 0.85; 0.77–0.93). Falling asleep in lecture decreased by 14% (IRR 0.86; 0.82–0.91).

Conclusion: Resident safety, patient safety and resident education improved for resident physicians after implementation of the 2011

duty hour standards. The significant improvements in safety and education outcomes are important, particularly in light of forthcoming policy changes that will abolish extended duration shift restrictions.
Support (If Any): National Institute for Occupational Safety and Health R01OH07567 and R01OH010300; National Heart, Lung and Blood Institute U01 HL111478, 5T32HL007901, and 1F32HL134249.

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PAGING ACTIVITY AND SLEEP DISRUPTIONS FOR MEDICAL RESIDENTS DURING OVERNIGHT SHIFTS

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Introduction: With resident fatigue associated with unsafe patient care, concern regarding insufficient sleep in residents has increased. In 2003, the Accreditation Council for Graduate Medical Education (ACGME) implemented new standards limiting hospital overnight shifts to no more than 6 consecutive nights. However, lack of protected sleep time during overnight shifts continues to be a concern, and resident sleep time is often interrupted by multiple pages of varying urgency. Measures targeting napping, increased sleep duration, and sleep hygiene are paramount to attaining optimal levels of alertness in on-call residents. The current project was designed as a Quality Improvement (QI) Project to assess sleep patterns of night-shift residents via actigraphy and paging frequency via digital data logs. We then aimed to use these data to develop interventions to reduce identified sleep disruptions in an effort to improve the quality of patient care and resident well-being.
Methods: Pediatric residents on inpatient oncology rotations were asked to wear an actigraph during overnight shifts to measure sleep efficiency and duration. Frequency data for each resident's pager were collected, and residents completed a qualitative diary describing the perceived urgency of the pages received during their shift.
Results: Nine residents were followed for a total of 37 overnight shifts. The average number of pages received per night per resident was 49.31 ± 9.53; range=38 - 59. Actigraph data revealed that residents slept an average of 124.14 ± 55.25 minutes total per shift (range=73.8 - 179.4 minutes).
Conclusion: Baseline data of this QI Project reveal that residents are experiencing sleep interruption approximately 50 times per night, allowing for approximately 2 hours of non-consecutive sleep throughout their shift. These data, in conjunction with the residents' qualitative perceptions of page content, will be used to inform an intervention to optimize paging that allows for more prolonged protected sleep time.
Support (If Any):

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ON-CALL AND SLEEP HABITS OF U.S. MIDWIVES: TOWARDS A POSITION STATEMENT ON ADEQUATE SLEEP

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Introduction: Many industries provide parameters for protected sleep time after extended hours of wakefulness, but little is known about the on-call and sleep habits of U.S. certified nurse-midwives. American College of Nurse-Midwives (ACNM) convened an ad hoc Sleep Task Force to write a position statement on adequate sleep parameters for its members. To strengthen the statement, a national survey was developed and distributed to members.
Methods: An online survey was constructed and validated by 15 nurse-midwifery educators and researchers consisting of 39 questions related to work schedules, on-call, sleep time, "near misses", and driving drowsy. The survey was sent to 4,358 members. IRB approval was obtained.
Results: Of 726 respondents (16.6%), the majority were female (98.5%), Caucasian (92.4%) and between 25 and 76 years (M=50, SD=11.67). The majority attended clinic hours prior to (76.4%) and following (52%) a night call shift. Most births (85%) were attended in hospitals. Many respondents reported no hospital policy for protected sleep time (88.7%) and only 4.9% had the dangers of sleep deprivation discussed during their educational programs. 30.6% were on call an average of 25 or more hours. Most had access to a call room (90.7%) and slept or napped while on call (96.9%). 48.4% reported sleeping prior to driving after a busy call shift. 73.8% felt too drowsy to drive after working, but 65% drove anyway. 28% had fallen asleep driving resulting in 3.8% accidents. Sleepiness resulted in self-reported clinical errors (23.6%) and "near misses" (39.4%). The majority (71%) of midwives who reported limiting or leaving practice did so in part due to fatigue or sleep loss.
Conclusion: Midwives work extended duty hours and report somnolence with related errors/risk/accidents. Midwife means "with woman" which has long been interpreted to remain in support of a woman in labor despite extended provider wake time that carries attendant adverse workforce implications. New graduates require adequate preparation for the rigors of rotating and extended shift work. An ACNM position statement may effect culture change that includes protected sleep time and increases awareness of adequate sleep recommendations.
Support (If Any): Access to ACNM membership email list was granted.

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HEALTH INSURANCE STATUS IN SUBJECTS WITH SLEEP DISORDERED BREATHING

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Introduction: Study Objective: To evaluate health insurance status in subjects with sleep disordered breathing.
Methods: Design: Cross-sectional.
Setting: Population-based research.
Participants: Nationally representative sample of 2005–2006 and 2007–2008 National Health and Nutrition Examination Survey participants (n= 11,329 adults).
Intervention: None.
Results: A total of 11,329 subjects, who after weighting, were representative of 175,247,251 U.S. non-institutionalized population. Obstructive sleep apnea (OSA) risk score was calculated by using the modified STOP-Bang questionnaire. This score consisted of 7 variables excluding neck circumference since NHANES physical examination did not include this measurement. The estimated range for OSA risk score was from 0 to 7. Subjects who scored ≤3 were classified as low risk OSA group, and >3 as high risk OSA group. There were 83.4% subjects in low risk OSA and 16.6% in high risk OSA. Subjects in low risk group were younger compared to high risk group (mean age 42.7 years SE 0.45 vs. 57.3 years SE 0.57, p value <0.0005). There were 44.8% males in low risk OSA group compared to 71.4% males in high risk OSA group. Body

mass index was significantly higher in subjects in high risk OSA group compared to low risk OSA group (mean 33.4 kg/m2 SE 0.25 vs. 27.4 kg/m2 SE 0.12, p-value <0.001). 18.9% of all subjects were not covered by health insurance. 20.3% of subjects in low risk OSA group and 12% of high risk group were without health insurance. Of the subjects with health insurance 65.6% had private insurance. Medicare and Medicaid covered 15.2% and 4.7% of total subjects respectively.

Conclusion: Undiagnosed OSA is a major health problem. A significant percentage of subjects with sleep disordered breathing are without health insurance. Understanding of factors contributing to access to health care is important for timely diagnosis and treatment of sleep apnea.

Support (If Any): CDC for NHANES Data.

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RACIAL AND ETHNIC PARTICIPATION IN OBSTRUCTIVE SLEEP APNEA AND INSOMNIA CLINICAL TRIALS

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Introduction: Obstructive sleep apnea (OSA) and insomnia are two of the most common sleep disorders worldwide. Both conditions are associated with detrimental health consequences. Participation in clinical trials remains essential in understanding screening, diagnosing and treatment. However, the extent to which minority populations are represented in clinical trials that focus on sleep disorders is not yet known.

Methods: We queried the Clinicaltrials.gov website, the registry that includes trials conducted in the U.S. and globally to characterize trials (observational and interventional) that focused on OSA and insomnia. All registered trials conducted from 2000 to November 28, 2016 were included.

Results: Of the 230,894 trials registered in Clinicaltrials.gov, 826 trials were related to sleep disorders. Of the sleep disorders trials, 34% included drugs, 28% included a device, and 20% were behavioral. Half of the trials were completed (54%) and less than 10% were active, but not yet recruiting or recruiting by invitation only. Eighty percent of the trials were treatment related. Of the 826 sleep trials, 21% reported results, and 12% reported information on race/ethnicity enrollment. Overall, 7,321 of participants in these studies were white followed by 1,461 black, 624 Asian, 551 Hispanic, and 283 'other or unknown'.

Conclusion: These results suggest that the number of minority populations in sleep disorders trials are relatively low, specifically compared to the number of trials reported overall. OSA and insomnia treatments are efficacious and effective in the general population. However, the extent to which treatments are effective and utilized by minority populations is not clear; this may in part be related to limited participation in clinical trials. Without appropriate representation in clinical trials, it is difficult to assess which screening, diagnostic, and treatment options work best for minorities, and which factors may influence uptake of treatment. Failure to address this issue may contribute to the increasing disparities in sleep health.

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INSURANCE RESTRICTIONS ON POLYSOMNOGRAPHY: COMPARISON WITH AASM GUIDELINES AND ECONOMIC IMPLICATIONS

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Introduction: Many insurers in the United States have restricted coverage for laboratory polysomnography in favor of at-home pathways. Although cost-savings are an assumed benefit of this paradigm shift, economic models that consider chronic time horizons and other important features do not support this assumption. Furthermore, third-party prior authorization entities utilize medical necessity requirements that may not align with American Academy of Sleep Medicine practice standards.

Methods: We reviewed published regulations regarding polysomnography (diagnostic and titration procedures), and manually curated the documents to compare indications and exclusions for at-home diagnostic kits and at-home auto-titrations with clinical practice standards of the Academy. We performed economic modeling in TreeAge that combines factors typically considered in isolation: obstructive sleep apnea, complex apnea, periodic limb movements of sleep, and co-morbid insomnia.

Results: None of the reviewed insurance regulations matched all components of the published standards of the Academy, although most advertised their content as evidence-based. For at-home diagnostic kits, the most common points of divergence between Academy standards and insurer regulations involved the requirement of high pre-test probability of at least moderate obstructive sleep apnea, the exclusion of home testing if co-morbid insomnia is present, and the suspicion of periodic limb movements of sleep requiring in-lab evaluation. Some insurance regulations included impossible-to-meet criteria to authorize in-lab testing (e.g., approving an in-lab test for central apnea or periodic limb movements only if they were already objectively documented, which would have required in-lab testing). We present an economic analysis that incorporates uncertainty regarding the presence of exclusions such as central apnea or periodic limb movements, and the impact of co-morbid insomnia, using a range of prevalence to capture both published epidemiology studies and include the higher prevalence that may occur in academic referral centers.

Conclusion: Divergence between insurance regulations and Academy standards are common among private payers. Failure to account for the limitations of at-home pathways is predicted to negatively impact patient care in terms of quality of life and resource utilization. Balancing the perspectives of payers, patients, and providers is necessary to preserve optimal patient care.

Support (If Any): American Sleep Medicine Foundation

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QUALITATIVE ANALYSIS COMPARED WITH NATURAL LANGUAGE PROCESSING OF A PATIENT FORUM FOR IDENTIFYING PATIENT CENTERED OUTCOMES IN SLEEP APNEA

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Introduction: Clinicians often rely on their personal interactions with selected groups of patients to formulate their view of patient interests.

Online forums provide a space for larger numbers of patients to express themselves and could be used by researchers to identify patient centered outcomes. The Sleep Apnea Patient Centered Outcomes Network has a forum page embedded in its MyApnea website (www.MyApnea.Org). Our aims were to: 1) Ascertain the main areas of interest for patients with sleep apnea by analyzing an online patient forum, and 2) Compare qualitative analysis methods with automated natural language processing for the identification of topics from forum entries.

Methods: The text from the MyApnea forum, collected from October 2014 until May 2016, was analyzed using two methods: conventional qualitative analysis, and topic modelling using automated Natural Language Processing. Ten key topics from the text were identified by each method.

Results: The MyApnea forum comprised of 2263 entries in 253 discussion threads, contributed by 474 members. 180 concepts were identified and organized using a coding system. Using the text based qualitative analysis the most frequently discussed concepts were 1) A negative response to CPAP treatment 2) A positive response to CPAP treatment 3) CPAP mask choices 4) The role of sleep forums 5) Acclimatization to CPAP 6) The need for persistence and commitment to therapy 7) CPAP downloads to assist in self-management 8) Dry mouth as a side effect of CPAP 9) Customer service - including experiences with home care companies 10) Delays in diagnosis. The ten major topics identified using natural language processing were: 1) The use of sleep study data to guide therapy 2) Online communities sharing information 3) Advocating for oneself 4) Sleep apnea symptoms 5) Diagnostic delay 6) Troubleshooting comfort issues 7) Beginning therapy 8) Interacting with the research community 9) Troubleshooting technical issues 10) Treatment option comparisons

Conclusion: Traditional qualitative methods produced similar results to natural language processing in the analysis of a patient sleep apnea forum. Both techniques identify the frequency of patient interest in treatment responses, side-effects, self-management and in providing support to one another.

Support (If Any): None

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OLDER ADULTS' PREFERENCES FOR OBSTRUCTIVE SLEEP APNEA TREATMENT ELICITED FROM A PILOT DISCRETE CHOICE EXPERIMENT

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Introduction: Older adults' preferences for aspects of obstructive sleep apnea (OSA) treatments have not been elicited. Discrete choice experiments (DCE) estimate preferences based on economic theory that value is derived from a combination of characteristics or attributes of the goods. We used DCE to elicit OSA treatment preferences and estimate relative weights for treatment attributes.

Methods: Participants recruited from an academic and a Veterans Affairs medical center were provided 9 treatment scenarios for newly-diagnosed OSA. For each scenario, they compared three options: 2 unlabeled treatment options, which had varying attribute (long-term benefits, short-term benefits, major side effects, and minor side effects) values across the 9 scenarios, and 1 "no treatment" option, which had constant attribute values. Participants selected their preferred option for each scenario. The experiment was repeated two weeks later to estimate test-retest reliability. A multilevel mixed-effects logistic regression model estimated preference weights, and a mixed effects linear regression model with an interaction term assessed differences in the attributes between sessions.

Results: 30 individuals (mean age 71 years [range 65–91]; 27 [90%] had OSA) participated. Treatment selection patterns revealed that participants weighted long-term benefits as most important (odds ratio [OR] 2.41, p<.001). Preference weights for other attributes were: short-term benefits (OR 1.41, p<.001), major side effects (1.38, p<.011), and minor side effects (OR 1.37, p<.001). No differences in preferences were found between the two sessions (all p-values > .120).

Conclusion: Older adults weighted long-term benefits most strongly and minor side effects least strongly. These results have implications for patient education material aimed at improving acceptance and adherence to OSA therapy among older adults. We also demonstrated that it is feasible to use DCE to elicit individual preferences among older adults. This method could be used to personalize treatment decisions related to OSA.

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1191

ADHERENCE TO CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)THERAPY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA (OSA)ACCESSING MEDICAL CARE AT MULTIPLE CENTERS IN KERALA STATE OF INDIA

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Introduction: Adherence to Continuous Positive Airway Pressure (CPAP) therapy in patients with Obstructive Sleep Apnea (OSA)is a problem which affects most resource constrained nations. The primary reasons for non-adherence to CPAP therapy are economic, ergonomic and socio-cultural. Kerala, a southern Indian state, has achieved remarkable success in healthcare and socio-economic development in the last few decades. The study was done with an objective to find out the level of adherence to CPAP and the reasons for non-adherence in the state of Kerala

Methods: The study was done on patients who were diagnosed to have moderate to severe OSA on sleep study at three specialist pulmonary centers in Kerala. All of them had undergone CPAP titration and a free three day trial with an appropriate CPAP machine. At the end of the trial, they were asked to buy a CPAP machine for personal use. The investigators contacted these patients over telephone in the months of October-November 2016, and they were included into the study after obtaining an informed consent.

Results: Out of the total 68 participants in the study, only 14(20.5%) had bought a CPAP. Of the people who bought the CPAP, only 10(71.4%) were using it for more than 4 hours a day while 2(14.2%) were not using it at all. Of the 54 participants who did not buy CPAP, 30(55.5%) said cost of the equipment was the primary factor for non-adherence while 20(37%) said they found it uncomfortable during the trial period.

