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SCIENTIFIC INVESTIGATIONS

Prevalence, risk correlates, and health comorbidities of insomnia in US military veterans: results from the 2019–2020 National Health and Resilience in Veterans Study

Simon P. Byrne, PhD[1]; Elissa McCarthy, PhD[2]; Jason C. DeViva, PhD[3,4]; Steven M. Southwick, MD[4]; Robert H. Pietrzak, PhD, MPH[3,4,5]

[1]Department of Psychiatry, Westmead Hospital, Sydney, Australia; [2]US Department of Veterans Affairs National Center for Posttraumatic Stress Disorder, White River Junction, Vermont; [3]US Department of Veterans Affairs National Center for Posttraumatic Stress Disorder, Veterans Affairs Connecticut Healthcare System, West Haven, Connecticut; [4]Department of Psychiatry, Yale School of Medicine, New Haven, Connecticut; [5]Department of Social and Behavioral Sciences, Yale School of Public Health, New Haven, Connecticut

Study Objectives: Veterans experience high levels of trauma, psychiatric, and medical conditions that may increase their risk for insomnia. To date, however, no known study has examined the prevalence, risk correlates, and comorbidities of insomnia in a nationally representative sample of veterans.

Methods: A nationally representative sample of 4,069 US military veterans completed a survey assessing insomnia severity; military, trauma, medical, and psychiatric histories; and health and psychosocial functioning. Multivariable analyses examined the association between insomnia severity, psychiatric and medical comorbidities, suicidality, and functioning.

Results: A total of 11.4% of veterans screened positive for clinical insomnia and 26.0% for subthreshold insomnia. Greater age and retirement were associated with a lower likelihood of insomnia. Adverse childhood experiences, traumatic life events, lower education and income were associated with greater risk for insomnia. A "dose-response" association was observed for health comorbidities, with increasing levels of insomnia associated with elevated odds of psychiatric and medical conditions (clinical vs no insomnia odds ratio = 1.8–13.4) and greater reductions in health and psychosocial functioning (clinical vs no insomnia Cohen's d = 0.2–0.4). The prevalence of current suicidal ideation was 3–5 times higher in veterans with clinical and subthreshold insomnia relative to those without insomnia (23.9% and 13.6% vs 4.5%, respectively).

Conclusions: Nearly 2 in 5 US veterans experience clinical or subthreshold insomnia, which is associated with substantial health burden and independent risk for suicidal ideation. Results underscore the importance of assessment, monitoring, and treatment of insomnia in veterans as they transition from the military.

Keywords: insomnia, posttraumatic stress disorder, trauma, veterans, anxiety

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BRIEF SUMMARY

Current Knowledge/Study Rationale: Military veterans are believed to experience greater levels of insomnia compared to the general adult population. To date, however, no study has examined the prevalence, risk factors, and comorbidities associated with clinical and subthreshold insomnia in a contemporary, nationally representative sample of veterans.

Study Impact: Nearly 2 in 5 US veterans experience clinical or subthreshold insomnia, which is independently associated with medical and psychiatric comorbidities, functional difficulties, and independent risk for suicidal ideation.

INTRODUCTION

Light or disrupted sleep is common among military personnel and may be protective during periods of high stress or threat. Poor sleep typically subsides once stress associated with military service is over; however, there is evidence that it persists in some veterans.[1,2] Insomnia disorder is characterized by ongoing difficulties falling asleep, staying asleep, and/or waking too early, which cause clinical distress and functional impairment.[3] It is associated with a multitude of mental, physical, and psychosocial problems that are prevalent in veterans, such as chronic pain, substance use, depression, and posttraumatic stress disorder (PTSD).[1,2] Insomnia in veterans is sometimes viewed as a symptom or feature of the many other problems they experience, yet accumulating evidence suggests that sleep difficulties in veterans and service members are prevalent and independently associated with dysfunction.[1,4] To date, research has not examined the prevalence of mental and physical health burden associated with insomnia in a representative sample of US veterans. Research has also not examined the health burden associated with milder, yet more prevalent subthreshold insomnia in this population.

There is some evidence that service members and veterans experience higher rates of insomnia than the general community.[1,2] Yet estimates vary, reflecting differences in samples studied (eg, younger vs older veterans), sampling approaches (eg,

convenience vs representative), and criteria used (single-item measures vs diagnostic assessments). In the general population, poor sleep is relatively common, with 30%–35% reporting insomnia symptoms and 5%–10% meeting diagnostic criteria for insomnia disorder.[5,6] The prevalence of insomnia symptoms among service members and veterans has been estimated at between 27% and 54%.[1] Among 471,000 active US Army personnel in 2017, 14.5% were diagnosed with a sleep disorder by a physician per army installation, which was associated with greater obesity and tobacco and substance use.[7] In the largest study to date, an examination of nearly 10 million Veterans Health Administration (VHA) medical records between 2000 and 2010 revealed that the age-adjusted prevalence of sleep disorders, mainly sleep apnea and insomnia, increased 6-fold (0.2%–1.5% for insomnia) over the 11-year study period.[8]

Using a single, validated measure of insomnia allows for direct comparisons between military and veteran samples. The Insomnia Severity Index (ISI)[9] has shown elevated rates of clinical and subthreshold insomnia in soldiers before deployment (19.9% and 25.8%, respectively).[4] Traumatic brain injury is a known cause of insomnia in deployed soldiers (34.2% with clinical insomnia; 29.8% with subthreshold insomnia)[10] and veterans (50.6% and 28.9%, respectively).[11] Younger post-9/11 veterans receiving VHA care have also reported high levels of insomnia using the ISI (40.5% with clinical insomnia; 28.0% with subthreshold insomnia).[12] To date, however, no known study has examined the prevalence and correlates of insomnia in general population samples of military veterans.

