Conclusions: Targeted minimally invasive upper airway surgery in children with SDB and ADHD symptoms can significantly improve their executive functioning. This pilot study shows the importance of restoring upper airway breathing and normal sleep as part of ADHD management in a majority of children with SDB and ADHD.

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MODERATOR EFFECT OF PHYSICAL ACTIVITY ON STRESS AND SLEEP RELATIONSHIP IN DAILY LIFE: AN OBSERVATIONAL STUDY USING WEARABLE DEVICES

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Introduction: Daily sleep may be affected by several conditions, including stress. Stress has been shown to impact our physical and mental health. Perceived stress can affect sleep quantity, quality, and architecture, with a detrimental effect on emotional responses to daily stressors. Moreover, poor quantity/quality sleep can increase the risk of severe medical and mental disorders that in turn can have a negative effect on sleep. However, some beneficial sleep/stress management interventions seem to have a mediator impact on a stress-sleep relationship. Physical activity (PA) is reported to prevent the negative effects of perceived stress on sleep, in stress conditions, as COVID-19 pandemic lockdown.

The study aimed to conduct a preliminary analysis on the relationship between PA, perceived daily stress (pdStress), and sleep parameters from data collected through Garmin and Apple wearable devices by LUCA app, a psychophysiological well-being application, helping to recognize and manage stress.

Materials and methods: Data from Australian users have been collected for 14 consecutive days. No inclusion and exclusion criteria were applied. PA and sleep parameters were selected if present on both Garmin and Apple devices.

We assessed: PA by daily calories consumption during active daily periods, and total steps; sleep as time spent asleep; pdStress as the total score obtained from four specific daily, day-framed questions investigating the ability to relax, the presence of somatic, and emotional/cognitive symptoms [total score range: 0-12; the higher is the score the higher is the pdStress.]

Statistical analysis included linear mixed models, with pdStress total score as independent variable and sleep duration as dependent variable. PA parameters were added separately as moderators of pdStress and sleep relationship, with age, sex, and the brand of the wearable devices as covariates.

Results: Sample: 46 Australian users (19 from Garmin and 27 Apple wearable devices), including 27 females (58.7%); age between 20 and 60 years (years; m=40.8, sd=±9.1). On average, the sample was characterized by: low to moderate levels of PA; mild levels of pdStress; and sleep duration as WHO's recommendations.

The analyses showed a statistically significant inverse association between level of pdStress and sleep duration ($p < 0.001$). This relationship was moderated by PA measured by active calories consumptions ($p = 0.015$) and total steps ($p = 0.038$), with higher activity levels resulting in a reduction of the strength of the inverse association between pdStress and sleep.

Discussion: Our results confirm the detrimental relationship between pdStress and nighttime sleep duration, as reported by the literature. Moreover, our data show that high levels of PA can reduce the negative effect of pdStress on sleep duration.

Despite the limitations concerning the limited number of subjects, device-related recording errors, indirect sleep parameters, and non-sophisticated PA measures, our results underline the importance of PA programs when daily stress conditions and sleep alterations occur.

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PREDICTING AGE, COGNITIVE SCORES, AND SLEEP STAGES FROM SLEEP EEG WITH A MULTI-TASK DEEP NEURAL NETWORK USING THE FRAMINGHAM HEART STUDY

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Introduction: Impaired sleep quality, quantity and timing are associated with neurological and mental health disorders, potentially through disruption of functional and anatomical neuronal pathways. Sleep state oscillations likely encode brain health, therefore, sleep may provide accessible biomarkers for estimating brain health. One potential biomarker is sleep electroencephalogram (EEG)-based brain age, which if elevated above chronological age, could indicate abnormal or accelerated aging. Another potential method to build a biomarker is to directly estimate cognitive function from sleep data. Here, we investigate how well age and neuropsychological test scores can be predicted from EEG using an artificial deep neural network.

Materials and Methods: We used data from 735 participants of the Framingham Heart Study (FHS). Each participant had at a minimum one polysomnographic recording (PSG) and one neuropsychiatric evaluation for fluid intelligence (Wechsler Adult Intelligence Scale, NPS). Additionally, age at evaluation was available for each participant, resulting in 1244 PSG-age-NPS triplets. We solely used EEG data from C3 electrodes for this analysis. The EEG signal, recorded in 125 Hz, was bandpass-filtered between 0-20Hz and transformed into the time-frequency domain with the multitaper method (2 second window length, 1 second step size). The resulting spectrograms were all zero-padded to 11 hours, harmonizing the numerical dimensions of the sleep representations across subjects.

We developed an artificial deep neural network with a “U-Net”-like architecture, i.e., consisting of an encoder and decoder part. The network's input was a subject's EEG spectrogram, and its tasks were to predict sleep stages for 30-second epochs, the subject's age, and the subject's neuropsychological test score (NPS). The model mainly consisted of convolution-batch normalization-max pooling/upsampling layers, with a total of 11 million parameters. Fully connected layers for the age and NPS prediction tasks consisted of 15,600 parameters. The loss functions used were cross entropy for the sleep staging task and mean squared error for the age and NPS tasks. We evaluated the model's performance with 10-fold cross-validation.

Results: Sleep staging: The accuracies (means and standard deviations across folds) per sleep stage were Wake 0.64 (0.02), N2 0.61 (0.02), N3 0.59 (0.04), NREM combined 0.79 (0.01), and REM 0.53 (0.06). Cohen's Kappa was $k=0.54$ (0.02). Predicting age: Pearson correlation between chronological age and predicted age was $r= 0.60$ (0.06). Predicting neuropsychological test score: Pearson correlation between the NPS and the predicted cognitive score was $r= 0.25$ (0.07).

Conclusions: A multi-task deep learning network was able to predict sleep stages, age, and cognitive scores from sleep EEG with varying performance precision. While there was a strong correlation between predicted age and chronological age, predicted cognition scores correlated weakly to moderately with the actual scores. It is likely that prediction performance for all tasks can be increased with larger and more variable datasets. The sleep-based, subject-specific estimates for age and cognition may serve as biomarkers for brain health, a hypothesis we will test in future studies.

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PROCESSING OF RANDOM AND PREDICTABLE TONE SEQUENCES IN WAKEFULNESS AND SLEEP

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