Conclusion: Even though CPAP has been introduced as the treatment of choice for moderate to severe OSA, the adherence rates are low in resource constrained settings. High costs were cited as the primary reason for non-adherence by majority of participants. This shows the

need for cost-effective equipment and calls for increased awareness about CPAP.
Support (If Any): None

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ADAPTATION OF A BRIEF MOTIVATIONAL ENHANCEMENT EDUCATION PROGRAM DURING CPAP INITIATION TO AN ACADEMIC PUBLIC SLEEP CLINIC

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Introduction: A brief motivational enhancement education program (BMEEP) developed in Hong Kong is a pragmatic intervention that may improve CPAP adherence (Lai, CHEST 2014). We adapted BMEEP to a Los Angeles County public sleep clinic (BMEEP-LA) and evaluated implementation and effectiveness. Our hypotheses: 1) Patient and staff acceptance of BMEEP-LA would be high; 2) Patients who received BMEEP-LA would achieve greater CPAP adherence compared to usual care.
Methods: BMEEP-LA was adapted to accommodate staffing, appointment availability, workflow and language/cultural factors, while maintaining core features of video education, motivation interviewing and negative message framing. BMEEP-LA encounters were provided by a Sleep NP-specialist trained in motivational interviewing. During 3/15/2016 - 7/15/2016, 78 newly-diagnosed patients completed BMEEP-LA. Acceptance was evaluated qualitatively by semi-structured patient and staff interviews. Electronic CPAP adherence data at 1 and 3 months were collected and compared to: 1) a case-matched control group that received usual care during 1/1/2014 - 12/31/2015 (informal education during CPAP set-up); and 2) published data from the BMEEP trial. Comparisons among groups were tested by student's t-test and binomial approximation.
Results: The BMEEP-LA and control groups were equivalent by age, gender, racial/ethnic, BMI, Epworth score, subjective sleepiness and AHI. Compared to the BMEEP trial, BMEEP-LA had similar age and AHI ranges, but lower proportion of men (50% vs 84%), dissimilar racial/ethnic composition (70% Hispanics/0% Chinese vs 100% Chinese) and higher mean BMI (37.4 vs 28.6). Interviews with patients and staff indicated high acceptance of BMEEP-LA. Adherence indicators were similar to the BMEEP trial at 1 and 3 months. Compared to controls, BMEEP-LA adherence indicators were similar at 1 month, but higher at 3 months (82 +/- 23% vs 66 +/- 33% days used (p=0.003), 4hr 47min vs 3 hr 36 min daily use (p=0.003), 63 +/- 23 vs 49 +/- 33% days with >4 hr use (p=0.016), and 36 vs 23% patients with >70% days of >4hr use (p=0.072)).
Conclusion: Despite having been developed for Chinese patients, BMEEP was successfully adopted in a Los Angeles County sleep clinic with disparate demographic/social-cultural characteristics and engendered long-term CPAP adherence improvement over usual care.
Support (If Any): none

1193

ROLE OF ACCESS TO CARE AND REGIONAL MORTALITY AMONG THOSE WITH DIAGNOSED SLEEP DISORDERS AFTER STATE MEDICAID EXPANSIONS

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Introduction: State Medicaid expansions to cover uninsured at-need adults have been shown to reduced mortality. We explored the relationship between regional variation in mortality rates among US states for all-causes of death among patient diagnosed with sleep disorders (ICD10:G47).
Methods: We analyzed de-identified data derived U.S. state level population mortality rates per 100,000 (2013–2015) from the National Center for Health Statistics publicly available databases and Medicaid Expansion, which was retrieved from the Kaiser Family Foundation Status of State Action on the Medicaid Expansion Decision Database as of October 14, 2016. Descriptive and bivariate analysis were used to explore the data. A repeated measures ANOVA was performed to test for between and within group differences in crude rate age-adjusted mortality between states enrolled in Medicaid Expansion and states not enrolled in Medicaid Expansion.
Results: There were 2,881 total deaths among patients with sleep disorders. Crude mortality varied among states and ranged from 0.2% in California to 0.8% in Oregon. Three expansion states, Ohio (Δ 0.30), Colorado (Δ 0.20), Michigan (Δ 0.20), had the greatest reduction in crude death rate compared to non-expansion states. Considerable reduction in all-cause mortality among those diagnosed with sleep disorders was noticed between Medicaid expansion and non-expansion states in the 3-year time period with most significant reductions in 2014 (0.53 vs 0.44; p<0.0001). The effect was present even after adjusting for various confounders such as male sex, black race, high school education and income (F=5343; p<0.0001).
Conclusion: In this analysis (2013–2015), US state-level mortality rates were significantly related to Medicaid expansion. These nationally representative findings provide novel insights into regional disparities and the role of access to care in patients with sleep related mortalities.
Support (If Any): This work was supported by a demonstration project from the US Children's Bureau Child Welfare/TANF Collaboration in Kinship Navigation Program Grant #: HHS-2012- ACF-ACYF-CF-0510 (90CF0050). CHI CW/TANF Kinship Interdisciplinary Navigation Technologically-Advanced Model (KIN-Tech), Juvenile Welfare Board of Pinellas County, Children's Board of Hillsborough County, and the United Way of Tampa Bay.

1194

A SLEEP NAVIGATOR AND TECHNOLOGY ENHANCE CARE FOR TRANSITIONING MILITARY MEMBERS

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Introduction: It is well-documented that demand for sleep medicine services far exceeds the available supply of sleep specialty providers in the military. Indeed, senior leadership in both the Veteran's Affairs (VA) and Department of Defense (DoD) Health Systems have identified increasing access to sleep health care, while maintaining the highest quality patient-centered care, as vital systems-level priorities. The consequences of this provider shortage are especially salient when military service men and women begin the transition away from active duty to veteran status. Time-sensitive sleep evaluation is frequently required and this process is complicated by several factors. To overcome these barriers, we developed a novel sleep navigator system to leverage technology, facilitate efficient communication, and enhance coordination of care between our sleep center in a military treatment facility and VA/DoD joint process of integrated disability evaluation system (IDES).
Methods: This was a performance improvement project in a single AASM-accredited sleep center. Primary outcomes included time to

treatment (including time from referral to consultation; from consultation to sleep study; and from sleep study to treatment initiation). Since inception, 50 high-priority IDES/MEB patients have been guided through the sleep navigator system. Results were compared to historical performance indicators using appropriate parametric (t-test) and non-parametric (Chi-Square) statistics based on item distributions.
Results: Compared to historical performance, the adoption of the sleep navigator program was associated with reduced times to consultation, to sleep study, and to treatment initiation. Please note that although all data has been collected and preliminary analyses conducted, results of final statistical analyses will be submitted for final abstract publication and presented at SLEEP 2017.
Conclusion: The development of this novel sleep navigator system has facilitated efficient communication between VA and DoD providers, and enhanced coordination of care. By leveraging technology we have been able to overcome systems-level barriers between different organizations that share a common mission. The sleep navigator system has optimized the delivery of timely, high-quality sleep medicine care to our service members.
Support (If Any): NA

1195

PREDICTORS OF GOOD SLEEP PRACTICES IN U.S. ARMY PHYSICIANS ARMY PHYSICIANS

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Introduction: In 2015, the Army Surgeon General implemented the Performance Triad (P3), an educational initiative to improve health-related behaviors of soldiers throughout the U.S. Army. The components of P3 are Sleep, Activity, and Nutrition with tenet behaviors for each component. This study reports the results of the U.S. Army Medical Corps survey regarding physician knowledge and adherence to the tenet behaviors of P3.
Methods: An anonymous survey of all active duty Army physicians assessed demographic information, work hours, and knowledge of and adherence to P3. The survey's sleep related questions were: "Do you obtain 8 hours of sleep per day?" and "Do you avoid caffeine for 6 hours before bedtime?" Four response options ranged from "Always" to "Never." A positive response was defined as answering frequently or always. The responses were analyzed by comparison of several physician categories utilizing descriptive statistics and multivariable analysis.
Results: Surveys were completed by 1,003 of approximately 4,500 U.S. Army physicians. 79.1% of the respondents were male. Staff physicians made up 834 (83.6%) of the respondents compared to 164 (16.4%) physicians in training. Reported work hours were significantly higher in physicians in training compared to staff physicians ($p<0.001$). 28.4% of staff reported a positive response to obtaining at least 8 hours of sleep per night, compared to 12.7% of residents/fellows. In multivariable analyses, better sleep was associated with being a staff physician [Odds Ratio 2.5 (95% Confidence Interval 1.47–4.33)], working fewer hours per week [1.78(1.39–2.27)], and believing that supervisors adhered to all components of P3 [2.04(1.59–2.56)]. Avoiding caffeine 6 hours before sleep was associated with being a staff physician [Odds Ratio 1.54 (1.00–2.36)], working fewer hours per week [1.35(1.09–1.67)], and having a positive opinion of the P3 as a core mission [1.22(1.04–1.21)].
Conclusion: Overall, a minority of U.S. Army physicians obtain at least 8 hours of sleep per night, with physicians in training being much less likely to get adequate sleep compared to staff physicians. Importantly, belief in supervisor adherence to P3 was associated with better sleep, suggesting that physician leadership has a positive effect on wellness behaviors.
Support (If Any):

1196

THE NOVEL APPROACH TO ASSESSING SLEEP QUALITY, ARCHITECTURE, DEPRIVATION AND FATIGUE IN LEVEL I TRAUMA SURGEONS

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Introduction: We hypothesize that the use of wrist-worn actimetry, supplemented with a subjective Karolinska Sleepiness Scale (KSS), allows for feasible assessment of sleep and wake parameters and identifies periods of previously unrecognized fatigue.
Methods: IRB-approved prospective cohort study conducted on four trauma surgeons following consent. Sleep and activity patterns were monitored by actigraphy, pre and post call shift fatigue assessed by KSS questionnaire.
Results: Sleep architecture, sleep duration (hours), duration of continuous wakefulness, sleep score and recovery patterns varied between the four trauma surgeons. Surgeon 1: Sleep: N=29, Mean 6.7, SD 2.92, min,max: 0, 11.6 Awake: N=26, Mean 17.6, SD 6.57, min,max: 10.8, 37.8 Sleep quality gradually increased peaking at day 5. Highest sleep duration post call day 1. Lowest sleep duration post call day 3. Surgeon 2: Sleep: N=26, Mean 6.5, SD 2.50, min,max: 1.8, 9.7 Awake: N=23, Mean 16.7, SD 3.24, min, max: 11.1, 22.95
Sleep quality gradually increases peaking at days 4 and 5. Highest sleep duration post call day 1. Lowest sleep duration post call day 3.
Surgeon 3:
Sleep: N=25, Mean 6.7, SD 1.27, min, max: 4.8,9.0
Awake: N=24, Mean 16.9, SD 2.06, min, max: 11.3, 20.6
Highest sleep quality and corresponding highest sleep duration post call days 1, 3, and 5 with highest on day 5. Lowest sleep quality and corresponding lowest sleep duration post call days 2 and 4.
Surgeon 4:
Sleep: N=11, Mean 7.2, SD 1.47, min, max: 4.6, 9.7
Awake: N=11, Mean 16.1, SD 2.10, min,max: 13.4, 20.2
Lowest sleep quality and lowest sleep duration post call day 3.
Conclusion: Actimetry provides an objective assessment of sleep architecture with potential for targeted, data driven interventions. Further analysis of the data via existing biomathematical models may provide additional insight into surgeon fatigue. Per the Dawson fatigue model, all four surgeons experienced a cognitive psychomotor decline equivalent to the performance impairment observed at a blood alcohol concentration of 0.05% Further intervention may include implementation of a Fatigue Risk Management System into the hospital structure, identification of optimal sleep-wake patterns, and individualization of management specific to each trauma surgeon's recovery pattern.
Support (If Any):

1197

MOBILE PHONE INTERVENTIONS FOR SLEEP DISORDERS: A SYSTEMATIC REVIEW

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Introduction: Sleep disorders and poor sleep quality and quantity are considerable issues in public health. Although various mobile health technologies have proliferated to improve sleep disorders, the

scientific evidence and effectiveness remain unclear. The purpose of our study is to review current research trends in mobile technology interventions for sleep disorders and the scientific evidence of its effectiveness.
Methods: Four electronic databases (CINAHL, PubMed/ Medline, Scopus (EBSCO), and Web of Science) were searched for articles published between January 2001 and December 2015. Studies were eligible for inclusion if they met the following criteria: adequate details on study design, focus on sleep intervention research, sleep index measurement outcome provided, and publication in peer-reviewed journals.
Results: Nine eligible studies were evaluated to examine the impact of mobile phone interventions on sleep disorders. These included one case study, two pre/posttest studies, and six randomized control trials (RCTs). The studies were categorized as mobile 'traditional intervention augmented with mobile phones' or 'smartphone application (Apps) intervention'. For outcome measurement tools, PSQI was most frequently used (n=5). All nine studies concluded that mobile phone interventions have the capability to attenuate sleep disorders.
Conclusion: We found evidence to support the use of mobile phone interventions to address sleep disorders, suggesting support for future intervention efforts.
Support (If Any): This work was partially supported by funds from the Department of Kinesiology and Community Health at the University of Illinois at Urbana-Champaign.

1198

IS TOTAL SLEEP TIME ASSOCIATED WITH APP BEHAVIORAL CONSTRUCT SCORE?

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Introduction: Little is known about how well sleep apps are grounded in behavioral theory. Additionally, limited research exists on whether apps that reflect behavioral constructs influence sleep behavior.
Methods: A validated instrument was used to assign a behavioral construct score to a commercially available sleep app. The score was based on features of the app that encouraged realistic goal setting, self-monitoring, and other behavioral constructs related to sleep behavior. Data from approximately 4000 users across 32 countries were made available to analyze total daily sleep time. However, users without 5 days of sleep data, and less than 5 users per country were eliminated for a final sample of 213 users and 4600 unique daily entries on wake and sleep times.
Results: The sleep app was assigned a behavioral construct score of 40 out of 100 possible points. The final sample consisted of users from 10 countries: Australia, Belarus, Canada, France, Germany, Great Britain, Russia, Spain, Ukraine, and the United States. The average sleep time across all countries was 6.9 hours (95% CI, 3.5, 10.9), and users in four countries reported less than the recommended 7 hours of sleep per night. Users in France reported the least amount of sleep (6.02 hours, 95% CI, 4.3, 8.2) while users in Belarus reported the most sleep (7.3 hours, 95% CI, 6.3, 8.3).
Conclusion: Sleep apps with low behavioral construct scores may not encourage healthy sleep behaviors. However, additional comparisons with high scoring apps are needed to determine whether integrating behavioral constructs in sleep apps influence sleep time among adults.
Support (If Any): This work was supported by research funds from the Department of Kinesiology and Community Health at the University of Illinois at Urbana Champaign.

1199

FEELING VALIDATED YET? A SCOPING REVIEW OF CONSUMER-TARGETED WEARABLE AND MOBILE TECHNOLOGY TO MEASURE AND IMPROVE SLEEP

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Introduction: Consumer-targeted fitness devices, most of them containing sleep monitoring technology, are rapidly growing in popularity. We sought to evaluate the use of consumer-targeted sleep monitoring technology, identify gaps in the literature, and determine the evidence for the use of these types of devices in behavioral interventions.
Methods: We undertook a scoping review of English-language studies in adult populations using consumer-targeted wearable technologies designed to measure or improve sleep. We searched MEDLINE, EMBASE, PsycINFO, CINAHL, Science Citation Index Expanded, and Compendex. Two co-authors screened each article abstract for inclusion, and two authors extracted data from each article that met inclusion criteria.
Results: Our search returned 1836 unique article records, 80 of which met inclusion criteria. The majority of studies sought to validate new sleep measurement technology or algorithms (n=45) or were observational studies (n=24). Few studies used wearable technology to identify sleep disorders (n=5), evaluate response to interventions (n=3), or to deliver interventions (n=3).
Conclusion: The use of consumer-targeted mobile and wearable sleep technology has largely focused on validation, but opportunities exist for observations in large populations and for self-management interventions. Future research is needed to determine utility in behavioral interventions and in different populations, including patients with sleep disorders.
Support (If Any): None

1200

SLEEP GREAT! A WELLNESS PROGRAM TO PROMOTE SLEEP IN THE WORKPLACE

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Introduction: Sleep problems predict negative health outcomes, increase healthcare costs, and lower work productivity. Over 70 million persons in the U.S. report sleep insufficiency (lack of time asleep) and poor sleep quality. Lack of sufficient sleep impairs both physical and mental health. There are no published workplace wellness programs that address sleep insufficiency in the U.S. Based on local an employee survey data, Sleep Great!, an online challenge to raise awareness about the importance of good sleep hygiene, was created. The online tool used evidenced-based lifestyle practices to support adopting or maintaining habits that improve the length and quality of sleep. Employee spouses were also invited to participate. The purpose of this study was to describe the outcomes on eight campus sites for day shift, night shift, and spouse pairs who completed the 4-week challenge.
Methods: Descriptive study of baseline and weekly outcome data of participants in the sleep wellness program. Descriptive statistics, including frequencies and percentages of the outcome data was used for data analysis.

Results: Approximately 17,000 full-time employees and spouses were invited to complete the online sleep wellness program. A total of 893 day shift and 50 night shift employees and spouses started the challenge. At week 4, 492 day shift and 19 night shift completed. Improvements in sleep, energy levels, stress management, behavior change, and impact of behaviors on sleep will be reported. Initial impact shows that avoiding electronic device use at least 60 minutes before sleep and getting at least 7 hours of sleep had the greatest benefit to improving overall sleep quality.
Conclusion: Results from this program demonstrate interest from employees to complete a sleep-focused wellness modular program. The data provides an example of how employers can integrate an evidenced-based program to improve sleep and related outcomes.
Support (If Any): Data from this project was supported by the Healthy IU team.

1201

OUTCOMES OF AN EVIDENCE-BASED SLEEP EDUCATION AND PROMOTION PROGRAM FOR COMMUNITY-DWELLING OLDER ADULTS

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Introduction: There is growing concern regarding sleep disorders and associated comorbidities that threaten public health and health care costs. This work describes an evidence-based sleep education program tested with community-living older adults to promote sleep health.
Methods: The community-based program is an adaptation of a training manual developed for lay health educators that includes sleep promotion methods. Data were derived from survey ratings regarding knowledge of obstructive sleep apnea (OSA), insomnia, short sleep duration (SSD), restless legs syndrome (RLS), circadian rhythm disorders (CRD), and drowsy driving (DD) on a 5-point Likert-like scale, as well as 5 true/false questions regarding misconceptions about sleep. Data were analyzed with frequencies for age, sex, and sources of sleep information, and paired *t*-tests using SPSS (V21) with significance set at $p<0.05$. Calculations of Cohen's *d* with scores ≥ 0.80 were used to indicate clinically meaningful findings.
Results: Participants (N=158; 68% women) were 56 years of age and older, who resided in a retirement community. Means with standard deviations showed significant learning for all sleep disorders following the training (OSA: 3.2 ± 1.3 to 4.4 ± 0.79; Insomnia: 3.3 ± 1.1 to 4.3 ± 0.71; SSD: 3.5 ± 1.1 to 4.3 ± 0.71; RLS: 2.8 ± 1.2 to 4.1 ± 0.85; CR: 2.1 ± 1.2 to 4.0 ± 0.89; DD: 2.8 ± 1.3 to 4.3 ± 0.89, all *p*-values<0.001). The total pre- to post-scores (range=0 to 30) for sleep disorders moved from 17.7 ± 4.7 to 25.0 ± 3.9, $p<0.001$. Participants also demonstrated significant learning regarding misconceptions about sleep pre- 4.4 ± 0.79 to post-testing 4.9 ± 0.27, $p<0.001$. Clinically meaningful findings ranged from $d=0.85$ (SS) to a high of $d=1.81$ for CR problems. Respondents reported most of their information came from their physicians (31%), television (30%), and newspapers (27%).
Conclusion: Findings suggest this brief evidence-based sleep education program is a salient and cost-effective approach to training community-dwelling older adults regarding sleep disorders and sleep health promotion strategies. Results also indicate that findings are both statistically significant and clinically meaningful.
Support (If Any): N/A.