Veterans may experience stressors before, during, and after their military service, which can increase the risk for poor sleep. Acute or chronic stress increases hypothalamic-pituitary-adrenal axis activation and releases cortisol, resulting in ongoing sleep difficulties.[5] For example, dangerous and highly stressful environments can cause hyperarousal, disrupting the body's homeostatic state and sleep patterns.[2,4] Furthermore, military personnel often live and work in environments where they are sleep-deprived or have disrupted sleep, causing ongoing irregularities in circadian rhythms.[13,14] Combat exposure and the number of deployments have been shown to contribute to sleep problems among military personnel.[1,8,15] In service members returning from deployment, 64% were diagnosed with insomnia,[16] and significant differences in the prevalence of insomnia was reported for those deployed to conflict zones relative to those who were not (41% vs 25%).[17] Service members are often recruited from more stressful and lower socioeconomic backgrounds, and these factors have also been linked to poor sleep.[18] Early life stress and trauma before military service can have a cumulative effect, increasing the risk for poor sleep after military service.[1] For example, Taylor and colleagues[4] found that soldiers with probable insomnia had higher scores on all childhood trauma questionnaire domains (Cohen's d = 0.3–0.5). Sociodemographic factors related to poverty and race are known to be associated with insomnia in the general public.[19] In civilians, older age is reliably associated with greater insomnia[6]; however, there is evidence that older age is associated with reduced sleep difficulties in veterans,[20] possibly because of the "healthy survivor bias" (only veterans who are alive and well are studied). Finally, civilian data suggest that female veterans are at greater risk of poor sleep because of factors such as hormonal changes and greater risk of mood disorders.[5,6]

Poor sleep is related to several psychiatric, substance use, and medical disorders in service members and veterans.[1,2,4] Poor sleep and hyperarousal are characteristics of several psychiatric disorders experienced by veterans, such as posttraumatic stress disorder and depression.[1,2,21] Physical health conditions are also strongly related to insomnia and poor sleep. Among the general population, poor sleep is related to arthritis, hypertension, fibromyalgia, and liver disease, particularly when these conditions are associated with pain.[5,22,23] In active soldiers, poor sleep has been linked to head injuries, back pain, headaches (odds ratio [OR] = 1.4–3.3),[4] and PTSD and other pain syndromes (OR = 1.5–2.1).[24] Among younger VHA outpatients (mean age = 34.8 years), those with an elevated ISI ≥ 11 experienced high levels of depression (95.0%), PTSD (93.3%), and pain (69.6%).[12] In some patients, poor sleep is initiated by stress but is maintained by lifestyle and behavioral factors, such as alcohol and substance use.[5] Substance use is prevalent among veterans[25] and has been shown to independently predict poor sleep in service members and veterans.[1,4] Of particular concern, several recent studies have linked insomnia to an increased risk of suicidality in the community[26] and the military.[27]

Poor sleep may also deleteriously affect health and psychosocial functioning in the general population[28] and in veterans.[2] Among the general community, poor sleep has been associated with decrements on nearly all domains of the 36-Item Short-Form[29] which assesses health-related functioning.[30] Katz and McHorney[31] found that patients with insomnia had similar reductions in emotional and mental health effects on the 36-Item Short-Form Survey as those with depression or congestive heart failure. Poor sleep is known to particularly impact cognition and executive functioning, which can in turn affect areas like work performance.[32] Because poor or disrupted sleep is a feature of medical and psychiatric conditions that negatively impact functioning, it is important to examine its independent effects. A unique relationship between poor sleep and functioning implies the need to treat it independently. Greater levels of insomnia are typically associated with greater functional deficits[9]; however, it is also important to determine the extent to which milder sleep difficulties are associated with impairment.

In the current study, we sought to provide the first known nationally representative data on the prevalence and health burden of insomnia in US veterans. We had four aims: (1) to characterize the prevalence of clinical and subthreshold insomnia; (2) to identify sociodemographic, military, health, and psychosocial characteristics of veterans with clinical and subthreshold insomnia; (3) to evaluate independent correlates of clinical and subthreshold insomnia; and (4) to determine how clinical and subthreshold insomnia relate to physical, mental, and cognitive functioning, over and above medical and psychopathology variables.

METHODS

Sample

The National Health and Resilience in Veterans Study is a nationally representative survey of 4,069 US veterans that was conducted between November 18, 2019, and March 8, 2020

(median completion date November 21, 2019). The National Health and Resilience in Veterans Study sample was ascertained from KnowledgePanel, a research panel of more than 50,000 US households that is maintained by Ipsos, a survey research firm. KnowledgePanel is a probability-based, online, nonvolunteer access survey panel that covers approximately 98% of US households. To permit the generalizability of study results to the entire US veteran population, the Ipsos statistical team computed poststratification weights based on demographic distributions (age, sex, race/ethnicity, census region, metropolitan status, education, household income, branch of service, and years in service) from the most contemporaneous Current Population Survey Veterans supplement of the US Census Bureau's American Community Survey.[33] An iterative proportional fitting (raking) procedure was used to produce the final poststratification weights. All participants provided informed consent, and the study was approved by the Human Subjects Committee of the Veterans Affairs Connecticut Healthcare System.

Assessments

Sociodemographic and military characteristics

Data on age, sex, race (Caucasian or not), marital status, education (some college/higher education or not), employment status, and household income were collected. Military characteristics included enlistment status, combat exposure (yes or no), and years in the military.

Insomnia

The ISI[9] was used to assess insomnia symptoms. The ISI is a 7-item self-report questionnaire that assesses the nature, severity, and impact of insomnia over the past 2 weeks (Cronbach's $\alpha = 0.90$). Questions assess the severity of sleep onset, sleep maintenance and early morning awakening problems, sleep dissatisfaction, interference of sleep difficulties with daytime functioning, noticeability of sleep problems by others, and distress caused by sleep difficulties. Total scores range from 0–28, with scores of 0–7 indicative of no clinically significant insomnia, 8–14 for subthreshold insomnia, 15–21 for clinical insomnia (moderate severity), and 22–28 for clinical insomnia (severe). In the current study, we classified participants into 3 groups based on total ISI scores: no insomnia (score of 0–7), subthreshold insomnia (score of 8–14), and clinical insomnia (score of 15–28).