1202

EVIDENCE-BASED SLEEP EDUCATION AND PROMOTION PROGRAM FOR MEXICAN HEALTH PROVIDERS TRAINED AS CERTIFIED DIABETES EDUCATORS

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Introduction: Increased rates of diabetes throughout Mexico contribute to rising rates of morbidity, mortality and health care costs. This work describes a Spanish-language evidence-based sleep education program tested with health providers enrolled in a certified diabetes educator program in Mexico.
Methods: The training is an advanced adaptation of a program developed for lay health educators. Data were derived from survey ratings regarding knowledge of sleep apnea (OSA), insomnia, short sleep duration (SSD), restless leg syndrome (RLS), circadian rhythm disorders (CRD), and drowsy driving (DD) on a 5-point Likert-like scale, as well as 5 true/false questions regarding misconceptions about sleep. Data were analyzed with frequencies for profession, sex, and sources of sleep information, and paired *t*-tests using SPSS (V23) with significance at $p<0.05$. Calculations of Cohen's *d* with scores ≥0.80 were used to indicate clinically meaningful findings.
Results: Participants (N=50; 64% women) enrolled in a semester-long diabetes educator program were from nursing, medicine, nutrition, psychology and physical activity professions. Means with standard deviations showed significant learning for all sleep disorders following the training (OSA 2.7 ± 1.2 to 4.4 ± 0.70; Insomnia 2.9 ± 0.80 to 4.4 ± 0.64; RLS 1.8 ± 1.0 to 4.1 ± 0.86; SSD 2.3 ± 0.97 to 4.3 ± 0.71; CRD 2.2 ± 1.19 to 4.4 ± 0.72; DD 2.2 ± 1.09 to 4.3 ± 0.80, all *p*-values<0.001). The total pre- to post-scores (range=0 to 30) for sleep disorders moved from 14.2 ± 4.9 to 25.9 ± 4.0, $p<0.001$. Participants also demonstrated significant learning regarding misconceptions about sleep, pre- 4.3 ± 0.62 to post-testing 4.8 ± 0.42, $p<0.001$. Clinically meaningful findings ranged from $d=1.78$ (OSA) to a high of $d=2.42$ for RLS. Respondents reported most of their information came from the internet (40%), doctors (22%), and books (20%).
Conclusion: Findings suggest this brief evidence-based sleep education program is a salient and cost-effective approach to training health providers regarding sleep disorders across the lifespan, as well as behavioral sleep promotion strategies. Results also indicate that findings are both statistically significant and clinically meaningful.
Support (If Any): N/A

1203

THE EFFECT OF AN EDUCATIONAL HANDOUT ON PATIENT KNOWLEDGE OF AND INTENTION TO DISCUSS SCREENING FOR OBSTRUCTIVE SLEEP APNEA IN THE ISCHEMIC STROKE POPULATION

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Introduction: Obstructive sleep apnea (OSA) is recognized as an independent risk factor for ischemic stroke and current guidelines recommend OSA screening for secondary stroke prevention. This study evaluated the effect of a brief educational intervention on patient knowledge of the link between OSA and stroke and interest in OSA screening.

Methods: An IRB-approved educational intervention was administered to patients aged 18 years or older who were admitted with an acute ischemic stroke to a community hospital in Columbus, Ohio between 6/2015 - 10/2016. Inclusion criteria included ability to consent and minor or moderate stroke per the NIH Stroke Scale of 1–15, with a Level of Consciousness score of zero. Patients with known dementia or OSA were excluded. Following a pre-intervention survey assessing perceived risk and knowledge about OSA, patients were given a brief educational pamphlet reviewing OSA and its association with stroke. Patients could choose to discuss the pamphlet with their neurologist. A post-intervention survey was then administered at 24–72 hours which examined patient knowledge and intention to seek OSA screening, as well as perception of the pamphlet's educational value.

Results: Of 124 eligible patients, 36 consented and 26 completed both pre and post-intervention surveys. Pre-intervention knowledge scores averaged 69.7% (sd 21.3%) versus post-intervention score 80.8% (sd 21.0%), p = 0.005, effect size =1.00. Likelihood of speaking with a physician about OSA testing improved from 3.5 (sd 2.0) to 5.0 (sd 1.8), p = 0.001, effect size = 0.89. Pamphlet educational value was scored at 5.2 (sd 1.7), on a scale of 1 (not valuable) to 7 (quite valuable).

Conclusion: A brief educational pamphlet describing risks of OSA and its link to stroke was considered valuable, and improved both patient knowledge and intention to discuss OSA screening with a physician. This may hold important implications in both primary and secondary stroke prevention.

Support (If Any): This project was supported by the OhioHealth Research Institute's resident research fund.

1204

RESOURCE UTILIZATION OF POLYSOMNOGRAPHY AT THE ALBERTA CHILDREN'S HOSPITAL

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Introduction: The gold standard for the diagnosis of sleep related breathing disorder (SRBD) is polysomnography (PSG). PSG testing is expensive and often inaccessible. The waiting time to have a PSG completed at the Alberta Children's Hospital (ACH) is greater than 1 year. The aim of this quality improvement project is to assess our current practice and identify areas for reduction of PSG wait-times.

Methods: A retrospective chart review of PSG completed at the ACH from April 2015 to May 2016 was completed. Data were collected to measure: the total number of PSG completed, source of PSG requisition, average time to PSG completion, indication for PSG, new versus repeat PSG, age ranges of patients for whom PSG was completed, Apnea Hypopnea Index (AHI) for new studies, and recommendations by the interpreting sleep physician.

Results: A total of 518 polysomnography studies were completed over the time period evaluated. Just under half of completed polysomnograms (44%) were repeat studies. Of the polysomnograms completed for the first time, sleep physicians requested the greatest number (56%) followed by otolaryngologists (18%) and sleep neurologist (10%).

Conclusion: Polysomnography are a scarce resource. Re-evaluating processes is important to ensure appropriate utilization of this resource. A closer assessment of the indications and findings of repeat PSG studies may help to shorten our wait-times. More data is actively being collected to further clarify the implications of this finding.

Support (If Any): None.

1205

SLEEP DIFFICULTIES ASSOCIATED WITH ACADEMIC PERFORMANCE IN STUDENT ATHLETES

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Introduction: Student athletes frequently report sleep disturbances due to overscheduling and balancing academics and athletics. This study examined associations between a wide range of sleep complaints and academic performance in a large, national sample.

Methods: Data were obtained from the National College Health Assessment of US college/university students from 2011–2014 (N=8,683 student athletes). Overall academic performance (GPA) was self-reported. Sleep difficulties included: report of "sleep difficulties" being "traumatic or very difficult to handle" over the past 12 months (SLEEP-DIFFICULTY), extreme difficulty falling asleep ≥3 nights/week (INSOMNIA), extreme daytime tiredness ≥3 days/week (TIREDNESS), nights/week of insufficient sleep (INSUFFICIENT-SLEEP), and whether sleep difficulties interfered with academics (INTERFERE). Multinomial regression analyses (Reference=A) were adjusted for age, sex, and survey year.

Results: Prevalence was 20% for SLEEP-DIFFICULTY, 22% for INSOMNIA, 61% for TIREDNESS, 27% for sleep problems that existed but did not INTERFERE and 18% for sleep problems that did INTERFERE. Mean days of INSUFFICIENT-SLEEP was 3.2 (SD=1.9), with 61% reporting insufficient sleep at least 3 nights per week. SLEEP-DIFFICULTY was associated with an increased likelihood of B (OR=1.47,p<0.0001) or C (Or=2.18,P<0.0001) grades. INITIAL-INSOMNIA was associated with increased likelihood of B (OR=1.35,p<0.0001), C (OR=2.08,p<0.0001) and D/F (OR=3.71,p=0.001) grades. TIREDNESS was associated with increased likelihood of B (OR=1.25,p<0.0001), C (OR=1.62,p<0.0001), and D/F (OR=2.90,p=0.024) grades. Each night of INSUFFICIENT-SLEEP is associated with an increased likelihood of B (OR=1.04,p=0.001), C (OR=1.17,p<0.0001) and D/F (OR=1.34,p=0.002) grades. For those for whom sleep difficulties INTERFERE with academics, there is an increased likelihood of B (OR=1.87,p<0.0001) and C (OR=3.17,p<0.0001) grades. Those who felt that sleep problems did not INTERFERE were not at increased risk of lower grades.

Conclusion: Sleep difficulties, including insufficient sleep, insomnia, and daytime tiredness are highly prevalent and associated with poorer academic performance in student athletes.

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1206

EVALUATION OF A SLEEP HEALTH INTERVENTION IN STUDENT ATHLETES: INSIGHTS FOR INTERVENTION DEVELOPMENT

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Introduction: Student athletes are at high risk of sleep problems, perhaps due to over-scheduling and difficulty balancing academics and athletics. To address this, a pilot intervention that focused on education and tracking was implemented. This program was evaluated to determine (1) what did participants learn from the educational content, and (2) what elements of the intervention were most helpful.
Methods: A pilot sleep health intervention was conducted across the Fall 2016 semester among student athletes. It included an intake survey, education session, 10 weeks of tracking (sleep diary, sleep/fitness tracker, and daily text message reminders), 24/7 access to support, a weekly drawing providing financial incentive for adherence, and a follow-up survey. N=40 students were enrolled, though N=35 have yet completed. Participants were asked to evaluate the helpfulness of various components of the survey (0=10 scale, >5="helpful"). Also, participants were asked whether they learned from the intervention, rated on a scale of 0–4. Responses ≥3 ("a lot" or "very much") were coded as "learned a lot."
Results: Eighty-nine percent reported benefit from the educational session (basic sleep knowledge and sleep tips were equally helpful). Only 29% found the daily text messages helpful, 54% found the 24/7 access helpful, 43% found the sleep diary helpful, 80% found the sleep/fitness tracker helpful, and 83% found the financial incentive helpful. Seventy-four percent reported that they learned a lot about the importance of sleep, 86% each about how sleep affects daytime functioning, athletic performance, and mental health, 60% about how to tell if they are sleepy, 80% about their own sleep patterns, and 77% about how their sleep affects daytime function.
Conclusion: Respondents found many elements helpful, especially the educational content, sleep/fitness tracker, and financial incentive. Participants reported learning a lot about sleep in general, how it affects performance, and how this relates to their own sleep patterns.
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1207

PRELIMINARY RESULTS OF A SLEEP HEALTH INTERVENTION IN STUDENT ATHLETES: PERCEIVED CHANGES TO SLEEP, PERFORMANCE, AND MENTAL AND PHYSICAL WELL-BEING

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Introduction: Student athletes are at high risk of sleep problems, perhaps due to over-scheduling and difficulty balancing academics and athletics. The present study evaluated whether students perceived benefits of a relatively simple sleep health intervention.
Methods: This single-group pilot of a sleep health intervention was conducted across the Fall 2016 semester among student athletes. It included an intake survey, a 90min education session, 10 weeks of tracking, 24/7 access to peer support and study staff for questions, and a follow-up survey. N=40 students were enrolled, though only N=35 have yet completed the follow-up survey. During the follow-up survey, participants were asked if they agreed with statements about changes as a result of the intervention.
Results: Most participants reported benefits of the intervention: "I sleep better" (83% agreed), "I am more satisfied with my sleep" (83%), "I fall asleep easier" (77%), "Awakenings at night are less of a problem" (74%), "My sleep timing is better" (91%), "I know what to do if I have trouble sleeping" (86%), and "I know what to do if I am sleepy during the day" (97%). The percent that agreed that they experienced positive changes in the following are reported: "Stress" (66%), "Academic performance" (77%). "Athletic performance" (89%), "Social Life" (77%), "Family Life" (71%), "Mental Health" (77%), "Physical Health" (86%), "Energy Level" (91%), and "Ability to Focus" (83%). Of these 16 domains, improvement was reported in M=13.2(SD=3.3) domains per student.
Conclusion: A relatively simple intervention based on education and monitoring in a small group of student athletes produced perceived improvements across many domains of sleep, performance, and mental and physical health.
Support (If Any): K23HL110216 and NCAA Innovation Grant

1208

IMPACT OF TIME AND ACTIVITY DEMANDS ON SLEEP OF STUDENT ATHLETES: IT'S NOT ABOUT REDUCED SLEEP OPPORTUNITY

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Introduction: Student athletes are at high risk for poor sleep, yet sleep impacts academic and athletic performance. Despite speculation about the role of over-scheduling, little evidence examines time demands relative to sleep duration and insomnia in this population.
Methods: Data were collected from N=190 Division-1 student athletes. Sleep duration was assessed using the Pittsburgh Sleep Quality Index (PSQI) item. Insomnia was assessed using the Insomnia Severity Index (ISI). Students were asked how many hours/week were spent in training/practice/competition, work, class, and studying/homework. They were also asked to rate whether activities interfered with sleep: practice, competition, training, class, homework/studying, and work/job. Regression analyses were adjusted for sex and year in school. Also, analyses examining interference of activities adjusted for time in that activity.
Results: Mean sleep duration was 6.96 (SD=1.17) hours and mean ISI score was 7.68 (SD=5.15). Mean weekly time spent in training/practice/competition, work, class, and studying/homework were 16.21 (SD=9.02), 1.81 (SD=5.47), 8.36 (SD=6.12), and 8.86 (SD=6.82) hours, respectively. Percent reporting interference with sleep were as follows: practice:40%, competition:33%, training:44%, class:33%, homework:51%, and job:7%. Neither sleep duration nor insomnia were associated with hours spent in any activity. Shorter sleep duration was seen among those who indicated that the following interfered with sleep: practice (B=-0.43hrs,p=0.013), competition (B=-0.49hrs,p=0.007), training (B=-0.4hrs,p=0.012), and homework (B=-0.56hrs,p=0.001). Higher ISI score was seen among those who indicated that the following interfered with sleep: practice (B=3.86pts,p<0.0001), competition (B=3.68pts,p<0.0001), training (B=3.26pts,p<0.0001), class (B=3.35pts,p<0.0001), and homework (B=4.07pts,p<0.0001). Mediation analyses showed that sleep duration relationships were fully mediated by ISI score.
Conclusion: Scheduled hours were not associated with shorter sleep or insomnia among student athletes. But individuals who perceived that activities interfered with sleep reported shorter sleep duration and higher ISI scores, even after adjustment for hours spent. Since sleep duration effects were explained by insomnia, this suggests that impacts on sleep are related to reduced sleep quality, not opportunity.
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1209

STUDENT ATHLETES' ACCESS TO HEALTHY SLEEP INFORMATION ON CAMPUS: HOW DOES IT RELATE TO OTHER TYPES OF HEALTH INFORMATION AND TO SLEEP DIFFICULTIES?

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Introduction: Sleep difficulties are common among student-athletes. The availability of healthy sleep information on campuses is unknown, as is the level of interest for more information about sleep. Further, it is possible that personal sleep difficulties motivate interest in sleep.
Methods: Data were collected as part of the 2011–2014 National College Health Assessment, conducted by the American College Health Association (N=8,618 student athletes). Participants were asked if they received information from on-campus sources about: sleep, alcohol/drugs, cold/flu, depression/anxiety, eating disorders, grief/loss, helping others, injury prevention, nutrition, exercise, birth control, excessive computer/internet use, relationships, sexual assault, sexually-transmitted disease/infection, stress, suicide, tobacco, and violence. They were also asked if they were interested in receiving more information on these topics. Prevalence of "sleep difficulties" that were "traumatic or difficult to handle" over the past 12 months was recorded.
Results: Only 32.6% of respondents reported getting information about sleep. This was less frequent than all other domains except excessive computer/internet use (all $p<0.0001$). Yet, 52.0% of respondents reported that they were interested in more information about sleep. This was higher ($p<0.0001$) than the level of interest expressed for alcohol/drugs, cold/flu, depression/anxiety, eating disorders, grief/loss, injury prevention, exercise, pregnancy, computer/internet use, relationships, sexual assault, sexually-transmitted disease/infection, suicide, tobacco, and violence. Access to information about sleep was not associated with difficulty sleeping. However, those who were interested in more information about sleep were more likely to have sleep difficulties (OR=2.63,95%CI[2.34,2.95], $p<0.0001$). Those that expressed interest but did not have access to information had a greater likelihood of sleep difficulties (OR=3.20,95%CI[2.76,3.70], $p<0.0001$) compared to those who had access to information (OR=1.76,95%CI[1.44,2.15],$p<0.0001$).
Conclusion: Information about healthy sleep is accessible to <1/3 of student-athletes, less than nearly all other health concerns. However, the majority are interested in receiving more information about sleep (more than most other domains). Those who are interested are more likely to experience poor sleep themselves, especially if they also lack access to information. These findings highlight the need for more sleep health programs on campus.
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1210

EXCESSIVE DAYTIME SLEEPINESS IN A CHILD WITH TRISOMY 21; IT'S NOT ALWAYS APNEA. A CASE OF TRISOMY 21 WITH COMORBID NARCOLEPSY

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Introduction: Given the predilection for increased rates of obesity and the generalized hypotonia seen in patients with trisomy 21, there is an increased rate of obstructive sleep apnea (OSA) compared to healthy controls.[1–3] However, OSA is not the only comorbid sleep disorder that can lead to daytime sleepiness and a thorough sleep evaluation must be undertaken.[4]

Report of Case: A 13 yof, with a history of trisomy 21, presented to the pediatric sleep clinic in 2014 with snoring, possible apnea, and excessive daytime somnolence. An increased sleep time and reinstitution of daytime naps was also noted two years prior to presentation. There was no cataplexy, sleep paralysis, or hypnagogic/hypnopompic hallucinations. Physical exam showed 3+ tonsils and a BMI of 26. A prior home sleep study, ordered by an outside physician, showed a REI of 8.4, ODI of 1, and O_2 nadir of 94%.

She underwent a polysomnogram (PSG) and multiple sleep latency test (MSLT). The PSG showed an overall AHI of 4, a hypopnea index of 3.1, and an obstructive apnea index of 0.67. The MSLT showed a mean sleep latency of 4:37 and three sleep onset REM periods. The HLA DQB1 06:02 was positive.

She was diagnosed with mild obstructive sleep apnea which was positionally dependent and narcolepsy without cataplexy. She was started on positional therapy and modafinil, 100mg each morning. After institution of therapy the patient and family noted a drastic improvement in daytime sleepiness, improved school performance, and increased levels of physical activity. The Epworth sleepiness score was 8 after treatment.

Conclusion: Obstructive sleep apnea is the most common comorbid sleep disorder associated with Trisomy 21 and can result in daytime symptoms.[4] However, daytime somnolence can be caused by other disorders and narcolepsy needs to be maintained within the differential diagnosis. This represents the first case describing trisomy 21 with comorbid narcolepsy.

1211

SLEEP-DISORDERED BREATHING IN NORMAL PRESSURE HYDROCEPHALUS

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Introduction: The classic triad of normal pressure hydrocephalus (NPH) is urinary incontinence, gait apraxia, and subcortical dementia. There is limited data in NPH that shows that these patients often have obstructive sleep apnea. Case reports suggest that those with central sleep apnea in the setting of NPH may improve with shunting.

Report of Case: A 66 year old man with a remote history of traumatic brain injury presented with falls, confusion, and urinary incontinence over one year. A computerized tomography scan was performed which showed concern for NPH. There was clinical improvement after lumbar puncture followed by ventriculo-peritoneal (VP) shunt placement. During follow-up, he reported snoring and hypersomnia and was referred to the sleep clinic. He denied cataplexy, hypnagogic or hypnopompic hallucinations, restless leg syndrome symptoms, or unusual behaviors during sleep. Epworth Sleepiness Scale Score (ESS) was 11/24. The short form of the Functional Outcomes of Sleep Questionnaire (FOSQ-10) score was 13.5. His physical exam revealed BMI 29 kg/m^2, neck circumference 16.5 inches, Mallampati III upper airway with peritonsillar narrowing and 1+ tonsils. An attended in-laboratory polysomnography performed after VP shunting showed severe central sleep apnea with an overall AHI of 76 event/s hour (all in supine position). Positive airway pressure (PAP) titration study showed that continuous and bi-level PAP (spontaneous-timed mode) did not abolish the respiratory events. Pulmonary function tests and arterial blood gases were within normal limits so the patient was titrated on adaptive servo ventilation (ASV) which appropriately treated his respiratory events.

Conclusion: Sleep-disordered breathing (SDB) should be considered in patients with NPH. Repeat sleep studies may be needed during follow-up since central apnea has been reported to resolve with improvement of NPH. In this case the central apnea persisted after shunt placement. This case is novel for the use of ASV in a patient with NPH.

1212

WHEN EVERYTHING ELSE FAILS: VOLUME ASSURED PRESSURE SUPPORT IN A PATIENT WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE, SLEEP APNEA AND MORBID OBESITY

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Introduction: Chronic Obstructive Pulmonary Disease (COPD) and Obstructive Sleep Apnea (OSA) are highly prevalent. Their co-existence "overlap syndrome" carries worse prognosis and ultimately survival. Obesity hypoventilation syndrome (OHS) is a common, yet largely undiagnosed and undertreated condition carrying high mortality. Hypoxemia and hypercapnia can be difficult to treat when the three collide. Despite increased prevalence of this "triple overlap", there is scarce information on its pathophysiology and management. We present a challenging case of COPD, OSA, OHS overlap who failed continuous positive airway pressure (CPAP) and Bi-Level due to persistent nocturnal hypoxia, resolved with initiation of intelligent volume-assured pressure support (iVAPS) therapy.

Report of Case: A 55-yo woman with oxygen-dependent COPD, multiple admissions for acute on chronic hypercapnic/hypoxic respiratory failure, morbid obesity (BMI 49.2) and OSA presented for re-evaluation after Bi-Level intolerance. Polysomnography (PSG) showed mild OSA with apnea-hypopnea index (AHI) of 5.9/hour (10.5/hour supine) and severe hypoxia despite additional 2l/min O2 (mean SpO2 <80%). On follow up PSG, Bi-Level and 2 l/min O2 supplementation were titrated from 12/5 to 20/15 cmH2O with 3l/min O2, with AHI 0.7/h but persistence of hypoxia (mean SpO2 81.2%). This triggered therapeutic PSG using iVAPS (S9 VPAP ST-A with iVAPS-ResMed) plus oxygen. Pressure support was set 4–20 cmH2O, EPAP was titrated from 6 to 8 cmH2O to correct obstructive events, target alveolar ventilation was titrated from 3 to 3.3L/min to correct hypoventilation related hypoxemia and rise time adjusted (min 0.3- max 1sec). On the final settings, longer sleep time and REM sleep were achieved; AHI was 1.6/hr with lowest O2 saturation 89% and mean SpO2 of 93.4%. Six-month follow up shows no ED or hospital visits, sleep quality and symptoms resolved.

Conclusion: Patients with overlap syndrome effectively treated with noninvasive positive pressure ventilation (NPPV) have adequate nocturnal oxygen saturation. In those with additional OHS, supplemental

oxygen may not be sufficient and worsen hypoventilation. Combining end expiratory pressure and pressure support variation targeting alveolar ventilation, along with adjustable rise time and set respiratory rate via iVAPS, might be an effective alternative mode for challenging "triple overlap" cases that are not adequately treated with conventional therapy.

1213

A CASE OF NARCOLEPSY WITH CATAPLEXY IN AN ELDERLY MAN TREATED WITH SODIUM OXYBATE

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Introduction: Narcolepsy with cataplexy is a chronic, debilitating central nervous system disorder characterized by symptoms of excessive daytime sleepiness and cataplexy along with hypnogogic hallucinations, sleep paralysis and fragmented sleep (1, 2).The approval of Sodium Oxybate by FDA for treating both EDS and cataplexy in adults with Narcolepsy opened a new paradigm (2). Even though clinical trials have established the safety of Sodium Oxybate for treating Narcolepsy in adults, the mean age of patients in those studies ranged from 36 – 47.7 years (3). It is not really clear how much dose should be started in geriatric patients and what is the highest dose that can be used safely in geriatric patients.
Report of Case: We are presenting a case of a 79 year old male who was diagnosed with Narcolepsy with Cataplexy many decades before the approval of Sodium Oxybate by FDA. He was initially treated with Modafinil for Excessive Daytime Sleepiness (EDS) for many years, which was somewhat helpful and tried Venlafaxine for Cataplexy without success. He also had comorbid sleep apnea for which he was treated with CPAP and was very compliant with it. He still had multiple cataplexy episodes every week and was excessively sleepy. His Epworth Sleepiness Scale (ESS) was 24 on initial evaluation. Sodium Oxybate, was started at 2.25 gm before bedtime with a repeat dose in 2.5 – 4hrs. The dose was gradually increased to 3.75 gm twice every night in a span of 4 weeks, which improved the EDS and completely resolved the cataplexy attacks and this dose was well tolerated. The dose was further increased to 4.5 gm twice nightly for better control of symptoms of excessive sleepiness. But immediately after increasing the dose, he experienced confusion and palpitations which resolved on it's own without any intervention once he stopped the medication. As a result the dose was decreased to 3.75 gm twice every night and he is tolerating this dose without any side effects.

Sodium Oxybate is taken in two equally divided doses due to its short half-life. Starting dose is 4.5 gm/night administered orally in two equal, divided doses. The dose is titrated up in increments of 1.5 gm/night at weekly intervals to a maximum dose of 9 gm /night (6). Sodium Oxybate is metabolized in Krebs cycle to water and CO2 and a major portion of the medication is excreted through lungs as CO2 and only <5% of the medication is excreted unchanged through kidneys. The starting dose should be reduced by one-half in liver impairment but no adjustment is recommended in renal impairment (6). Clinical trials showed that the common adverse events included nausea, vomiting, dizziness, somnolence and enuresis, which were dose related (1,4,5). A 12 month, open label, Multicenter Extension Trial of Orally administered Sodium Oxybate showed headaches, viral infection and pain also occur commonly in addition to the prior mentioned side effects. In the same study a 76 year old female experienced agitation up on increasing the dose (5). Confusion is also identified as infrequent side effect of Sodium Oxybate with greatest risk at 9 gm /night dose (1,2,3,4,5).
Conclusion: Sodium Oxybate can be used effectively in geriatric population. Patients should be well educated about side effects and care should be taken while prescribing high doses especially in geriatric patients. Further studies to establish the safe dosing range for Sodium Oxybate in geriatric population will greatly help the clinicians.

1214

HOME CPAP THERAPY MAY UNDERESTIMATE APNEA AND HYPOPNEA INDEX IN INFANTS WITH OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is a significant cause of childhood morbidity with long-term cognitive, behavioral, and cardiopulmonary sequelae. Factors causing airway obstruction or affecting pharyngeal compliance precipitate OSA. While OSA prevalence is about 1–4% in healthy children, it is much higher in children with genetic/neuromuscular disorders. Despite widespread use of continuous positive airway pressure (CPAP) in children, CPAP is not FDA-approved for patients ≤ 30 kilograms. We describe a 6-month infant with Prader-Willi and OSA on home CPAP, which detected only 34% of reported usage.
Report of Case: Our patient presented at 1-month with hypersomnolence (sleeping 20–22 hours) and concerns for sleep-disordered breathing. Polysomnogram confirmed OSA; apnea/hypopnea index (AHI) was 42 events/hour. Home CPAP was started (ResMed's Air Sense10 AutoSet, CPAP 10 cm H_2O). At 4-months, weighing 7 kg, patient had improved tone and alertness. Over 33 days, the sensor detected only 34% of hours used (average 3/11 hours per day) despite parents reporting excellent adherence. Parents denied difficulties with equipment. At 7-months with weight of 8.9 kg, detection rate improved (55%) with 5/11 hours captured daily. AHI detection had improved from 2.5/hour to 3.4/hour. Patient continued to demonstrate improved alertness, tone, and acquisition of developmental milestones.
Conclusion: Despite the increasing burden of OSA in infants, current CPAP equipment remains FDA-approved only for children ≥ 30 kg. Our case highlights the unreliability of AHI and usage detection in this patient cohort, likely stemming from inadequate sensitivity of CPAP sensors and relatively low inspiratory flow generated by infants and toddlers. In our patient, 66% of usage time was undetected initially, thereby potentially under-estimating AHI on CPAP therapy. In patients without clinical improvement, accurate AHI is requisite for CPAP therapy monitoring. Further research and equipment development is imperative to reliably assess treatment response and manage OSA in this vulnerable infant population.

1215

CHEYNE-STOKES RESPIRATION ON POLYSOMNOGRAPHY IN A 7-YEAR OLD CHILD

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Introduction: Cheyne-Stokes respiration (CSR) is a common manifestation of central sleep apnea (CSA) in adults with heart failure, but has only been described in a few cases in children. We describe a case of a child with dilated cardiomyopathy, who exhibited CSR on polysomnography.
Report of Case: A seven-year-old female arrived as a transfer to our facility for further management of dilated cardiomyopathy and severe systolic dysfunction. She was previously healthy until about five

months prior, when she first developed intermittent abdominal pain. She subsequently developed a three-day history of abdominal pain, vomiting, and lethargy. An abdominal CT revealed bilateral pleural effusions, cardiomegaly and hepatomegaly. An echocardiogram revealed severely dilated left ventricle and depressed left ventricular ejection fraction of 8%.

The etiology of her systolic dysfunction was most likely viral myocarditis. She developed new apneic episodes while on room air. The episodes lasted about ten seconds and were not associated with hypoxia or color change. Inpatient baseline overnight polysomnography revealed central apnea-hypopnea index (CAHI) of 24.10 with associated oxygen nadir of 87%. She also had mild snoring and 4.85 obstructive respiratory events per hour. Transcutaneous pCO2 were not elevated above 45 mmHg. Periodic breathing was recorded for 33% of total recording time, of which significant portions met criteria for Cheyne-Stokes breathing based on the adult scoring rules. CPAP therapy was recommended for her OSA, however, family refused therapy because the patient had difficulty tolerating the device. After multiple meetings with the Heart Failure Team, the family opted not to pursue cardiac transplantation and therefore the patient was not a candidate for a ventricular assist device. The patient passed away about seven months later.

Conclusion: CSR can be present in children with heart failure, although it is more commonly described in adults. The prognostic value of CSR in children with heart failure remains uncertain.

1216

X-LINKED MYOTUBULAR MYOPATHY IN A SYMPTOMATIC FEMALE CARRIER

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Introduction: X-Linked myotubular myopathy (XLMTM) is a rare genetic neuromuscular disorder characterized by mild to severe muscle weakness. It is caused by a mutation in the myotubularin (*MTM1*) gene. The diagnosis is considered in young male neonates with muscle weakness and hypotonia. The disorder predominantly affects males, but female carriers develop a range of symptoms. Only 24 cases of symptomatic female carriers are reported in the literature. We present a case of a woman with XLMTM who was evaluated for nocturnal hypoventilation.

Report of Case: A 24-year-old woman diagnosed in 2012 with XLMTM reported morning headaches and frequent gasping with waking. She denied daytime sleepiness, snoring, insomnia, or symptoms of restless legs or narcolepsy. Spirometry showed a restrictive pattern with a proportionate reduction of FVC and FEV1 that significantly decreased in the supine position. Daytime arterial blood gas demonstrated a normal pH of 7.44, pO2 of 92 mmHg, and pCO2 of 38 mmHg. A polysomnogram in November 2013 demonstrated mild obstructive sleep apnea with an AHI of 7.7 with an oxygen saturation nadir of 73.7% and oxygen desaturation less than 90% of 20.3 minutes. A BiPAP titration with transcutaneous carbon dioxide (TCO_2) monitoring demonstrated a baseline awake TCO_2 of 55–60 mmHg and sleep TCO_2 of 60–70 mmHg.

Respiratory muscle weakness due to neuromuscular disease can cause insufficient ventilation and result in excessive daytime sleepiness and morning headaches. Pulmonary function testing shows a restrictive pattern with a FVC reduction of >10% in the supine position, reduced maximal inspiratory and expiratory pressures, and reduced total lung capacity. A polysomnogram with carbon dioxide monitoring can assess for hypoventilation. Management of respiratory muscle weakness due to neuromuscular disease can provide symptomatic relief, improve quality of life, and prolong life. Options for respiratory support include noninvasive positive pressure ventilation (NPPV) or invasive positive pressure ventilation.

1217

NARCOLEPSY IN A PRESCHOOL-AGED CHILD

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Introduction: The diagnosis of Narcolepsy in the pediatric population is a challenging process, and can result in unnecessary diagnostic work-ups and hospital admissions.

Report of Case: 4-year-old African American female is admitted following an episode of "passing out" while on stage at a school dance rehearsal. A teacher described a 2-minute episode with "diffuse shaking" without incontinence, consciousness was preserved. She had a one-month history of excessive daytime sleepiness (EDS). An anti-epileptic drug was started, by her Pediatrician after presenting with periods of staggering, nonsensical speech, and enuresis. Mother also noted snoring and weight gain. An exhaustive work up was negative for seizures, autoimmune disease, stroke, CNS infection, or metabolic disease. She was treated for presumed autoimmune encephalitis with IV methylprednisolone and immunoglobulin. She developed visual hallucinations, but was discharged after resolution of all symptoms. A second admission with similar symptoms occurred a week later. Sleep Medicine was consulted and ordered an HLA DQ1B*0602 marker, which was positive. In-lab Polysomnography showed fragmented sleep with an Apnea-Hypopnea Index = 0.2/h, Total Sleep Time = 4.6 h, Sleep Latency = 55.5 min, REM Latency = 55.5 min, Sleep Efficiency = 53%, and Periodic Limb Movement Index = 0/h. The Multiple Sleep Latency Test was unremarkable with a Mean Sleep Latency = 12.8 min and Sleep-onset REMs = 0, but struggled to stay awake in-between naps. Finally, a cerebral spinal fluid sample was sent to the Center for Sleep Sciences at Stanford University, revealing a hypocretin-1 level of 0 pg/mL.

Conclusion: This case demonstrates the challenges in diagnosing Narcolepsy, in the prepubescent population. EDS is usually the presenting symptom, but even with cataplexy, the diagnosis can be missed. Patients can be referred to multiple physicians, undergo overwhelming and lengthy work-ups, or be treated inadequately. Consulting a sleep specialist early in the clinical course may be of significant benefit.

1218

REM SLEEP ONSET DURING CATAPLEXY: AN UNUSUAL MANIFESTATION IN A PATIENT WITH NARCOLEPSY AND INTRACRANIAL HYPERTENSION

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Introduction: Type 1 narcolepsy is a disorder characterized by excessive daytime sleepiness (EDS) and cataplexy, an abrupt and transient episode of muscle weakness in the setting of consciousness typically precipitated by emotions. Deficiency of the hypocretin-orexin axis is common in human type 1 narcolepsy. EDS typically precedes cataplexy by several years in type 1 narcolepsy. It is atypical for narcoleptics to enter sleep in the course of cataplexy. We present

an unusual course of cataplexy where the muscle atonia of cataplexy evolves into physiologically documented REM sleep.
Report of Case: A 20-year-old morbidly obese female (BMI 41.09kg/m^2) seropositive for HLA DQB1*0602 presented to the sleep clinic with 3 to 5 daily episodes of muscle atonia/sleep attacks episodes provoked by emotions and excessive daytime sleepiness (sleeping 10 hours per day, Epworth 18), with onset 02/2016 and 2005, respectively. Past history is remarkable for postural orthostatic tachycardia, migraines, and intracranial hypertension (ICH) with functional ventriculoperitoneal shunt inserted 08/23/16. She was not taking psychoactive agents. On examination she had abrupt loss of muscle tone followed shortly by visible REM. She was conscious for the initial portion of the seven minutes before restoration of muscle tone. A 16 lead EEG during an unprovoked atonia/sleep attack was negative for epilepsy. Overnight polysomnography revealed a total sleep time of 495.5 minutes, apnea hypopnea index 2.5, and respiratory disturbance index 2.8. Multiple sleep latency test had mean sleep latency of 2.25 minutes and sleep onset REM in 4 of 5 naps. Laughter provoked atonia was captured after the 5th nap with EEG prompt transition to REM sleep (video and EEG tracings available). Sodium Oxybate therapy proved effective in increasing alertness and reducing episodes of atonia/sleep attacks.
Conclusion: Cataplexy evolving to REM sleep is an atypical feature of this case. ICH may have played a facilitating role in this case.