Trauma history

Adverse childhood experiences were assessed using the Adverse Childhood Experiences questions,[34] which assess exposure to 10 potentially traumatic events during childhood, such as abuse and neglect. The standard self-report version of the Life-Events Checklist for the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (DSM-5),[35] was used to assess lifetime exposure to 16 potentially traumatic events and 1 item that assesses any other extraordinarily stressful event not captured in the first 16 items. The Life Events Checklist asks respondents whether the event happened to them, whether they witnessed it, whether they learned about it happening to someone else, and whether they were exposed to it as part of their job. The total number of potentially traumatic events endorsed was summed to yield a measure of the number of lifetime traumas.

Lifetime and current PTSD

Lifetime and past-month PTSD symptoms were assessed using the Posttraumatic Stress Disorder Checklist for the DSM-5,[36] a 20-item self-report measure of DSM-5 PTSD symptoms. Referencing their "worst" stressful experience assessed by the Life Events Checklist, veterans were asked to rate the degree of distress (0 = "not at all" to 4 = "extremely") associated with each PTSD symptom in their lifetime ($\alpha = 0.96$) and in the past month ($\alpha = 0.96$). Scores ≥ 38 indicated probable PTSD.[37]

Lifetime major depressive disorder

Lifetime major depressive disorder (MDD) was assessed using a modified self-report version of the MDD module from the Mini Neuropsychiatric Interview for the DSM-5.[38]

Current depressive and anxiety symptoms

Past 2-week depressive and anxiety symptoms were assessed using the Patient Health Questionnaire-4,[39] a reliable and valid screening measure of depression and anxiety that has shown to correlate highly with diagnostic psychiatric interviews. Items were summed to quantify the severity of current depression ($\alpha = 0.87$) and anxiety ($\alpha = 0.85$), with a score ≥ 3 on the depression and anxiety items indicative of a positive screen for these conditions.

Lifetime and current alcohol use disorder

Lifetime alcohol use disorder (AUD) was assessed using a modified self-report version of the alcohol use disorder module from the Mini Neuropsychiatric Interview for the DSM-5,[38] which assesses mild, moderate, and severe AUD. Past-year AUD was assessed using the Alcohol Use Disorders Identification Test.[40] An extensive systematic review has found the Alcohol Use Disorders Identification Test to be psychometrically sensitive and suitable to screen for AUD in diverse populations, including veterans.[41] A score of ≥ 8 ($\alpha = 0.85$) was indicative of probable current AUD, given its utility in nationally representative veteran samples.[41]

Lifetime drug use disorder

Lifetime drug use disorder (DUD) was assessed using a modified self-report version of the DUD module from the Mini Neuropsychiatric Interview for the DSM-5.[38] In the current study, positive screens for mild, moderate, or severe DUD were combined into a single DUD category.

Current DUD

The Screen of Drug Use[42] was used to assess current drug use disorder. A response of ≥ 7 days to the question "How many days in the past 12 months have you used drugs other than alcohol?" or ≥ 2 days to the question "How many days in the past 12 months have you used drugs more than you meant to?" was classified as a positive DUD screen.

Lifetime nicotine dependence

Lifetime nicotine dependence (ND) was assessed using the Fagerström Test for Nicotine Dependence[43], which consists of 6

items with a total score of 10. A score ≥ 5 was considered a positive screen.[44]

Suicidality

Suicidal ideation was assessed using 2 items that were adapted from item 9 of the Patient Health Questionnaire-9,[39] which asks participants to report the frequency of suicidal ideation. Suicidal ideation was operationalized as an endorsement of "several days or more" to at least 1 of the following 2 items, which assessed for suicidal symptoms during the past 2 weeks: "How often have you been bothered by thoughts that you might be better off dead?" and "How often have you been bothered by thoughts of hurting yourself in some way?"[45] Lifetime suicide attempt was operationalized as participants answering yes to a separate item asking, "Have you ever tried to kill yourself?"

Psychotropic medication

Current use of psychotropic medication was assessed with the question "Are you currently taking prescription medication for a psychiatric or emotional problem?" Response options were yes or no.

Medical conditions

A total of 24 medical conditions were assessed using the following question: "Has a doctor or health care professional ever told you that you have any of the following medical conditions?" (eg, arthritis, cancer, diabetes, heart disease, asthma, kidney disease). In the current study, a summary count of these conditions was computed.

Health and psychosocial functioning

Mental and physical health–related functioning were assessed using the Short Form-8 Health Survey.[46] This is an 8-item abbreviated version of the 36-Item Short-Form Survey[29] and assesses 8 domains of health-related functioning, including physical functioning, physical role limitations, bodily pain, general health, vitality, social functioning, emotional role limitations, and mental health. Cognitive functioning was assessed using the Medical Outcomes Study Cognitive Functioning Scale,[47] a 6-item self-report measure of past-month difficulties with executive function, memory, attention, concentration/thinking, confusion, and processing speed (α = 0.92). Psychosocial functioning was assessed using the Brief Inventory of Psychosocial Functioning, a 7-item measure of past-month difficulties in various life domains, including interpersonal relationships, work, education, and day-to-day activities (α = 0.84).[48]

Data analysis

Data analyses proceeded in 4 steps. First, we conducted analyses of variance and chi-square tests to compare demographic, military, and trauma characteristics by current insomnia status. Second, we conducted multinomial logistic regression analyses to identify demographic, military, trauma, and health variables that were independently associated with subthreshold and clinical insomnia. Third, we conducted a series of multivariable logistic regression analyses to examine associations between insomnia status and lifetime and current psychiatric morbidities. Fourth, we conducted a series of multivariable analyses of variance to examine the relationship between insomnia status and measures of mental, physical, cognitive, and psychosocial functioning. Demographic, military, and trauma variables that differed by insomnia status at the $P < .05$ level in bivariate analyses were adjusted for in these multivariable analyses; for analyses of suicidality and functioning, we additionally adjusted for lifetime MDD, PTSD, AUD, DUD, and ND. Raw unweighted frequencies are reported and post-stratification weights were applied when computing prevalence and inferential statistics to allow for generalizability to the US veteran population.