1219

POST LVAD IMPLANTATION RELATED HYPERCAPNIA SUCCESSFULLY TREATED WITH NIPPV: A CASE REPORT

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Introduction: To our knowledge, this is the first report of hypercapnic respiratory failure post LVAD implantation successfully treated with non-invasive positive pressure ventilation (NIPPV).
Report of Case: A 58 yo male with history of ischemic cardiomyopathy (EF of 20%), Hodgkin's lymphoma s/p radiation, radiation induced pulmonary fibrosis and recurrent pleural effusions underwent LVAD implantation; and a month later, LVAD exchanged due to hardware malfunction and blood clot in the device.

Pulmonary function test (PFT) prior to LVAD implantation showed combined obstruction and restriction with mild diffusion impairment: PaCO2 41.4 mmHg, FEV1 1.95 L (52%), FVC 2.95 L (60%), FEV1/FVC 66%, and DLCO2 62%.

One year later, after an admission for congestive heart failure and PaCO2 of 72 mmHg, PFTs showed worsening obstruction, restriction and diffusion: FEV1 0.93L (25%), FVC 1.11L (23%), FEV1/FVC 84%, and DLCO 33%. Diuresis and nocturnal auto-BiPAP were started. Workup showed: normal TSH, non-diagnostic sniff-test and no changes between CTs of the chest before and after the LVAD implantation.

After a month of NIPPV, PFT showed: FEV1 0.92L (25%) FVC 1.45L (35%) FEV1/FVC 64% DLCO 47% and PaCO2 of 51. The patient's dyspnea improved as well as sleep quality.

A split night study showed AHI 18.2 events/hour and BiPAP 18/8 cmH2O with 2L oxygen was prescribed.
Conclusion: Mohamedali et al, compared spirometry results before and after LVAD implantation in 23 patients and showed significant pulmonary restriction and decrease diffusion post LVAD. Hypercarbia was not reported in that study. Restriction of the left anterior hemi-diaphragm post-surgery could explain the changes in lung volumes, however the deterioration in the DLCO is not clear and needs further studies. NIPPV in this case improved hypercapnia and PFTs and could be an addition to the treatment options for this condition.

1220

VETERAN WITH SLEEP EATING, POST-TRAUMATIC STRESS DISORDER AND SEVERE OBSTRUCTIVE SLEEP APNEA

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Introduction: Obesity is a risk factor for obstructive sleep apnea (OSA), and typically results from caloric intake in excess of energy expenditure. Sleep-related eating disorder, a parasomnia associated with binge eating during the sleep period, typically with minimal recollection or conscious control, is also associated with weight gain. In some instances, sleep eating episodes may be induced by arousals related to untreated OSA that occur during sleep.
Report of case: A 41-year old male veteran with a medical history of obesity, post-traumatic stress disorder, alcohol use disorder in remission, vitamin D deficiency, hypothyroidism and chronic pain, who was prescribed gabapentin, aripiprazole, prazosin, escitalopram, levothyroxine, cholecalciferol, meloxicam, methocarbamol and nicotine supplements for these difficulties, presented with complaints of snoring, nightly sleep eating behaviors, excessive daytime sleepiness, fatigue, non-restorative sleep and 40 pounds weight gain over 8 months. The patient's main concern was sleep eating which had been occurring nightly, for at least two years. Behaviors were characterized by getting up, going to the kitchen and eating whatever was easily available, without preferences for certain types of foods. The patient did not have recollection for these events in the morning. Nocturnal polysomnography demonstrated severe OSA with an overall apnea/hypopnea index (AHI) of 108.3/hour. Titration of positive airway pressure (PAP) was tolerated well, and the patient was prescribed AutoCPAP 8–14 cmH2O. There was no sleep eating behavior or other parasomnia noted during the polysomnogram.
Conclusion: This case highlights the possible associations between sleep eating behaviors and sleep disordered breathing. When these sleep disorders co-occur, it is often difficult to identify which disorder is causal. Longitudinal assessment is required to clarify the effects of positive airway pressure therapy on sleep eating, and whether such treatment has a direct impact on body habitus.

1221

WORSENING CENTRAL SLEEP APNEA AFTER ADENOTONSILLECTOMY

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Introduction: Central sleep apnea following initiation of positive airway pressure (PAP) device for obstructive sleep apnea (OSA) is frequently seen. Rapid decline in carbon dioxide level after initiation of PAP therapy is considered to result in central apnea. Multiple studies have reported improved central sleep apnea after adenotonsillectomy. Few studies reported worsening central apnea after surgical interventions for OSA and nasal obstruction in adults. We report a case of central sleep apnea and obstructive hypoventilation where central sleep apnea worsened after adenotonsillectomy.

Report of Case: A 10 year old, overweight girl without past medical history presented to clinic complaining of loud snoring, witnessed apnea, daytime sleepiness and tonsillar hypertrophy. Physical exam revealed Mallampati 3, 4+ tonsils bilaterally, over bite, normal hard palate, height 148 cm, weight 77.3kg with BMI at 96.6 percentile. Polysomnography (PSG) showed predominantly central apnea and obstructive hypoventilation with apnea hypopnea index (AHI) 10.9/hour, nadir oxygen saturation 92.6% and ETCO2>50 mmHg for 37% of total sleep time. Magnetic Resonance Imaging of brain without contrast did not show any intracranial abnormalities. She received adenotonsillectomy for grade 4+ bilateral tonsils and 50% obstruction of adenoid pad. After 2 months of surgery, she complained of persistent sleep symptoms. Repeat PSG showed primary central sleep apnea with AHI 44.4/hour with nadir oxygen of 85.9%. Hypoventilation was resolved. Another PSG after 8 months of surgery showed persistent central sleep apnea with AHI 37.7/hour with nadir oxygen saturation of 86.7%. She will be evaluated for nocturnal oxygen supplementation.
Conclusion: Although studies reported improved central sleep apnea after adenotonsillectomy in pediatric patients, we experienced worsening central sleep apnea which persisted after 8 months of surgery. Future studies are needed to understand the pathophysiology of worsening central sleep apnea after surgical correction of upper airway obstruction.

1222

POSITIVE AIRWAY PRESSURE IN THE SETTING OF FACIAL FRACTURE

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Introduction: CPAP use in patients with acute facial fractures is associated with an increased complication rate. We describe a case where CPAP use following traumatic mid-facial fracture was associated with severe facial cellulitis, abscess and osteomyelitis.
Report of Case: A 59 year old male was involved in a motor vehicle accident with resultant maxillary fracture. Past medical history was significant for severe OSA for which the patient had been compliant with CPAP therapy.

A maxillofacial CT revealed a minimally displaced, non-operative fracture of the anterior maxillary sinus wall, facial hematoma and subcutaneous emphysema overlying the maxilla.

Three weeks following his injury, the patient resumed CPAP therapy and noted progressive facial swelling and pain over a two-day period. A repeat CT revealed a 2 x 3 cm rim enhancing fluid collection anterior to the maxilla consistent with a facial abscess, erosive changes of the maxilla and pre-septal cellulitis involving the right orbit. The abscess was incised and drained and the patient required a three week course of antibiotics prior to resolution of his infection.
Conclusion: Acute facial trauma associated with facial fracture is a rare contraindication to CPAP use. Even subclinical fractures that involve the sinuses or skull base may place a patient at increased risk for development of complications including infection and pneumocephalus. CPAP may force either air and intraoral/nasal mucous with associated respiratory flora into the soft tissues of the face, orbit or intracranial cavity increasing the risk of infection during healing. Maxillofacial surgeons typically recommend at least a six-week period following injury or repair of facial fractures to allow sufficient time for bony healing prior to resumption of CPAP use.

1223

SEVERE SLEEP APNEA IN AN INFANT TREATED WITH HIGH-FLOW NASAL CANNULA THERAPY.

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Introduction: OSAS is a common condition with a prevalence in pediatric population of 1% to 4%.[1] standard treatment for obstructive sleep apnea (OSA) in children is adenoidectomy and/or tonsillectomy when indicated. In other cases CPAP is then proposed as recommended by recent evidence based guidelines. However, many kids may not tolerate CPAP therapy.[2] High-flow nasal cannula (HFNC) therapy has been used in pediatric OSA in selected cases.[3] We present a case of severe sleep apnea in an infant treated successfully with high flow nasal cannula.
Report of Case: An 11 week-old female infant with laryngomalacia, retrognathia, cleft palate with G-Tube placement, and supraglottoplasty, was brought by her mother with complains of witnessed apnea. She occasionally appears to sleep restlessly and to "kick her legs" while asleep. No history of snoring, second hand smoking exposure, abnormal sleep related behavior or sleep attacks. Her physical examination is notable for mild inspiratory stridor and substernal retractions. Her tonsils and adenoids remain intact. Nocturnal PSG evaluation reveals severe OSA with AHI of 72.7/hour and SaO2 nadir of 89%. Surgical treatment was refused by patient's mother. A titration study was done utilizing both HFNC and CPAP was performed during same night to evaluate efficacy of both.

The HFNC therapy was administered utilizing an AirVo2® at 10 L/min with 60% FIO2. The duration of the HFNC trial was 4 hours and 57 minutes. It resulted in a residual AHI of 4.1/hour. Oxygen desaturation nadir was 96.9%. The second half of the night a standard CPAP titration protocol was instituted at 4cmH2O and titrated up to 7cmH2O along with oxygen supplementation of 1.5L/min. However, Patient still had very high residual AHI with oxygen desaturation nadir was 74.5% with a mean oxygen saturation of 97.1%.

To the best of our knowledge, this represents the first case in the literature where CPAP and HFNC were compared side-by-side in an infant to treat severe OSA. We hypothesized that the reduction of inspiratory resistance and work of breathing by increasing inspiratory flow rate, as well as the positive airway pressure effect of the HFNC were responsible for its AHI reduction.[4]
Conclusion: In infants whom surgical approach is refused or ineffective and CPAP treatment fails to improve obstructive events, HFNC is an approach to consider. Even with this dramatic results, many questions persist and long term prospective studies are needed to evaluate efficacy and safety of HFNC therapy in infants with OSAS.

1224

NON 24 HOUR SLEEP WAKE CIRCADIAN RHYTHM DISORDER IN A SIGHTED PATIENT WITH NORMAL FUNCTIONING AND INTELLIGENCE

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Introduction: We present a rare case of Non 24-Hour Sleep Wake Rhythm Disorder (N24SWD) in a sighted patient with normal functioning and intelligence. N24SWD is rare in non-blind patients. Sighted patients reported in the literature have had significant psychiatric, intellectual, developmental, or medical comorbidities.

Report of Case: A 23-year-old male PhD student presented with a 5-year history of difficulty falling asleep and excessive daytime sleepiness. His sleep and wake times were variable, but he averaged 8 hours of sleep in 24 hours. Two years before presenting to our sleep center, he underwent polysomnography and multiple sleep latency testing. It was significant for mean sleep latency of 5.5 minutes and normal AHI. Morning armodafinil was started for possible diagnosis of idiopathic hypersomnolence by his previous sleep specialist. For insomnia, temazepam, zolpidem, and diphenhydramine were prescribed with minimal success.

His medical history was significant for mild depression and anxiety, diagnosed three years after the onset of his circadian symptoms. It is currently being managed nonpharmacologically with optimal symptom control.

For workup, 20-weeks of sleep diary data was obtained. During this time, he was on leave from school and allowed himself to wake and sleep spontaneously. He also abstained from all pharmacotherapy. The data showed progressive delay in sleep and wake times between 1 to 3 hours, consistent with N24SWD. Two weeks of actigraphy were obtained, confirming these results. He responded well to nightly melatonin. Morning light therapy and armodafinil were also prescribed, which the patient has not yet started. His functioning at his graduate school has significantly improved.

Conclusion: Unlike many previously reported cases of N24SWD in sighted patients, our patient does not have intellectual and developmental disabilities. His mild depression and anxiety are well-controlled and were perhaps secondary to N24SWD. In previously reported cases, limited or inappropriate exposure to light or other entraining cues was noted, which was not the case in this patient.

1225

A CASE OF PHANTOM RESTLESS LEGS SYNDROME IN A PATIENT WITH UNILATERAL AMPUTATION - RESPONSE TO PREGABALIN

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Introduction: We report a unique case of restless legs syndrome (RLS) in a phantom limb treated with pregabalin.

Report of Case: The patient was a 61 year old woman with a history of RLS whose left leg was amputated due to complications of post-polio syndrome. After amputation, symptoms of RLS persisted in the phantom limb. She reported an urge to move the phantom limb, as well as the remaining limb, that was worse in the evening. When she imagined, or "pretended," moving the distal (and missing) part of the amputated limb, symptoms subsided. A sleep study obtained after amputation revealed an elevated periodic limb movement index (PLMI) of 24.8 including recording from the muscles of the amputated limb stump.

The patient was prescribed pregabalin 75 mg nightly and noted significant improvement in symptoms with the International RLS Study Group (IRLSSG) scale falling from pre-treatment score 27 to a score of 20 with therapy within weeks.

We found only 5 prior published case studies of RLS in phantom limbs. The fact that our case had symptoms prior to amputation, makes it more likely that it represents a mechanism related to RLS rather than a pain syndrome triggered by amputation. All prior cases were treated with dopaminergic agonists and a proposed mechanism for the phantom RLS was dysfunction of central dopaminergic systems[1]. Our case suggests that pregabalin can be a viable option for patients with Phantom RLS.

Conclusion: RLS may persist after amputation of the limb, which further supports the central mechanism of restless leg syndrome. Pregabalin should be considered as a potential therapeutic option especially in patients with comorbid sleep disturbance and pain, or in patients at risk for augmentation of RLS symptoms.

1226

TWO CASES OF CENTRAL SLEEP APNEA IN PATIENTS ON INTRATHECAL BACLOFEN (ITB)

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Introduction: Central sleep apnea (CSA) has been reported in association with baclofen, a $GABA_B$ receptor agonist. Few studies have described CSA in patients using intrathecal baclofen (ITB). Here we describe two such patients seen in sleep clinic.

Report of Case: A 32-year-old male was referred for snoring and gasping sensations. History was significant for treated childhood astrocytoma and strokes resulting in left hemiparesis, spasticity and functional deficits. He had been on ITB for nine years prior to presentation. Apnea-hypopnea index (AHI) was 154.3 events/hour, including 332 central apneas. CPAP failed to resolve central apneas, but adaptive servo-ventilation (ASV) at 9 cm H_2O resolved both obstructive and central apneas.

A 40-year-old male with spastic tetraplegia from a traumatic brain injury (TBI) in 1995 was seen for unrefreshing sleep and excessive daytime sleepiness. He had been using an ITB for 10 years prior to presentation. A polysomnography (PSG) showed an overall AHI of 42, predominantly from 238 central apneas, which improved after treatment with ASV.

Conclusion: CSA has previously been described in patients on baclofen therapy for alcohol withdrawal, but few studies have described CSA in patients with ITB for spasticity. Baclofen decreases minute ventilation in animals, but the mechanism by which it does so is unclear at this time. A pilot study revealed bolus administration of ITB can worsen pre-existing sleep apnea, whereas a continuous infusion did not significantly affect previous sleep disordered breathing. It may be important to perform PSG in patients prior to ITB pump placement. Another study demonstrated changes in sleep architecture and minor decreases in mean oxygen saturations following administration of oral baclofen, but limited effects on sleep-disordered breathing (SDB). It is possible that TBI and/or stroke may have contributed to the SDB observed in our patients. Our patients experienced improvement in CSA following ASV.

1227

SLEEP DISTURBANCE IN AN ADOLESCENT WITH POTS

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Introduction: Postural Orthostatic Tachycardia Syndrome (POTS) is commonly associated with sleep disturbance. Reported factors include dysautonomia, medications, and pain, but objective sleep assessments including Polysomnography (PSG) and Actigraphy have demonstrated sleep-wake misperceptions to be common.

Report of Case: 15-year-old female with POTS, characterized by orthostatic intolerance, dysautonomia, fatigue, gastrointestinal disturbance, depression and pain, presented with a 1-year onset of insomnia. Patient reported a bedtime at midnight with a 1 hour sleep latency (SL), nighttime awakenings, and daytime sleepiness. She complained of nocturnal emesis, pain and leg discomfort relieved

by movement disturbing her sleep. She had been homeschooled for the past 3 months, and sleep hygiene was inadequate. Home medications included propranolol, midodrine, cyclobenzaprine, and later fludrocortisone. An in-lab PSG suggested Insomnia, with a Total Sleep Time (TST) of 5.7 hrs, Sleep Efficiency of 83%, SL of 37 min, Wake-time after Sleep-onset of 31.5 min, Apnea-hypopnea Index of 0.7/hr, and Periodic Limb Movement Index of 0/hr. Melatonin was started besides cognitive behavioral intervention. Gabapentin and iron therapy (ferritin = 32 ng/ml) were started for Restless Leg Syndrome-like symptoms, and improved. Insomnia also improved, but then the patient complained of "not sleeping at all". Finally, a 2-week Actigraphy demonstrated an average Bedtime at 1 am (1 am – 5 am), SL of 29 min, Sleep Efficiency of 85%, TST of 9 hrs, suggesting Delayed Sleep Phase Syndrome. She was advised to restructure her sleep schedule, helped by returning to school, along with melatonin, bright light exposure and good sleep hygiene which ultimately improved her insomnia.