RESULTS

Sample characteristics by insomnia status

The ISI mean score in the full sample was 6.99 (standard deviation = 5.60, range = 0–28). **Table 1** shows demographic, military, and trauma characteristics of the sample by insomnia status. Group differences were observed for all variables assessed except education. Greater insomnia was associated with being younger, female, and non-Caucasian; not being retired; enlistment in the military; more deployments; adverse childhood experiences; potentially traumatic life events; medical conditions; and taking more psychotropic medications. Clinical and subthreshold insomnia groups had lower income, were more likely to be single and to be combat veterans than those with no insomnia, and were more likely to be currently taking psychotropic medications. The no-insomnia and subthreshold insomnia groups spent fewer years in the military than the insomnia group.

Demographic, military, trauma, and health correlates of insomnia

Table 2 shows the results of the multinomial logistic regression analyses of demographic, military, trauma, and health variables associated with subthreshold and clinical insomnia. Relative to veterans with no insomnia, those with subthreshold insomnia were younger (mean age = 59.3 vs. 64.8 years) and more likely to screen positive for lifetime MDD/PTSD, AUD/DUD, and ND and to report having more adverse childhood experiences, potentially traumatic life events, and medical conditions. Post hoc analyses revealed that those with subthreshold insomnia were more likely to report having been physically abused by their mother/stepmother (OR = 1.65; 95% confidence interval [CI], 1.21–2.26), to have been emotionally neglected during childhood (OR = 1.27; 95% CI, 1.01–1.60), and to have been diagnosed with chronic pain (OR = 1.66; 95% CI, 1.36–2.02), arthritis (OR = 1.46; 95% CI, 1.22–1.75), and diabetes (OR = 1.37; 95% CI, 1.11–1.70).

Relative to veterans with no insomnia, those with clinical insomnia were younger (mean age = 53.6 vs. 64.8 years), reported more medical conditions, and were more likely to be non-Caucasian, have enlisted in the military, and have screened positive for lifetime MDD/PTSD and AUD/DUD. Posthoc analyses revealed that they were more likely to have been diagnosed with migraine headaches (OR = 2.65; 95% CI, 1.85–3.79),

Table 1—Demographic, military, and trauma characteristics by insomnia status in US military veterans.

	1	2	3	Test of Difference (χ^2 or *F*)	*P*	Pairwise Contrasts
	No Insomnia (n = 2,631)	Subthreshold Insomnia (n = 1,028)	Clinical Insomnia (n = 409)			
	Weighted 62.6%	Weighted 26.0%	Weighted 11.4%			
Age (y)	64.8 (15.3)	59.3 (15.9)	53.6 (14.3)	126.15	< .001	1 > 2 > 3
Male sex	2,367 (92.0%)	873 (89.1%)	323 (82.7%)	40.18	< .001	1 > 2 > 3
Caucasian race/ethnicity	2,216 (80.5%)	829 (77.0%)	272 (66.9%)	43.61	< .001	1 > 2 > 3
College graduate or higher	1,201 (32.2%)	464 (34.3%)	161 (31.4%)	1.89	0.39	—
Married/partnered	1,918 (74.8%)	702 (69.8%)	264 (65.4%)	22.33	< .001	1 > 2, 3
Retired	1,507 (48.4%)	540 (40.4%)	178 (30.5%)	59.83	< .001	1 > 2 > 3
Annual household income > $60,000	1,571 (60.6%)	569 (56.2%)	216 (52.6%)	13.30	.001	1 > 2, 3
Enlisted in military	1,947 (76.8%)	818 (81.9%)	363 (90.7%)	50.55	< .001	3 > 2 > 1
Combat veteran	786 (30.1%)	386 (41.7%)	180 (46.3%)	73.14	< .001	2, 3 > 1
Number of deployments				82.24	< .001	
0	1,850 (70.5%)	642 (58.8%)	231 (55.1%)			
1	492 (18.4%)	234 (24.3%)	91 (22.7%)			
≥2	273 (11.1%)	143 (16.8%)	83 (22.2%)			3 > 2 > 1
Years spent in military	4.3 (1.8)	4.5 (1.9)	4.6 (1.9)	5.42	.004	3 > 1, 2
Adverse childhood experiences	1.1 (1.6)	1.9 (2.2)	2.6 (2.4)	136.88	< .001	3 > 2 > 1
Total traumas	7.4 (7.3)	10.6 (9.5)	13.2 (9.5)	123.86	< .001	3 > 2 > 1
Number of medical conditions	2.5 (1.9)	3.3 (2.2)	4.2 (2.6)	303.27	< .001	3 > 2 > 1
Psychotropic medication use	136 (4.9%)	131 (13.5%)	116 (32.7%)	335.46	< .001	3 > 2 > 1

Values presented as weighted mean (standard deviation) or n (weighted %).

chronic pain (OR = 2.47; 95% CI, 1.88–3.24), kidney disease (OR = 1.91; 95% CI, 1.14–3.19), arthritis (OR = 1.86; 95% CI, 1.42–2.44), heart disease (OR = 1.71; 95% CI, 1.16–2.50), and hypertension (OR = 1.41; 95% CI, 1.08–1.86).

Relative to veterans with subthreshold insomnia, those with clinical insomnia were younger, reported more medical conditions, and were more likely to be non-Caucasian and screen positive for lifetime MDD/PTSD. Post hoc analyses revealed that they were more likely to be diagnosed with migraine headaches (OR = 2.06; 95% CI, 1.47–2.87), kidney disease (OR = 1.79; 95% CI, 1.07–3.00), chronic pain (OR = 1.49; 95% CI, 1.14–1.95), and hypertension (OR = 1.41; 95% CI, 1.07–1.85).