Conclusion: Sleep-wake misperception is reported to be common in POTS, but this patient had many other factors that could contribute to insomnia. Actigraphy played a key role in understanding and treating this patient's sleep disturbance. Thus, Actigraphy should be part of the work-up in complicated insomnia.

1228

NIGHT EATING SYNDROME: AN UNDIAGNOSED CONTRIBUTOR TO OBESITY IN NARCOLEPSY TYPE I

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Introduction: Narcolepsy with cataplexy (NC) has been associated with excessive weight gain via several mechanisms. Some studies have suggested a common genetic predisposition, intrinsic increased BMI or decreased energy expenditure. Compulsive nighttime eating has been suggested as another possible underlying contributor. We report a clinical case so as to illustrate some of the issues involved.

Report of Case: A 38 year old female with a past medical history of narcolepsy with cataplexy diagnosed in 1998 who later established care at our center in 1999 for management and follow up. Patient was initially put on sodium oxybate (GHB, Xyrem, Jazz Pharmaceuticals), methylphenidate and fluoxetine. During her pregnancy in 2009 and after delivery, patient stopped taking sodium oxybate for fear it may prevent her from waking up at night to care for her child. She was off the medication until December 2015 when she presented to our clinic for new symptoms of snoring, worsening of daytime sleepiness and nocturnal arousals. The patient weighed 108 lbs in 2000 while at her visit in 2015 she weighed 170 lbs. Patient endorsed nocturnal eating whereby she wakes up at around 1 am and is not able to return to sleep before eating a meal. This nocturnal eating impulse has been present since her college years. Decision was made to have repeat polysomnography to rule out obstructive sleep apnea (OSA). PSG done on 2/24/2016 confirmed moderate OSA AHI= 15.7 with a supine AHI of 32.7. Patient was later titrated on a CPAP of 8 cmH2O. Patient opted for an oral device.

Conclusion: Night Eating Syndrome (NES) is characterized by hyperphagia after the evening meal, either before bedtime or after fully awakening during the night. Monitoring for weight gain and screening for NES should be considered in NC patients.

1229

SEXSOMNIA: ONSET OF SLEEP RELATED MASTURBATION AFTER SUCCESSFUL TREATMENT OF DAYTIME OBSESSIVE-COMPULSIVE DISORDER

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Introduction: Sexsomnia was first coined by Shapiro in 2003 with case series in the literature focusing on related sleep disorders and clinical manifestations. Little is reported regarding underlying psychopathology. We report a case of sexsomnia preceded by effective treatment of daytime obsessive-compulsive disorder (OCD).

Report of Case: A male in his late 20s was referred to our tertiary sleep disorders center for evaluation of nocturnal masturbation in sleep. Symptoms began after successful treatment of OCD (obsessive, intrusive, recurrent thoughts sexually oriented). After completing therapy, using daytime clonazepam and selective-serotonin reuptake inhibitor his daytime symptoms resolved; however, there was emergence of nocturnal masturbation. The patient's religious beliefs made this behavior extremely upsetting to him causing him to bind his arms and legs to the bed to prevent the behaviors. At presentation, he denied snoring, somnambulism, and depression. All medication was stopped without a change in nocturnal masturbation. He reported somniloquy and a family history of parasomnias, eating disorder, depression, and anxiety. His Epworth Sleepiness Scale was 14/24. Physical examination was normal other than mild retrognathia. A two-night polysomnogram with seizure and parasomnia montage was obtained. The studies showed snoring without sleep apnea. The patient was started on clonazepam nightly and referred to psychology for psychotherapy.

Conclusion: We describe a novel case where treatment of underlying co-morbid psychiatric condition was associated with onset of sexsomnia. Previous case reports have focused on treatment of co-morbid sleep conditions. This case highlights the role daytime psychopathology and treatment of daytime disorders can influence the expression of nocturnal behaviors when one has little or no voluntary control over their actions. Obtaining a thorough history of psychopathology is essential to understanding sexsomina cases and should not be overlooked. With appropriate psychological treatment and use of clonazepam he will hopefully not have to be a prisoner in his bed.

1230

STEVENS-JOHNSONS SYNDROME AFTER ARMODAFINIL USE

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Introduction: Stevens- Johnson Syndrome (SJS) is reported as a possible adverse effect for modafinil and armodafinil, yet no definitive case has been presented in the literature. A warning associating these drugs with SJS is primarily based on a rash that formed on one patient during modafinil clinical trials. We present a case of a patient who developed SJS less than two weeks after starting armodafinil.

Report of Case: A 21 year old female with a significant history of maintenance immunotherapy for common allergies presented with excessive daytime sleepiness dating back since childhood despite 9 hr sleep per night. Diagnostic testing with PSG demonstrated no significant obstructive breathing, but the MSLT showed markedly shortened sleep onset latencies (mean=1.6 min.) without REM. Final diagnosis was idiopathic hypersomnia. She was started on Nuvigil 150 mg PO QAM. The medication was discontinued 13 days later after experiencing mild subjective fevers and

cervical lymphadenopathy on day 9. Within 12 hours of discontinuation, ulcers appeared on her mouth and lips, with a generalized rash that spread over her body. She was hospitalized on day 14, received supportive care, and was diagnosed with biopsy supported SJS. Follow up 3 months later showed subtle skin discolorations over blistered areas. She remained symptomatic with daytime sleepiness. No alternative agent was initiated.
Conclusion: On label warnings for both modafinil and armodafinil report the risk for serious rash, including SJS. Of the 13 cases of non-specific rash resulting in discontinuation of modafinil in clinical trials, only 1 case was reported as possible SJS, all occurring in pediatric patients less than 17 years old. There are no known predictive risk factors for skin rash prior to starting treatment, nor are there predictive features of rash severity once it appears. Recommended course of action is to promptly discontinue modafinil or armodafinil at symptom onset.

1231

A TRANSFORMING TREATMENT MODALITY FOR OBSTRUCTIVE SLEEP APNEA

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Introduction: Obstructive sleep apnea (OSA) is a heterogeneous disease process with different pathophysiological phenotypes. Treatment of OSA with continuous positive airway pressure (CPAP) is effective, but not always tolerated. Novel treatment approaches have been evaluated within the literature with varying success. We present a prospective treatment option for OSA amongst a unique and increasing patient population.
Report of Case: A 47 year old transgender female (biological male) patient with a history of severe OSA was referred to our center for treatment. The patient was diagnosed in 2008 and treated with UPPP. The patient subsequently underwent a polysomnogram (PSG) in November of 2014 for residual daytime somnolence, which demonstrated an apnea-hypopnea index (AHI) of 46.8. The following year, another PSG was performed at a different center revealing an AHI of 52. Treatment with CPAP was initiated, but poorly tolerated. Upon our evaluation the following year, she had been placed on transdermal estradiol 5 months prior, as part of the gender transition process. An ensuing diagnostic PSG demonstrated a complete resolution of OSA, with an AHI of 0.4 per hour.
Conclusion: To our knowledge, estrogen has never been used to treat a biological male with a sleep related breathing disorder. Estrogen is believed to be protective of sleep disordered breathing given the low prevalence of OSA in pre-menopausal women. Yet, the exact mechanism of estrogens role in preventing OSA is unclear. It has been suggested that estrogen raises the apneic threshold, thereby stabilizing the upper airway during sleep. When administered to post-menopausal women, estrogen has improved the AHI in several small studies. Given the drastic reduction in our patient's AHI following the initiation of transdermal estrogen therapy, hormone treatment should be investigated further to determine its role in the transgender female population with OSA.

1231

HYPERSOMNIA IN A PATIENT WITH A GLYCOGEN STORAGE DISEASE

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Introduction: Sleep disordered breathing (SDB) is associated with metabolic myopathies like Pompe's disease (glycogen storage disease type II). Late-onset Pompe's is characterized by progressive proximal and axial muscle weakness, rhabdomyolysis and respiratory insufficiency. Diaphragmatic weakness contributes to sleep disordered breathing and hypoventilation, and many patients also have concurrent obstructive sleep apnea (OSA), with significant hypoxemia in Stage REM sleep. McArdle's disease (glycogen storage disease type V), which is characterized by fatigue, exercise induced myalgia, rhabdomyolysis, episodic myoglobinuria and progressive proximal muscle weakness has not previously been associated with SDB. We present a patient diagnosed with McArdle's disease and an interesting presentation of sleep apnea.
Report of Case: A 36-year-old female presented with a clinical diagnosis of McArdle's disease and excessive daytime sleepiness. She reported six months of progressive bilateral upper and lower extremity weakness with worsening daytime sleepiness despite 9–12 hours of sleep per day. She experienced nocturnal awakenings with coughing several times per week, morning headaches that improved shortly after waking up but prior to caffeine intake, nocturnal reflux, irritability, weight gain, and nocturia. Polysomnography demonstrated a total sleep time of 481 minutes and an apnea hypopnea index of 4.5/hr (9 events/hour supine, 10.8 events/hour in supine REM, 2 events/hour nonsupine).
Conclusion: This case represents the first reported instance of REM dependent obstructive sleep apnea in a patient with McArdle's disease. Fatigue and daytime sleepiness are common presenting symptoms in patients with myopathies, and it is important to consider sleep disordered breathing in this population. Notably, cases involving younger patients and females may have REM dependent sleep apnea, and daytime sleepiness that is disproportionate to the absolute, or total, apnea hypopnea index.

1233

RECURRENT ATRIAL FIBRILLATION RESPONSIVE TO CPAP

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Introduction: The association between atrial fibrillation (AF) and obstructive sleep apnea (OSA) is well established. We present a case of recurrent nighttime AF responsive to CPAP therapy in a patient previously treated with catheter ablation.
Report of Case: A 67 year old man, with a prior history of catheter ablation of AF, presented with complaints of episodic, nighttime palpitations and excessive daytime sleepiness. Initial catheter ablation four years prior resulted in resolution of his palpitations. Approximately a year after the ablation his palpitations returned. These events would only occur at night and awaken him from sleep. Holter monitoring showed baseline sinus rhythm with multiple episodes of nocturnal AF with rates of 75 to 169 beats/min correlating with his nocturnal palpitations. The patient's wife reported that he snored loudly and had occasional apneic episodes. He was referred for a monitored sleep study. The apnea hypopnea index (AHI) was 36/hr overall with nadir desaturation to 72%. There were occasional short runs of atrial fibrillation on the night of the polysomnography correlating with decreased air flow. CPAP at 10 cm H20 treated the sleep disordered breathing and normalized the oxygen saturation. Initially the patient was non-compliant with CPAP but upon further education and encouragement he improved compliance. The patient reported resolution of the nocturnal palpitations after adherence with CPAP. A follow-up holter monitor did not reveal further AF.
Conclusion: Patients with OSA have a four-fold risk of developing AF compared to patients without sleep disordered breathing and may develop AF that recurs after catheter ablation. Patients with AF, especially if recurring after ablation should be screened for OSA. Treatment of OSA may help reduce the risk of developing incident AF.

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CONTROLLING CATAPLEXY AND STABILIZING BODY WEIGHT: THE YIN-YANG OF NARCOLEPSY TYPE 1 TREATMENT

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Introduction: Narcolepsy type 1 is often associated with drastic body weight changes prior to diagnosis and after beginning treatment. Weight gain is a well-known symptom in children that could be prevented by active treatment. However, even when improvement of hypersomnolence can be achieved with lifestyle changes and stimulant medications, the control of cataplexy with medications and achieving a healthy weight can be challenging for clinicians.
Report of Case: In this case report, we present a longitudinal perspective of sleep abnormalities in a 17 year old African American female that came for evaluation of inadequate and disabling hypersomnolence associated with weight gain, partial body weakness with laughing and recurrent nightmares since the age of 15 years old. Patient's physical examination was with in normal limits except for a Body Mass Index of 36.2 kg/m2. Initial polysomnography testing revealed adequate sleep efficiency with Mean Sleep Latency of 3 minutes and REM Latency of 1 min. A subsequent Multiple Sleep Latency Test was consistent with the diagnosis of Narcolepsy. The patient was progressively treated to the maximum dose of Modafinil for excessive daytime sleepiness, but cataplexy events continued to worsen, affecting her daily activities. Sodium oxybate was added to the regimen until maximum doses were achieved without much efficacy in cataplexy control. After 13 months of treatment and the addition of low dose Venlafaxine, an alarming drop of BMI from 36.2 kg/m2 to 22.4 kg/m2 during treatment prompted for dose adjustments until the patient's body weight stabilized was achieved.
Conclusion: Our clinical case portraits an overlooked effect of the treatment of patients with narcolepsy. While weight gain is a predominant symptom of undiagnosed narcolepsy, weight loss vigilance during treatment by qualified clinicians is imperative, especially while trying multidrug treatment of cataplexy events.

1235

COMPLEX SLEEP APNEA REFRACTORY TO POSITIVE AIRWAY PRESSURE (PAP) THERAPY WHILE ON BACLOFEN THAT RESPONDED TO CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP) THERAPY UPON CESSATION OF BACLOFEN

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Introduction: Complex sleep apnea represents a response to Positive Airway Pressure (PAP) therapy in patients with preexistent Sleep Disordered Breathing (SDB). Baclofen is a gamma-aminobutyric acid-B (GABA-B) agonist with muscle-relaxant properties used to treat spasticity. A recent publication showed that these central apneas responded to either discontinuation of the medication or Adaptive Servo Ventilation (ASV) initiation.
Report of Case: A 61-year-old male with hypertension, lower back pain, and SDB, taking gabapentin, escitalopram, and baclofen (20 mg, three times daily), without concurrent use of opioids, presented for a second opinion regarding his SDB. The patient completed three polysomnograms (PSG's) at an outside facility. The initial two PSG's revealed complex apneas non-responsive to CPAP or BiPAP. An ASV titration resulted in control of his respiratory events; however, he was unable to tolerate the pressure settings. After our initial evaluation, the patient underwent his fourth PSG that continued to demonstrate complex apneas, which were non-responsive at CPAP 11 cm. The apnea-hypopnea index (AHI) during this study was 81.4 at CPAP of 11 cm H2O. The patient was advised to proceed with a very slow and monitored tapering of his baclofen. His fifth PSG was completed three weeks after discontinuation of baclofen with a significant response of his SDB and complete resolution of complex apneas at CPAP 14 cm H2O with a final AHI of 3.
Conclusion: The adverse effects of baclofen causing varying degrees of hypersomnolence and respiratory depression have been well published. GABA is an inhibitory neurotransmitter in the central nervous system that specifically affects the ventilator drive. This case demonstrates SDB refractory to CPAP therapy in a patient on a standard dose of baclofen who then responded to CPAP therapy only after discontinuing baclofen. This case demonstrates CPAP resistant SDB that responded to the intervention of discontinuing treatment with baclofen.

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A CASE OF WILDERVANCK SYNDROME LIKELY PREDISPOSING TO OBSTRUCTIVE SLEEP APNEA WITH SUCCESSFUL TREATMENT WITH POSITIVE AIRWAY PRESSURE

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Introduction: Wildervanck Syndrome (WS), which is also known as Cervicooculoacoustic Syndrome, is a disorder that includes Klippel Feil Syndrome (KFS), along with ophthalmic abnormalities (typically, limited eye movement) and hearing impairment.
Report of Case: A 59 year-old female with a past medical history of hypertension, hyperlipidemia, Primary Open Angle Glaucoma (POAG), external auditory canal atresia (bilaterally), and conductive hearing loss (bilaterally), presented to Sleep Medicine clinic complaining of snoring and excessive daytime sleepiness. Physical exam revealed body mass index: 29, Mallampati class: IV, tonsils: 2+, macroglossia with lateral scalloping, a high arched palate, a short neck (with limited extension), a low posterior hairline, scoliosis, and an external auditory canal malformation. Polysomnography showed an apnea-hypopnea index of 23- consistent with obstructive sleep apnea (OSA). She underwent Positive Airway Pressure (PAP) titration, and was placed on Bilevel Positive Airway pressure (BiPAP) at 25/18 cm H2O. Further evaluation of physical exam findings included a neck radiograph revealing fusion of cervical vertebrae C1-C3 and chest radiograph showed dextro-scoliosis. MRI of the cervical spine confirmed fusion of C1-C3. Ophthalmology referral revealed POAG, anterior uveitis, and an unreliable test using the Humphrey Visual Field Analyser, possibly as a result of limited eye movement. Otolaryngology consultation confirmed conductive hearing loss and bilateral aural atresia/microtia. The combination of these medical problems is consistent with the diagnosis of WS. This patient has continued to use BiPAP at 25/18 cm H2O, and states her quality life has improved significantly.
Conclusion: We present a rare case of WS that may have a significant correlation with sleep disordered breathing (SDB), which responded well to PAP therapy. Careful attention should be paid to ophthalmic and otologic pathologies when evaluating patients with KFS, as they may have WS. This should serve to help other clinicians be aware of WS as a possible predisposition to SDB.