Psychiatric correlates of insomnia

Figure 1 shows the prevalence of lifetime and current psychiatric variables by insomnia status. A "dose-response" association was observed between increasing insomnia severity and higher prevalence of suicidal ideation, suicide attempts, and all disorders except for lifetime DUD, lifetime ND, and current AUD, which did not differ between the clinical and subthreshold insomnia groups.

Table 3 shows the results of the multivariable analyses of lifetime and current psychiatric variables by insomnia status. Relative to the no-insomnia group, the subthreshold and clinical insomnia groups were more likely to screen positive for lifetime MDD, PTSD, AUD, and DUD and current MDD, PTSD, GAD, AUD, DUD, and suicidal ideation; the subthreshold insomnia group was additionally more likely to screen positive for lifetime ND. Relative to the subthreshold insomnia group, the clinical insomnia group was more likely to screen positive for lifetime MDD, PTSD, and AUD and current MDD, PTSD, and GAD.

Insomnia and health and psychosocial functioning

Table 4 shows the results of multivariable analyses of variance of measures of health and psychosocial functioning by insomnia status. Results revealed a dose-response association for all assessed measures, with the clinical insomnia group reporting worse mental, physical, cognitive, and psychosocial functioning than the subthreshold insomnia group, which reported worse functioning than the no-insomnia group. Relative to the no-insomnia group, the subthreshold insomnia group had the largest-magnitude reductions on measures of general health, vitality, and mental health, and the clinical insomnia group had the largest-magnitude reductions on measures of overall cognitive functioning, concentration/thinking, and attention. Relative to the subthreshold insomnia group, the clinical insomnia group had the largest-magnitude reductions on measures of concentration/thinking, overall cognitive functioning, and attention.

DISCUSSION

This study examined the prevalence, risk correlates, and mental and physical conditions associated with clinical and subthreshold insomnia in a contemporary, nationally representative sample of US military veterans. Results revealed that poor sleep

Table 2—Multinomial regression model of demographic, military, trauma, and health correlates of subthreshold and clinical insomnia.

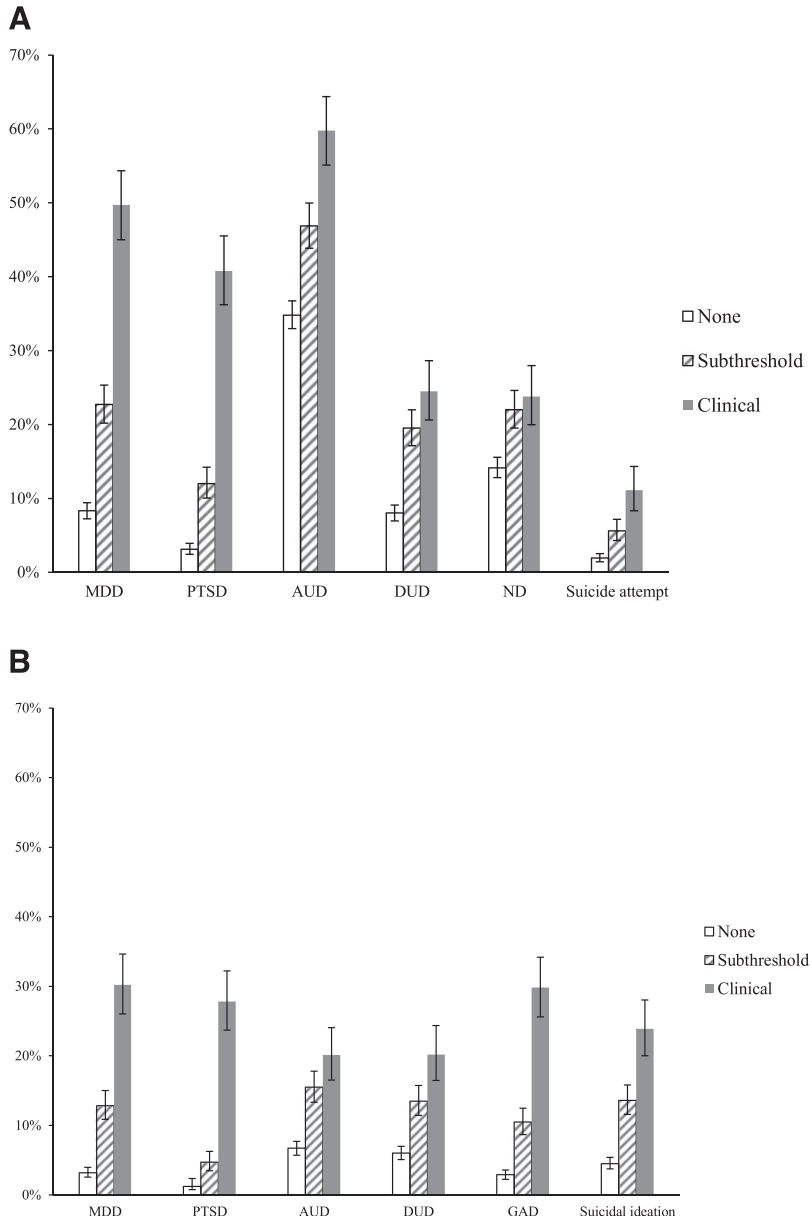
	Subthreshold Insomnia vs No Insomnia	Clinical Insomnia vs No Insomnia	Clinical Insomnia vs Subthreshold Insomnia
Age	0.98 (0.97–0.99)***	0.96 (0.95–0.97)***	0.98 (0.97–0.99)**
Male sex	0.99 (0.75–1.32)	0.97 (0.67–1.41)	0.98 (0.68–1.41)
Caucasian race/ethnicity	0.96 (0.78–1.18)	0.59 (0.44–0.78)***	0.61 (0.46–0.80)***
Married/partnered	0.92 (0.76–1.11)	0.97 (0.73–1.28)	1.05 (0.80–1.39)
Retired	0.92 (0.74–1.15)	0.83 (0.59–1.17)	0.90 (0.64–1.27)
Annual household income > $60,000	0.94 (0.78–1.12)	0.97 (0.74–1.26)	1.03 (0.79–1.34)
Enlisted vs drafted/commissioned	1.02 (0.82–1.27)	1.50 (1.02–2.22)*	1.47 (0.99–2.18)
Combat veteran	0.44 (0.10–1.98)	0.46 (0.08–2.86)	1.05 (0.15–7.22)
Number of deployments			
0 (reference)	—	—	—
1	1.06 (0.80–1.40)	1.19 (0.80–1.78)	1.00 (0.14–7.04)
2	3.27 (0.72–14.9)	3.28 (0.52–20.83)	1.13 (0.76–1.66)
Years in military	1.00 (0.96–1.05)	0.98 (0.91–1.06)	0.98 (0.91–1.05)
Adverse childhood experiences	1.08 (1.03–1.13)**	1.07 (1.01–1.13)	0.99 (0.93–1.04)
Lifetime traumas	1.02 (1.01–1.03)**	1.01 (0.99–1.02)	0.99 (0.98–1.01)
Lifetime MDD and/or PTSD	2.26 (1.84–2.79)***	8.70 (6.58–11.36)***	3.83 (2.92–5.03)***
Lifetime AUD and/or DUD	1.29 (1.09–1.53)**	1.51 (1.17–1.96)**	1.18 (0.90–1.53)
Lifetime nicotine dependence	1.27 (1.02–1.57)*	1.07 (0.78–1.46)	0.84 (0.62–1.14)
Number of medical conditions	1.26 (1.20–1.31)***	1.57 (1.47–1.67)***	1.25 (1.17–1.33)***