1237

CSA WITH CHEYNE-STOKES RESPIRATION IN CONGESTIVE HEART FAILURE: TREATMENT WITH BIPAP-ST UTILIZING A NARROW PRESSURE SUPPORT

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Introduction: The treatment of central sleep apnea associated with CHF can be difficult, especially in the setting of comorbid OSA. While the optimal treatment is aimed at improving cardiac function, our goal as sleep physicians is to stabilize the loop gain while also treating upper airway obstruction.
Report of Case: This is a 50 yo male with history of OSA and systolic heart failure with EF 20–25%. He was referred to sleep medicine for evaluation of persistent hypersomnia and PND despite compliance with CPAP therapy. A split study was performed with a predominance of central apneas, Cheyne-Stokes Respiration (CSR) and AHI 93.1 seen during the diagnostic portion. Titration was initiated with CPAP 10cmH20, later switched to BIPAP-ST with supplemental oxygen. A final pressure of 24/20 cmH20 with back up rate 16 bpm and 4L oxygen was reached. However, at this pressure setting, AHI remained uncontrolled at 75.4 with predominant central events, CSR and oxygen nadir of 36% (average 89%). We hypothesized the pressure support of 4 cmH20 was exacerbating patient's hyperventilation and thus contributing to instability of loop-gain. For this, a repeat titration study was done the following night with BIPAP-ST utilizing a narrow pressure support of 2 cmH20. Titration resulted with optimal final pressure of 18/16 cmH20, BUR 15 and 4L oxygen. Results showed a decrease in AHI to 33 with oxygen nadir of 82% (average 97%).
Conclusion: These results support the idea that a wide pressure support may exacerbate the underlying hyperventilation and thus contribute to a high loop-gain system. However, by utilizing a narrow pressure support with oxygen, the goal is to diminish this effect and stabilize the pCO2 levels above the apneic threshold. In conclusion, despite potential confounding factors, further attention to the treatment of CSA-CSR in CHF with BIPAP-ST and a narrow pressure support with oxygen should be pursued.

1238

WEST NILE ENCEPHALITIS WITH SUSPECTED DIAPHRAGMATIC DYSFUNCTION LEADING TO SLEEP APNEA WITH ASSOCIATED HYPOVENTILATION

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Introduction: Currently, there are no guidelines on the management of acute sleep disordered breathing in the ICU or inpatient setting. Here, we report a case in which an acute sleep medicine evaluation was utilized to treat a patient with West Nile Encephalitis and sleep related hypoventilation with suspected diaphragmatic weakness.
Report of Case: This is an 82 yo male who presented with lethargy and dyspnea after a recent trip to El Salvador. Physical exam was significant for shallow, rapid respirations with mild use of accessory muscles and fluctuating mental status. Patient denied any history of lung disease or OSA but became progressively more somnolent with rising pCO2 levels. This prompted a sleep medicine consult to optimize PAP therapy as patient had declined elective intubation. Due to patient's unstable condition, a bedside trial was performed in the Step Down Unit utilizing BIPAP with settings of 18/8 cmH20, PS 4 cmh20 and 2L O2. Results showed an AHI of 72 with evidence of worsening hypoventilation based on his pCO2 of 80 (ABG). However, this study was limited due to the inability to differentiate central from obstructive events given the available equipment. Concurrently, further workup for encephalopathy revealed presence of West Nile Encephalitis based on positive IgM antibodies in CSF. Upon review of additional studies, chest imaging was concerning for diaphragmatic dysfunction. This concern was corroborated by ultrasonography which, although of poor image quality, failed to show any significant inspiratory contraction of the R diaphragm. A repeat BIPAP trial was then performed utilizing a backup rate of 12 bpm with pressure of 16/10 cmH20 and 2L O2. Results showed an AHI of 15.7 with average O2 91.6%. In the days following, his pCO2 levels improved to 50. In conclusion, WNV-induced myositis vs phrenic neuropathy leads the differential for this patient's diaphragmatic dysfunction/hypoventilation. Further testing is needed.

1239

DEEP BRAIN STIMULATOR ARTIFACT ON POLYSOMNOGRAPHY

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Introduction: This is the first reported case documenting the a unique Deep Brain Stimulator (DBS) artifact during polysomnography (PSG) in a patient with primary dystonia as 100 Hz interference external artifact.
Report of Case: A 49-y/o male with DYT1 early-onset primary dystonia (DYT1) status post bilateral globus pallidus pars interna (GPi) DBS placement presented to the sleep clinic for evaluation of sleep apnea, teeth grinding and daytime sleepiness for the past 3 years. The patient underwent a diagnostic PSG with a bruxism electromyographic montage.

During the recording, a 130 Hz interference artifact was captured-seen throughout the PSG channels referred to the patient's DBS. The DBS artifact was characterized by a series of narrow band and periodic artifact at the harmonic frequency of his DBS stimulation at 100Hz. While his DBS could be temporarily turned off at night to allow for accurate scoring, the patient declined this request. His PSG revealed severe obstructive sleep apnea.
Conclusion: A DBS consists of electrodes implanted into the GPi that connect to an impulse generator placed subcutaneously over the chest and acts by inhibiting the abnormal brain activity responsible for dystonia. The patient's DBS was set to a frequency of 1300 Hz, a pulse width of 450 μs and amplitude of 1.3 V to 2.3 V130 Hz. This case report illustrates the DBS interference artifact characterized by a 100Hz frequency of 130 Hz which obscuredartifact obscuring the entire PSG epoch assuming a checkerboard morphology. The DBS may be turned off during the PSG to allow for adequate sleep scoring, butthough patients may not tolerate it. The case highlights that in patients in whom DBS requires activity at night, alternative diagnostic tools excluding electroencephalography (such as home sleep apnea testing) may be considered. (HSAT) as a diagnostic tool in patients who refuse to have their DBS device deactivated at night Sleep physicians may have to consider Home Sleep Apnea Testing (HSAT) as a diagnostic tool in patients who refuse to have their DBS device deactivated at night. Alternatively, new filtering methods such matched filtering or frequency-domain Hampel filtering algorithms may be used to remove the DBS artifact from a PSG.1,2

1240

NON-REM PARASOMNIAS AS THE PRESENTING SYMPTOM OF NARCOLEPSY WITHOUT CATAPLEXY

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Report of Case: Narcolepsy without cataplexy and non-REM parasomnias are both relatively rare disorders with prevalence of 0.05% and 2.5% respectively. Parasomnias occur more frequently in patients with narcolepsy, however, most of these parasomnias are REM related. A cross sectional study in Japan reported that dream enactment behavior occurs more in narcoleptics than controls. The most common presenting symptom of narcolepsy is excessive daytime sleepiness. We report a case of a 25 year old male with obstructive sleep apnea with good adherence to CPAP who presented with the chief complaint of parasomnias. From the age of 14 years he has had nightly episodes of complex parasomnias involving sleep walking, sleep talking and various dream enactment behaviors. The patient had been diagnosed with OSA 2 years ago and placed on CPAP at 15 cm of water pressure. In the past 367 days his adherence for four or more hours of use five nights per week was 75.7%. His average use for the nights he used CPAP was over 6 hours. His residual apnea hypopnea index was 2.1 events per hour. His Epworth was 15/24, and he was treating his fatigue by routine consumption of more than six cups of coffee a day. He denied cataplexy. A titration polysomnogram followed by a multiple sleep latency test (MSLT) revealed five brief episodes of NREM parasomnia in which the patient was talking, laughing, making purposeful movements and attempting to leave the bed. These episodes were unrelated to any breathing events. The MLST showed a severe tendency to sleepiness with a mean sleep latency of 3.3 minutes. Three of four naps showed early onset REM sleep. In conclusion, this patient had a rare presentation of narcolepsy, with the primary complaint of parasomnias over excessive daytime sleepiness. The role of caffeine in his parasomnias is unclear.

1241

NON-SUICIDAL INGESTION OF HIGH DOSE ANTI-HISTAMINE IN A 57 YEAR-OLD WOMEN WITH INSOMNIA AND RESTLESS LEG SYNDROME

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Report of Case: Restless leg syndrome (RLS) is a common sleep-related disorder affecting approximately 7% of the European and American population, increasing in severity with advancing age and more common in women. It is classically described as an urge to move the legs when resting, with commonly associated dysesthesia, and a circadian appearance. These symptoms can be severe. RLS can cause sleep-onset or sleep-maintenance insomnia, unrestorative sleep and poor quality of life. This 57 year-old Caucasian female was brought to the Emergency Department with altered mental status and hypersomnolence after she was found unarousable at home. She had ingested twenty to thirty, 25 mg diphenhydramine tablets. Laboratory testing did not show any other intoxications and head CT was unremarkable. Physical examination revealed bruising on both upper thighs at different stages of healing. The patient acknowledged the ingestion but was adamant that this gesture was not an intentional overdose, but an attempt to treat her insomnia. She reported a 5-year history of sleep-onset insomnia with the routine use of diphenhydramine as a sleep aid. She stated that she "punches" her legs to get relief from the restlessness in her legs. She had been increasing the diphenhydramine dose, thinking it would help with her insomnia, not realizing that it was actually making RLS worse. The patient was discharged from the hospital on 2 mg of clonazepam with significant benefit on follow-up encounter. This patient had an intentional non-suicidal ingestion of high doses of diphenhydramine in an attempt to treat her insomnia. Diphenhydramine is a common over-the-counter medication for insomnia that has the potential to worsen RLS. The patient used this medication, not realizing that this was worsening her RLS. Delayed diagnosis and her lack of awareness of the effects of diphenhydramine on RLS prolonged and complicated her illness and resulted in self-injury and hospitalization.

1242

A CASE OF FRIEDREICH'S ATAXIA AND REM SLEEP BEHAVIOR DISORDER IN A TEENAGER CAUSING SUBOPTIMAL NON-INVASIVE POSITIVE PRESSURE (NIPPV) COMPLIANCE

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Introduction: Friedreich's ataxia (FA) is the most common autosomal recessive ataxia. This disorder is associated with progressive development of sensory and cerebellar ataxia, along with cardiomyopathy and scoliosis. In the pediatric population, FA can be associated with obstructive sleep apnea (OSA) and hypoventilation; REM sleep behavior disorder (RBD) is not well described in the pediatric literature.
Report of Case: A 16 year old male with a history of FA, cardiomyopathy, scoliosis, restrictive lung disease, and severe OSA treated with Noninvasive Positive Pressure Ventilation (NIPPV) therapy presented to the pediatric home ventilator clinic with symptoms of daytime fatigue and hypersomnolence with reported inability to tolerate bilevel PAP therapy with spontaneous –timed mode. By parent report, he consistently took off his mask at night after 2–3 hours of use, had vocalizations and excessive movements during sleep. Given concern for intolerance to NIPPV or suboptimal treatment of sleep-disordered breathing, the patient underwent a retitration polysomnogram (PSG) resulting in the initiation of Pressure Control / Average Volume Assured Pressure Support (PC/AVAPS) therapy. Notably, the patient was also seen on PSG to remove his mask several times during rapid eye movement (REM) sleep resulting in frequent awakenings and sleep fragmentation. The patient was sent to a neurologist specializing in movement disorders and was diagnosed with REM sleep behavior disorder. The patient was trialed on melatonin, both 5 and 10 mg, without benefit. He was then started on clonazepam with titration up to 1 mg at bedtime which effectively controlled his nocturnal movements. On clonazepam, the patient demonstrated significant improvement in compliance with NIPPV therapy and improvement in both daytime fatigue and hypersomnolence.
Conclusion: Pediatric patients with Friedreich's Ataxia have high risk for OSA and hypoventilation often requiring NIPPV. In this population, RBD, although rare, should be considered as a potential cause for the NIPPV non-adherence.

1243

REVISION ADENOIDECTOMY IN THE MANAGEMENT OF RESIDUAL OSA POST-ADENOTONSILLECTOMY IN A CHILD

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Introduction: In children post adenotonsillectomy (AT), reassessment for residual OSA depends on the initial severity. When OSA remains severe, clinicians often choose positive airway pressure (PAP) therapy, but adherence is challenging. We present a case that highlights the importance of on-going monitoring of therapy, PAP adherence with advanced diagnostics, and upper airway re-evaluation for adjunctive surgical procedures, as OSA persisted.
Report of a Case: Seen post-AT, this 7 yr-old boy had worsening OSA symptoms and was started on PAP therapy (autotitrating device at 6–16 cwp) after an urgent split-night polysomnogram (PSG) showed an obstructive apnea-hypopnea index (oAHI) of 42 with significant hypoxemia and poor nasal airflow requiring a full face mask. Comorbidities included nasal allergies, asthma and obesity (BMI z-score=2.7). He was originally diagnosed at age 2 (oAHI=12), underwent AT at age 3, then had a repeat PSG at age 5 with mild residual OSA (oAHI=3.1). Over the next 9 months, his 90th percentile PAP pressure increased from 8 to 14 cwp. He used his PAP therapy 90% of nights, but only 60% of nights for >4 hr; when used residual AHI was ~1.7/hr. An ENT reassessment showed 90% adenoidal regrowth with no other anatomical abnormalities. He underwent revision adenoidectomy with dramatic relief of symptoms. Follow-up PSG off CPAP showed mild residual OSA (oAHI=3.2) with no impact on gas exchange or sleep continuity. He continues on medical management of nasal allergies and asthma, with continued efforts on weight reduction.
Conclusion: Regrowth of adenoids with recurrence may occur on CPAP, particularly in children undergoing adenoidectomy before 6 years of age. Benefit in terms of symptoms and freedom from CPAP can be derived from revision adenoidectomy. Re-assessment of OSA symptoms and response to treatments is also a key quality measure in children.

1244

NON-24-HOUR SLEEP-WAKE RHYTHM DISORDER: A SUCCESSFUL CASE OF A 50 YEARS-OLD BLIND WOMAN

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Introduction: Non-24-hour sleep-wake disorder (N24SWD) is characterised by insomnia and/or excessive daytime sleepiness due to misalignment between the 24-hour light-dark cycle and the endogenous circadian rhythm. Blind individuals are more susceptible to have nonentrained circadian rhythms due to the lack of photic input to the circadian pacemaker.
Report of Case: A 50-years-old totally blind woman, married, mother of two children and retired for 14 years was referred to Université Laval Sleep Clinic. She has complained of excessive daytime sleepiness (Epworth=20/24) and great fatigue for eight years. She also reported disruption in her self-esteem and social/occupational functioning. She was diagnosed with sleep apnea in 2012 and with RLS/PLMS in 2015. These sleep disorders were addressed, respectively, with a CPAP machine and the intake of 300 mg of iron every night. The results of her MSLT demonstrated sleep latency within the normal. At the Sleep Clinic, the patient meet the criteria for N24SWD and agoraphobia. She has past medical history of depression with suicidal ideation. Citalopram and Bupropion had been addressed since 2009 in order to prevent recurrence of depression. Her treatment was based on CBT-I adapted for excessive daytime sleepiness and anxiety-depressive symptoms. Actigraphy and sleep diaries were used to monitor her sleep patterns, wakes times and the alignment of her sleep to external environment. Light therapy twice a day and structured social and physical activities were also employed. Her drugs doses were revised, since Citalopram is likely to increase sleepiness and RLS/PLMS symptoms.
Conclusion: The patient totalised 23 sessions at the Sleep Clinic from March 2015 to March 2016. The synchronization between her circadian rhythm and the 24-hour light-dark cycle, as well as the use of light therapy and the reduction of Citalopram's dose helped her to significantly decrease fatigue and daytime sleepiness levels (Epworth=7/24), stabilise her humor, and increase general daytime functioning.

1245

REM ASSOCIATED INCREASE IN INTRACRANIAL PRESSURE IN A CHILD WITH CRANIOSYNOSTOSIS

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Introduction: Clinical associations between increased intracranial pressure (ICP) during rapid eye movement (REM) sleep and upper airway resistance have been described previously but few pediatric patients have undergone ICP monitoring during sleep. This case report describes a child with Saethre-Chotzen (craniosynostosis) syndrome with headache, vomiting and snoring who had elevated ICP during REM sleep.
Report of Case: A 7 year-old girl with Saethre-Chotzen syndrome presented with headaches, vomiting and loud snoring. She subsequently underwent intracranial pressure (ICP) monitoring, which demonstrated increase in ICP during sleep with pressure normalization during wakefulness. Overnight polysomnography with ICP monitoring was performed to evaluate for obstructive sleep apnea (OSA). Polysomnography demonstrated no OSA but revealed increase in ICP during REM sleep with two spikes in ICP at onset of REM. Interestingly, oxygen desaturations to the 80s as a result of multiple central events occurred during her first ICP elevation. Both ICP elevations normalized with transition to non-rapid eye movement (NREM) sleep. In healthy individuals, studies demonstrated 10–20% reduction in cerebral blood flow (CBF) during NREM sleep and 20–35% increase in CBF during REM sleep compared with wakefulness. The child underwent anterior cranial vault expansion with distraction resulting in markedly improved headache frequency. Repeat polysomnography demonstrated no OSA or desaturations and REM-related ICP elevations were lower than before surgery.
Conclusion: This case highlights the interesting finding of elevated ICP secondary to increased intracranial blood flow during REM sleep. Due to worsening cephalocranial disproportion and intracranial pressure dynamics, children with craniosynostosis may develop headaches due to sleep related increases in ICP. This child may have been particularly susceptible given history of craniosynostosis and dysmorphic cranium with flattening of frontal occipital bones. Symptoms improved markedly status-post cranial vault expansion. Although OSA can increase ICP, it is important to consider cephalocranial dynamics in patients with REM-related increases in ICP particularly when they are symptomatic.

1246

RECURRENT APNEIC EVENTS IN A PREMATURE INFANT – AN UNUSUAL PRESENTATION OF RETT SYNDROME

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Introduction: MECP2 related disorders overwhelmingly occur in females. Three variants have been described: 1) Classic Rett syndrome,

a neurodevelopmental disorder with apparently normal psychomotor development until 18 months of life, followed by regression in language and motor skills; 2) Atypical Rett syndrome, identified in patients with learning or intellectual disabilities along with motor findings of tremor or spasticity; and 3) Severe neonatal encephalopathy, described mainly in affected males with death before 2 years of age. Herein we present a case of the severe encephalopathy phenotype in a female infant with central sleep apnea.

Report of Case: We report a case of a 7 month old girl with a history of 29 week prematurity and bronchopulmonary dysplasia who presented with recurrent apneic spells at home during wakefulness and sleep, some requiring cardiopulmonary resuscitation. Polysomnography revealed a total apnea-hypopnea index (AHI) of 26.1/hour, obstructive AHI of 5.2/hour, central index of 20.9/hour, and end-tidal CO_2 levels greater than 50mmHg for 48.8 % of the total sleep time (worse during NREM). A diagnosis of central hypoventilation was confirmed. Testing for Phox 2B was negative. Full genome sequencing reported a mutation in the MECP2 gene. Additional workup revealed a patent ductus arteriosus, cortical visual impairment and EEG findings of encephalopathy without seizure activity. A tracheostomy was performed and respiratory support with mechanical ventilation was initiated.