Values presented as odds ratio (95% confidence interval). *P < .05; **P < .01; ***P < .001. AUD = alcohol use disorder, DUD = drug use disorder, MDD = major depressive disorder, PTSD = posttraumatic stress disorder.

was reported in 37.4% of US veterans, with 11.4% screening positive for clinical insomnia and an additional 26.0% reporting subthreshold insomnia. For studies using the ISI, this prevalence was lower than for active-duty service members (19.9% with clinical insomnia)[4] and soldiers and veterans with traumatic brain injury (28.9%–34.2% with clinical insomnia).[10,11] Insomnia prevalence in this study was also lower than for younger veterans seeking treatment through the VHA (40.5% with clinical insomnia; mean age 34.8 years).[12] Our rate was comparable to that in older veterans who screened as being at risk for insomnia while seeking treatment at the VHA (41.7%; mean age 62.5 years).[49] It was also similar to that of college students administered the ISI (12%–13% with clinical insomnia).[50] The lower prevalence after leaving the military was consistent with our findings that greater age and retirement were associated with lower risk of insomnia, yet more time in the military and deployments were associated with greater risk. The decreasing prevalence of insomnia with increasing age is noteworthy because it is a strong effect in the opposite direction to that observed in the general adult population[6] but consistent with prior research in older veterans.[20] These results may reflect that once stress associated with military service ceases, a veteran's sleep often improves. Reduced insomnia with age may also reflect findings of decreasing mental illness in older adults because of improved coping ability and the healthy survivor bias.[51] Finally, the lower prevalence may also reflect that the sample was predominantly composed of Caucasian men who were noncombat veterans and not seeking treatment.

However, our results do suggest that many veterans have difficulties with their sleep long after completing military service. They are consistent with findings in service members and veterans showing that stress has a cumulative and persistent effect on sleep.[1,5] Poor sleep may develop as a consequence of stress that occurred both before military service (eg, trauma, adverse childhood experiences) and during military service (eg, deployments, combat). The deleterious effects of combat on sleep are well established[15,16] and suggest that efforts to promote sleep hygiene before, during, and after deployment may help mitigate risk for the development of insomnia and related mental health problems.[52,53] Poor sleep was also associated with several sociodemographic factors associated with stress, such as being single, being female, or having lower income, which have also been linked to insomnia in active service members[4] and the general adult population.[19] For example, we found that being non-Caucasian distinguished between those with clinical insomnia and other groups, even when controlling for relevant variables (see **Table 2**). Socioeconomic disadvantage has been shown to be associated with poor sleep in the general community, often through its relationship with other factors like access to education or health care.[19] Collectively, these results underscore the importance of assessing distal factors such as stress before military service and

Figure 1—Percentage of veterans with disorder by insomnia severity.



(A) Percentage of veterans with disorder over lifetime by insomnia severity (with 95% upper and lower CIs). Prevalence increased as a function of insomnia severity, such that clinical insomnia > subthreshold insomnia > no insomnia for all disorders ($\chi 2$ range = 96.8–591.0, all $P < .001$) except for DUD and ND, where clinical insomnia = subthreshold insomnia > no insomnia ($\chi 2 = 47.4–151.4$, $P < .001$). **(B)** Percentage of veterans with current disorder by insomnia severity. Prevalence increased as a function of insomnia severity, such that clinical insomnia > subthreshold insomnia > no insomnia for all disorders ($\chi 2$ range = 110.3–524.0, all $P < .001$) except for AUD, where clinical insomnia = subthreshold insomnia > no insomnia ($\chi 2 = 112.2$, $P < .001$). AUD = alcohol use disorder, DUD = drug use disorder, GAD = generalized anxiety disorder, MDD = major depressive disorder, ND = nicotine dependence, PTSD = posttraumatic stress disorder.

sociodemographic factors when determining a veteran's risk of developing insomnia.