Conclusion: Although congenital central hypoventilation syndrome is a common cause of central hypoventilation in infancy, other etiologies must be considered in the differential diagnosis especially when testing is inconclusive. The presence of central sleep apnea in older females with Classic Rett syndrome has been reported. However, presentation during infancy in a female (as in our case) is rare.

1247

ONE THING LEADS TO ANOTHER. SLEEP TESTING OPENS A PANDORA'S BOX.

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Introduction: Sarcoidosis is a multisystem granulomatous disorder. Pulmonary sarcoidosis can cause lung manifestation and may be at higher risk of obstructive sleep apnea (OSA).

Report of Case: A 55 year-old patient presented with snoring, witnessed apneas and daytime somnolence. She had sarcoidosis with pulmonary involvement, fibromuscular dysplasia, and rheumatoid arthritis. She complained of intermittent diaphoresis, constipation, frequent falls and cognitive impairment. Sleep history suggested occasional sleep initiation/maintenance insomnia, leg movements during sleep, sleepwalking and non-injurious dream enactment behavior. Epworth sleepiness scale score was 14. Physical examination showed labile blood pressure, neck circumference of 38 cm, Freidman class III oropharynx, decreased bilateral breath sounds, and unsteady gait. Echocardiography, cardiac stress test, nerve conduction and electromyography were unremarkable. Pulmonary function testing revealed a mild obstructive pattern with normal inspiratory/expiratory loops. Attended polysomnography (PSG) showed mild OSA with an apnea-hypopnea index of 7 per hour, worse on the back and in rapid eye movement (REM) sleep, with low baseline oxyhemoglobin saturation. Inspiratory stridor was observed in the supine position. Periods of REM sleep without atonia were noted, but no dream enactment behavior. Continuous positive airway pressure therapy was initiated at 8 cm of water pressure. Due to these findings on sleep history and PSG, she was scheduled to undergo brain MRI, vocal cord exam and respiratory muscle strength testing. PAP therapy effectively controlled her OSA.

Conclusion: Sleep medicine evaluation was sought for possible OSA. Detailed history uncovered additional symptoms that led to the suspicion of sarcoid involvement of the nervous system. PSG revealed stridor and possible hypoventilation, raising the possibility of involvement of the vocal cords and diaphragm respectively. This case emphasizes the importance of a detailed history in a sleep evaluation. PSG often diagnose sleep disordered breathing, but as in this case, can reveal possible progression of the underlying disease.

1248

A CASE OF DELAYED ONSET POSTTRAUMATIC SLEEPINESS

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Introduction: We report a case of delayed onset narcolepsy with cataplexy secondary to head trauma

Report of Case: A 12-year-old boy sustained a fall from his bicycle in May 2009. He fell on his face and had loss of consciousness for a few minutes. He subsequently developed problems with headache, anosmia, loss of emotion and loss of memory for about 8 months. In 2010, he was diagnosed to have ADHD and was initiated on Ritalin. In early, 2011 he developed symptoms of aggressive behavior, hyperphagia, possible hypersexuality, hypersomnia for 18 hours daily, cataplexy, hypnagogic hallucinations and sleep paralysis. Multiple Sleep Latency Test revealed latency of 1.2 min, sleep onset REM in every nap. HLA typing for DQB1*0602 subtype was positive. Hypocretin levels in the CSF were undetectable. He was diagnosed to have Narcolepsy and treated with Modafinil. With stimulant medications, he experienced worsening aggressive behavior and psychosis. These were discontinued and he was then initiated on Sodium Oxybate with significant improvement in daytime sleepiness.

Conclusion: Symptomatic narcolepsy with cataplexy is a rare condition. Its association with symptoms like aggressive behavior and hyperphagia is even rarer, and implies hypothalamic dysfunction beyond that seen in idiopathic narcolepsy. Etiology and pathogenesis of posttraumatic sleepiness are unclear. Lesions in the wake promoting brain areas might contribute to sleepiness after traumatic brain injury. Absent CSF hypocretin supports a mechanism of neuronal loss in the hypothalamus related to injury. Positive HLA typing suggests an autoimmune etiology. Autoimmune mediated cell loss could explain the delay between injury and onset of presentation. Traumatic brain injury could facilitate immune cell entry to the brain by disruption of blood-brain barrier. Stimulation of the immune system could trigger narcolepsy by activating dormant T cell clones.

1249

ROHHADNET SYNDROME: PIECING IT ALL TOGETHER

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Introduction: Rapid-onset Obesity with Hypothalamic dysfunction, Hypoventilation and Autonomic Dysregulation (ROHHAD) syndrome is a very rare disease with manifestations involving the endocrine, respiratory and autonomic systems. Rapid-onset weight gain and alveolar hypoventilation are the two most common initial manifestations of the disease. A thorough systematic evaluation is

essential to the diagnosis and follow-up of patients with ROHHAD syndrome.

Report of Case: We report a case of a 2 year 11 month old female with a history of asthma and allergies who was transferred from a local hospital with difficulty breathing. She was found to be hypothermic, bradycardic and hypoxemic and her clinical exam was otherwise benign except for obesity characterized by a weight in the 99th percentile. She underwent infectious work-up and was empirically initiated on broad spectrum antibiotics however all culture results were negative. Laboratory studies were remarkable for a serum bicarbonate level of 38 and an arterial blood gas that revealed a chronic respiratory acidosis. On further review, it was noted that the child had been normal weight until 18 months of age when she began to gain a considerable amount of weight rapidly. Sleep medicine and Endocrinology consultations were obtained at which point she underwent a systemic evaluation which revealed hypothalamic, respiratory, and autonomic manifestations consistent with a diagnosis of ROHHAD syndrome. She also underwent further diagnostic testing with computed tomography of the abdomen and pelvis which revealed the presence of neural crest tumors leading to the ultimate diagnosis of ROHHAD syndrome with neural endocrine tumors (ROHHADNET).

Conclusion: ROHHADNET syndrome classically presents with rapid onset weight gain and hypoventilation. Additional supportive findings include a variety of other hypothalamic manifestations, autonomic dysregulation, and the discovery of adrenal ganglioneuromas. A negative Paired-like Homeobox 2B (PHOX2B) genetic mutation test can be used to distinguish this syndrome from Congenital Central Alveolar Hypoventilation (CCHS).

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BLAME IT ON THE MASK

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Introduction: Continuous positive airway pressure (CPAP) is considered the gold-standard treatment for obstructive sleep apnea (OSA). There are several different interfaces for CPAP including nasal pillows, nasal and full-face styles. Nasal pillows and masks can be used with a chin strap to prevent air leak through the mouth. Full-face interfaces tend to be more robust and may be preferred for higher pressures.

Report of Case: We present a case of an 81-year old lady with a history of stroke, systemic hypertension, mild chronic obstructive pulmonary disease and depression. She had a history of snoring, worse on the back, snort arousals and witnessed apneas. She reported 3–4 awakenings secondary to nocturia. She felt unrefreshed upon awakening and took hour-long daytime naps. Physical examination revealed high blood pressure, body mass index of 18.99 kg/m^2, Friedman class IV oropharynx, overbite and overjet. She underwent in-laboratory split-night polysomnography. The diagnostic study showed moderately severe OSA with an apnea-hypopnea index of 24 and respiratory disturbance index of 39 per hour, worse in rapid eye movement (REM) sleep and on the back, with an oxyhemoglobin saturation nadir of 83%. CPAP titration was conducted utilizing a full-face interface between 5 cm to 17 cm of water pressure. As the pressures were increased, obstructive sleep disordered breathing events worsened (see Figure). The patient was switched to a nasal mask with chin strap and the pressure was decreased gradually to 7 cm of water which eliminated most sleep disordered breathing events in REM supine sleep.

A full-face interface can depress the lower jaw simulating a pseudo-retrognathic condition. This may be more pronounced in a frail person with already existing retrognathia. In such circumstances, increasing pressures to eliminate events could be counterproductive. Changing to a nasal pillow or nasal interface may result in optimal treatment of OSA at lower pressures.

Conclusion: This case highlights one of the drawbacks of a full-face interface. Being cognizant of the relative merits and disadvantages associated with different CPAP interfaces may help sleep technologists and clinicians make appropriate choices for their patients on an individual basis and effectively treat their OSA.

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RESTLESS LEGS SYNDROME LEADING TO TRAUMATIC BRAIN INJURY

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Introduction: Restless leg syndrome (RLS), a sensorimotor disorder characterized by an urge to move that is worse with rest and relieved by movement, follows a circadian pattern. This common, underdiagnosed disorder, affecting 5% of individuals globally and up to 15% of Caucasians, becomes more prevalent with increasing age, when risk of fall and patient safety are important concerns. Little is known about the risk for fall related to RLS. We present a case of RLS leading to a fall with consequent severe traumatic brain injury (TBI).

Report of Case: A 56-year-old Caucasian gentleman with history of RLS presented to the emergency department after a fall. Earlier that night, he had been unable to sleep because of significant RLS symptoms. To relieve these symptoms, he walked around the house, and fell down a poorly-lit staircase, landing 8 feet below onto a cement floor, sustaining severe TBI. The resultant skull fracture, subarachnoid hemorrhage, and large subdural hematoma with pressure effects led to emergent craniotomy. Post-operative complications included seizures and respiratory failure requiring tracheotomy and gastrostomy tube placement. After extensive and prolonged rehabilitation, significant cognitive impairment with agitation, disinhibition, confabulation and short term memory loss continued; he was unable to return to his position as a university professor. Because of a fall that occurred while trying to obtain relief of RLS symptoms, this previously-high-functioning individual's life has changed. He now resides in a TBI facility and is no longer able to work or enjoy his previous family life.

Conclusion: RLS is common and consequential, and should not be ignored. Its predilection for the evening hours and sensation of "restlessness" that cause many individuals to ambulate at night, may lead to an increased risk for falls. To ensure patient safety, RLS should be diagnosed and treated, especially in patients with advancing age.

1252

EPILEPTIC OR A NON EPILEPTIC EVENT: DIVIDED OPINIONS

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Introduction: Complex motor behaviors can be a challenge for even a seasoned physician. Opinions may be divided when behaviors occur out of sleep as general tendency is to categorize them as a parasomnia.

Report of Case: A 43 y/o female with suspected obstructive sleep apnea (OSA) was referred for a sleep study. She had severe OSA and a subsequent PAP titration study was performed. At 6 am, she had an arousal from N2 sleep with abduction of arms followed by writhing in bed. It was followed by flailing of arms in air with deviation of the eyes to the right. Later patient exhibited fast circling movements of the arms with chewing movements. Episode lasted for 25 seconds. Immediately after, patient was able to answer questions appropriately and walk without any difficulty suggesting no confusion. Limited EEG (done with PSG) was mostly obscured by muscle artifact and no clear epileptiform discharges could be discerned. No other abnormal EEG activity was noted during this sleep study prior to this event.

She had similar behavior without any post event confusion on her sleep study 12 years ago. Patient demographic, clinical semiology and PSG/EEG features have been proposed to distinguish nocturnal frontal lobe epilepsy (NFLE) seizures from parasomnias, validated guidelines are still missing. The short-lasting motor events cannot always be established as epileptic nature, on the basis of one event of clinical phenomena, but the recurrence of these similar observed movements in individuals can be used as an indirect marker of epileptic etiology.

Conclusion: Distinguishing nocturnal epileptic seizures from parasomnias is critical from pathophysiological relationship but has treatment implications. This case illustrates importance of reviewing clinical history and behavior semiology that was recorded as well as limitations of the ancillary testing such as polysomnography or EEG monitoring.

1253

SLEEP ONSET INITIATED, REM ONSET RELIEVED "VAGALLY MEDIATED ATRIAL FLUTTER"

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Introduction: Sleep is considered a restorative period, however dynamic cardiovascular control during sleep may constitute it as an autonomic stress test for the heart.[1,2] Most studies of circadian patterns of atrial tachyarrhythmias (AF/AT) have been limited to ambulatory ECG data.[3] This case demonstrates that polysomnography (PSG) can have a role in identification and proper management of arrhythmias during sleep. In our case, paroxysmal atrial flutter presented precisely at the point of sleep onset, and was relieved with the first REM onset.

Report of Case: 44-year-old female with past medical history of refractory paroxysmal atrial flutter since 2009, obesity with BMI 49.16 kg/m2, Grave's disease s/p radioiodine ablation, referred for evaluation of OSA. Medications included flecainide, digoxin, rivaroxaban, risperidone, quetiapine, levothyroxine, aspirin, atorvastatin. During the PSG, patient was noted to have normal sinus rhythm during awake period which was disrupted into paroxysmal AF precisely at onset of sleep and converted back to normal sinus rhythm at first REM onset. [Figures 1–5]

Conclusion: The phenomenon of vagal mediated paroxysmal atrial fibrillation was first described in 1994 by P. Coumel, however specific contributions of vagal and sympathetic ANS effects on arrhythmogenesis are still being debated.[2]

At present, there is no clear evidence for differentiating medical treatment for nighttime versus daytime atrial fibrillation. Identifying circadian patterns of arrhythmia and underlying pathophysiology on an individual basis remains a major challenge yet has therapeutic implications. Commonly used AF therapies including beta blockers and digoxin have been shown to be not beneficial and even arrhythmogenic in vagal AF.[3,4] Our case demonstrates the importance of PSG evaluation in understanding pathogenesis and diagnosis of sleep related vagally mediated arrhythmias. The case attempts to bring the attention of cardiologists and electro-physiologists in utilization of PSG studies in evaluating patients with nocturnal related arrhythmias.

1254

RESOLUTION OF PERSISTENT NOCTURNAL HYPOXIA IN A PATIENT WITH TREATED OBSTRUCTIVE SLEEP APNEA AFTER CLOSURE OF A PATENT FORAMEN OVALE

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Introduction: A higher prevalence of patent foramen ovale (PFO) is documented in individuals with obstructive sleep apnea (OSA). Concurrent OSA and PFO can lead to more severe nocturnal desaturation although the effect of closure of PFO on nocturnal hypoxia is unclear.

Report of Case: A 38 year old male with hypertension, tobacco use and obesity presented to the WLA-VA sleep center with a prior diagnosis of OSA. A polysomnogram (PSG) performed 7 years prior demonstrated an AHI of 99.0/hr with 4.7% of TST spent at an O2 saturation of <89% and he was successfully titrated to a CPAP of 10 cm H20. The patient was non-compliant with CPAP and was restarted on his prior settings of 10 cm H20 through the VA. Polycythemia (hgb 18) was noted and a workup was initiated. PFTs and CXR were normal and a blood gas showed a daytime room air PaO2 at 67mmHg. A 3-night oximetry showed long periods of time < 88% SaO2 while on CPAP (residual AHI < 5/hr). Supplemental oxygen with CPAP was initiated although nocturnal hypoxia persisted at 3L/min with CPAP. Echocardiogram with bubble study did not demonstrate a shunt but transcranial doppler revealed a high grade right-to-left shunt at rest, increasing with Valsalva maneuver. Cardiac catheterization showed xygenation step up from RA (74%) to RV (82%) indicating significant left to right shunt and TEE showed a PFO. Patient underwent successful percutaneous PFO closure. Repeat PSG on CPAP and room air showed resolution of nocturnal hypoxia and hgb remained normal after cessation of supplemental nocturnal oxygen.

Conclusion: Comorbid OSA and PFO may lead to difficult to treat nocturnal hypoxia. A randomized trial is needed to assess if closure of PFO improves nocturnal hypoxia in these cases.

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AN UNUSUAL CLINICAL PRESENTATION OF A PARASOMNIA

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Introduction: Parasomnias are defined as undesirable physical events or experiences that occur during entry to sleep, within sleep, or during arousals from sleep. The non REM (NREM) parasomnias include confusional arousals, sleepwalking, and sleep terrors. In children, NREM parasomnias occur out of stage N3 (first part of the night) but in adults can occur out of stages N1 or N2 during any part of the night. We describe a case of NREM parasomnia with atypical clinical presentation.

Report of Case: A 21-year-old female with history of depression and anxiety was evaluated for sleep terrors, sleep walking and sleep eating since age 5. Over the period of past 4 years, her sleepwalking subsided, and was substituted with hallucinations. Patient woke up with loud screams and hallucinations, "living the dream" and was able to explain it to her parents with her eyes open, who eventually "woke her up out of the episode". Dreams were violent with "death" as the usual theme, approximately 2 hours after sleep onset with complete recollection after waking up. She also endorsed excessive daytime

sleepiness with adequate sleep time on actigraphy. Patient denied history of head trauma, encephalitis, epilepsy or family history of sleep disorders.

She was treated with Alprazolam and Sertraline in the past 3 years without improvement. She underwent a carefully conducted PSG and MSLT, which was negative for sleep disordered breathing or hypersomnia disorders. Extended Video EEG monitoring captured multiple stage 2 screaming and looking under the bed episodes with patient describing, "dead dogs around and under her bed". No epileptiform activity was seen. Patient was started on Protriptyline HCL 10 MG twice daily, which resolved her symptoms.

Conclusion: Sleep hallucinations are relatively common in teens and young adults, usually visual and reduce with aging. This case highlights an unusual presentation of hypnopompic hallucinations in stage 2, patient opening her eyes and being able to describe her hallucinations before she is "woken out of her sleep". Differential diagnosis includes disorders of NREM sleep arousals vs. epileptiform activity. Latter was ruled out with an extended video EEG monitoring. It's also interesting to note that her symptoms resolved with tricyclic antidepressant (TCA), which was used due to failure of SSRI and benzodiazepine therapy in the past. TCA use has been described to control sleep hallucinations in narcolepsy, our case delineates their possible use in NREM hallucinations.

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