Poor sleep was most strongly associated with PTSD/MDD, medical conditions, and DUD/AUD, suggesting that any direct stress on the body or mind can be associated with poor and disrupted sleep, consistent with findings in civilians[5] and the military.[1,4] PTSD and MDD are often characterized by hyperarousal and have shown a strong relationship with insomnia in other samples of veterans.[1,2] The relationship between sleep and mental health is known to be bidirectional,[54,55] suggesting that in some patients the treatment of one may ameliorate the other. Several medical conditions were also associated with poor sleep in our study, particularly if they were associated with pain (eg, migraine, chronic pain, arthritis; clinical insomnia OR = 1.4–2.7), consistent with findings in the general community.[2,22] Both current and lifetime alcohol and drug use disorders were related to clinical and subthreshold insomnia vs none (OR = 1.3–2.9), similar to findings in the community.[5] These health-related

Table 3—Multivariable analyses of psychiatric variables by insomnia level in US military veterans.

	Subthreshold Insomnia vs No Insomnia	Clinical Insomnia vs No Insomnia	Clinical Insomnia vs Subthreshold Insomnia
Lifetime			
MDD	2.15 (1.72–2.69)***	5.45 (4.14–7.16)***	2.53 (1.95–3.29)***
PTSD	2.50 (1.79–3.49)***	9.20 (6.47–13.09)***	3.68 (2.71–5.00)***
AUD	1.29 (1.10–1.51)**	1.79 (1.42–2.26)***	1.39 (1.10–1.77)**
DUD	2.13 (1.69–2.67)***	2.16 (1.60–2.93)***	1.02 (0.76–1.36)
ND	1.33 (1.09–1.63)**	1.23 (0.92–1.64)	0.92 (0.70–1.23)
Suicide attempt	1.21 (0.77–1.92)	1.25 (0.73–2.14)	1.03 (0.65–1.64)
Current			
MDD	2.82 (2.07–3.83)***	6.06 (4.30–8.55)***	2.15 (1.60–2.89)***
PTSD	2.51 (1.50–4.18)***	13.35 (8.13–21.90)***	5.33 (3.59–7.91)***
GAD	2.51 (1.80–3.48)***	6.31 (4.41–9.02)***	2.52 (1.84–3.44)***
AUD	2.32 (1.82–2.97)***	2.92 (2.11–4.03)***	1.26 (0.93–1.70)
DUD	1.91 (1.46–2.49)***	2.32 (1.64–3.28)***	1.21 (0.87–1.69)
Suicidal ideation	1.61 (1.20–2.17)**	1.79 (1.24–2.58)**	1.11 (0.80–1.54)

Values presented as odds ratio (95% confidence interval). *P < .05; **P < .01; ***P < .001. Odds ratios are adjusted for age, sex, race/ethnicity, marital/partnered status, employment status, household income, enlistment status, combat veteran status, number of deployments, years in military, adverse childhood experiences, lifetime traumas, and number of medical conditions; analyses of suicide attempt and suicidal ideation are additionally adjusted for lifetime MDD, PTSD, AUD, DUD, and ND. AUD = alcohol use disorder, DUD = drug use disorder, GAD = generalized anxiety disorder, MDD = major depressive disorder, ND = nicotine dependence, PTSD, posttraumatic stress disorder.

factors were more strongly associated with insomnia symptoms than sociodemographic, trauma, and military service–related factors, suggesting that conditions which directly affect the body and mind are more related to poor sleep than distal or sociodemographic ones. Although cognitive-behavioral interventions are the gold standard for insomnia,[28] these results indicate that assessment and treatment of concurrent medical and psychiatric conditions and substance use will reduce sleep difficulties in some patients. For example, trauma-focused psychotherapies, without any specific components designed to treat insomnia, can improve sleep.[56] It is noteworthy that subthreshold insomnia symptoms were to a lesser extent related to psychiatric, medical, and substance use disorders, suggesting that milder insomnia should be considered in assessment and treatment. This observation is consistent with findings that a lower ISI cutoff (≥ 11) predicts insomnia disorder in the community[9] and medical, psychiatric, and psychosocial difficulties in veterans.[12]

Insomnia was also associated with substantially elevated odds of suicidal ideation, even after adjustment for psychiatric disorders. Nearly 1 in 4 veterans who screened positive for clinical insomnia reported current suicidal ideation. Subthreshold insomnia was also associated with elevated odds of suicidal ideation, suggesting that even mild symptoms increase this risk. These results are consistent with findings that insomnia is an independent risk factor for suicidality in the general community[26] and in military populations.[27] Restoring sleep among distressed veterans should be a priority for managing suicide risk. For example, several treatments may have promise for managing suicidality associated with insomnia, including cognitive-behavioral therapy for insomnia,[57] the pharmacological agent zolpidem-CR,[58] and online programs.[59]

The similarity in risk factors and outcomes for the subthreshold and clinical insomnia groups compared to the no-insomnia group suggests that these classifications differ more in severity than in quality (**Table 2** and **Table 3**). However, there was typically a dose response, where increasing insomnia severity was associated with a greater risk of psychiatric disorders and greater reductions in health and psychosocial functioning (**Figure 1** and **Table 4**), similar to findings in the general community.[9] These results suggest that functional difficulties may become particularly pronounced when insomnia is clinically severe. Consistent with findings in civilians,[32] the largest-magnitude reductions were observed in self-report measures of cognitive functioning (clinical insomnia vs no insomnia; Cohen's d = 0.2–0.4), reflecting the direct effect of insomnia on cognitive function, which may in turn lead to functional difficulties in other areas such as employment or interpersonal relationships.

The main strengths of this study are that it examines the prevalence and correlates of insomnia in a large, contemporary, and nationally representative sample of veterans. It controls for relevant sociodemographic, trauma, and military-related variables, allowing an examination of insomnia's unique effects. It also employs a validated and commonly used insomnia severity measure, enabling direct comparison with other military and veteran samples. The main limitation of this study is that it is cross-sectional, so causal associations between insomnia, health, and functioning variables cannot be ascertained. The relationship between sleep and health-related outcomes is known to be complex and bidirectional,[54] so understanding directionality and temporal sequence is vital. Longitudinal research examining how sleep changes, particularly as service

Table 4—Multivariable analyses of health-related and psychosocial functioning measures by insomnia status in US military veterans.

	1	2	3	Test of Difference (*F*)	*P*	Pairwise Contrasts	Cohen's *d*		
	No Insomnia (n = 2,631)	Subthreshold Insomnia (n = 1,028)	Clinical Insomnia (n = 409)				2 vs 1	3 vs 1	3 vs 2
	Weighted 62.6%	Weighted 26.0%	Weighted 11.4%						
Mental component summary	51.4 (0.5)	49.1 (0.5)	45.8 (0.5)	104.96	< .001	3 < 2 < 1	0.10	0.23	0.23
Vitality	49.3 (0.5)	46.6 (0.5)	45.0 (0.6)	74.77	< .001	3 < 2 < 1	0.11	0.18	0.11
Social functioning	49.9 (0.5)	47.7 (0.5)	43.7 (0.6)	117.33	< .001	3 < 2 < 1	0.09	0.26	0.27
Emotional role	48.9 (0.4)	47.9 (0.4)	44.3 (0.4)	107.20	< .001	3 < 2 < 1	0.05	0.24	0.31
Mental health	50.5 (0.4)	48.5 (0.4)	45.9 (0.5)	85.85	< .001	3 < 2 < 1	0.11	0.24	0.21
Physical component summary	47.3 (0.6)	44.8 (0.6)	41.2 (0.6)	86.51	< .001	3 < 2 < 1	0.09	0.21	0.21
Physical functioning	46.9 (0.5)	45.0 (0.5)	42.3 (0.6)	54.52	< .001	3 < 2 < 1	0.08	0.19	0.18
Physical role	47.6 (0.5)	45.8 (0.5)	42.2 (0.6)	81.90	< .001	3 < 2 < 1	0.08	0.22	0.24
Bodily pain	48.6 (0.5)	46.3 (0.5)	43.3 (0.6)	80.97	< .001	3 < 2 < 1	0.10	0.22	0.20
General health	48.3 (0.4)	45.9 (0.5)	43.9 (0.5)	80.42	< .001	3 < 2 < 1	0.12	0.23	0.14
Cognitive functioning	88.3 (0.8)	84.8 (0.9)	74.4 (1.0)	183.87	< .001	3 < 2 < 1	0.09	0.36	0.39
Executive function	89.1 (1.0)	86.0 (1.0)	76.3 (1.2)	104.48	< .001	3 < 2 < 1	0.07	0.26	0.32
Memory	81.3 (1.2)	76.5 (1.2)	66.1 (1.4)	106.63	< .001	3 < 2 < 1	0.09	0.26	0.29
Attention	87.5 (1.1)	83.0 (1.1)	72.2 (1.2)	127.30	< .001	3 < 2 < 1	0.09	0.29	0.33
Concentration/thinking	89.3 (1.1)	85.2 (1.1)	72.2 (1.2)	174.19	< .001	3 < 2 < 1	0.08	0.32	0.40
Confusion	90.9 (1.0)	89.2 (1.0)	78.5 (1.1)	108.84	< .001	3 < 2 < 1	0.04	0.26	0.27
Processing speed	91.8 (1.0)	89.0 (1.0)	81.1 (1.1)	78.92	< .001	3 < 2 < 1	0.06	0.22	0.27
Psychosocial difficulties	12.0 (0.9)	15.3 (1.0)	21.4 (1.1)	70.47	< .001	3 > 2 > 1	0.08	0.22	0.21

Values are presented as mean (standard error of the mean). Means are adjusted for age, sex, race/ethnicity, marital/partnered status, employment status, household income, enlistment status, combat veteran status, number of deployments, years in military, adverse childhood experiences, lifetime traumas, number of medical conditions, lifetime MDD, PTSD, AUD, DUD, and ND. AUD = alcohol use disorder, DUD = drug use disorder, MDD = major depressive disorder, ND = nicotine dependence, PTSD = posttraumatic stress disorder.

members transition to civilian life, is also important; tracking and targeting treatment toward those whose sleep does not regulate is vital. A further limitation of this study is that data were collected retrospectively using an online self-report. The variation in prevalence rates observed in the insomnia literature suggests the need for research that employs standardized measures or interviews to assess insomnia and related health problems. Finally, although veterans with clinical and subthreshold insomnia were more likely than those without insomnia to be currently taking psychotropic medication, further research is needed to examine whether insomnia-specific medications (eg, sedative-hypnotics) and over-the-counter sleep aids may help mitigate insomnia severity and co-occurring health difficulties in this population.

Given its relationships with a variety of indicators of psychopathology, psychosocial stressors, and quality of life, insomnia provides a gauge of overall health and well-being in veterans. It is reassuring that for many veterans, their sleep seems unaffected or regulates as they resume their civilian life. Nevertheless, nearly 40% of veterans experience clinical or subthreshold insomnia, which are independently linked to a considerable personal, functional, and health burden. These findings suggest that insomnia, even at subthreshold levels, is a transdiagnostic risk factor for a range of health outcomes in veterans. They highlight the importance of assessing, monitoring, and treating insomnia symptoms as part of routine clinical care and ensuring accessible insomnia treatments for veterans through platforms such as primary care, telehealth, and online programs. Further research is needed to replicate these findings in more diverse samples of veterans, elucidate the biopsychosocial mechanisms linking insomnia to increased risk for comorbid health problems, and evaluate the efficacy of insomnia interventions in mitigating insomnia and risk for these problems in veterans and other at-risk populations.

ABBREVIATIONS

AUD, alcohol use disorder
CI, confidence interval
DSM, *Diagnostic and Statistical Manual of Mental Disorders*
DUD, drug use disorder
ISI, Insomnia Severity Index
MDD, major depressive disorder
ND, nicotine dependence
OR, odds ratio
PTSD, posttraumatic stress disorder
VHA, Veterans Health Administration

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Address correspondence to: Simon P. Byrne, PhD, Department of Psychiatry, Westmead Hospital, Westmead, NSW, Australia, 2145; Tel: +61-415-202-957; Fax: +61-2-9635-7735; Email: simonpatrickbyrne@gmail.com

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