Gender differences in sleep disorders in the US military☆,☆☆,★
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ABSTRACT
Objectives: The purpose of this study is to compare sleep disorders between male and female military personnel. Comorbid behavioral health disorders and chronic pain were also studied in relation to sleep disorders.
Design: We conducted a retrospective review of military personnel who underwent a sleep medicine evaluation and an in-laboratory attended polysomnography. Initial sleep questionnaires, demographics, polysomnographic variables, and comorbid disorders of interest were reviewed and compared for each sex.
Setting: All patients were referred to the Wilford Hall Ambulatory Surgical Center Sleep Disorders Center for evaluation of sleep disturbance.
Participants: Our cohort consisted of 209 military personnel with 51.7% men. The cohort was relatively young with a mean age of 34.3 years. Men had a significantly higher body mass index at 29.4 vs 27.3 in women.

Results: Insomnia was diagnosed in 72 women and 41 men (P < .001), whereas obstructive sleep apnea (OSA) was diagnosed in 92 men and 50 women (P < .001). Depression and anxiety were more common in women. Women had an average of 1.76 ± 1.36 comorbid conditions compared with 1.08 ± 1.19 in men. In patients diagnosed with both insomnia and OSA, women were more likely to have post-traumatic stress disorder, depression, and anxiety. Neither the Epworth Sleepiness Scale (12.8 ± 4.88) nor the Insomnia Severity Index (16.9 ± 5.33) differed between sexes.

Conclusions: Gender-related differences in sleep disorders are present in active-duty personnel. Behavioral health disorders were frequent comorbid disorders, and women diagnosed with both insomnia and OSA manifested greater psychiatric comorbidity. The frequent association between sleep and behavioral health disorders in military personnel requires further study.

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Introduction
Sleep disturbances are associated with multiple physical as well as behavioral health disorders. Poor sleep negatively impacts mood, cognition, decision making, and moral reasoning.1 In addition, in military populations, sleep disturbances can lead to increased body mass index (BMI), failure to meet exercise standards, suboptimal nutritional status, and poorer self-reported health.2 Thus, the importance of sleep is increasingly recognized throughout society as well as the military.

The prevalence of specific sleep disorders differs between men and women. Studies in the general population reveal that women are more likely to have insomnia and generalized sleep disturbances than men.3,4 Specifically, women are twice as likely to be diagnosed with insomnia, with this difference increasing with age.5 Regarding obstructive sleep apnea (OSA), data from civilian sleep centers, assessing middle-aged adults, show higher rates of OSA in men compared with women with ratios of 8:1 to 10:1.6,8 Overall, the incidence of OSA in women referred for polysomnography (PSG) is 16%-34.2% compared with 65.8%-83% in men.8,10 Women diagnosed with OSA are typically older and have less severe disease than their male counterparts.11 Most studies comparing gender-related differences in sleep disorders were performed in older populations. Research

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comparing sleep disorders in young men and women is limited, but one large population study showed that in adults aged 20-39 years, women were 64% more likely to have insomnia and 59% less likely to have OSA than men.12

Military personnel are a relatively young, healthy population at baseline who are subjected to multiple stressors, which can result in disturbed sleep and predispose them to sleep disorders. These stressors include deployments, frequent moves, shift work, family separation, and work hours that typically begin prior to 6:00 AM.13,14 Additionally, insufficient sleep is highly prevalent in the military, with only 24% reporting sleeping 7-8 hours.15 Although there is a relationship between deployments and sleep disorders, including insufficient sleep, insomnia, nightmares, and parasomnias, how this differentially affects men and women in the military is unknown.16

Data on the role of sex and sleep disturbance in the general military population are limited. The Millennium Cohort study analyzed almost 3000 female military personnel and found that women who are pregnant or have young children have the shortest sleep duration, ranging from 5.45 to 5.84 hours.17 In another non-clinical sample, Taylor et al18 surveyed a large sample of US Army soldiers, including more than 300 women, and found no gender-related differences in rates of insomnia. Although there is a number of clinical studies assessing sleep disorders, they are limited because they are focused on male military personnel and do not establish the prevalence of specific disorders. In one of the largest clinical samples to date, Mysliwiec et al19 studied 725 military service members who were referred to a sleep center. Although only 7% of their cohort was female, they reported that female military personnel were more likely to have insomnia and less likely to be diagnosed with moderate to severe OSA.

Based on the limited data, there appears to be gender-related differences in sleep disorders between female and male military personnel. The primary objective of this study was to characterize differences in sleep disorders between men and women serving on active duty in the US military. An exploratory objective was to determine if there were gender-related differences in comorbid behavioral health disorders and chronic pain between male and female military personnel who were referred for sleep disturbances.

Methods

Study sample

This is a retrospective cross-sectional cohort study of 209 military personnel who were referred for evaluation to an academic military sleep disorders center between March 2014 and January 2016. Military personnel with sleep disturbances are referred for evaluation to an academic military sleep disorders center between March 2014 and January 2016. Military personnel who were referred for evaluation to an academic military sleep disorders center between March 2014 and January 2016. Military personnel who were referred for sleep disturbances. Although only 7% of their cohort was female, they reported that female military personnel were more likely to have insomnia and less likely to be diagnosed with moderate to severe OSA.

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Study variables

Demographic/biometric parameters, sleep center intake questionnaires, polysomnographic variables, and electronic medical records (EMRs) were reviewed. Demographic/biometric parameters included age, BMI, branch of service, and history of deployment (at least 1 deployment in participant’s military career). The BMI values were used to classify participants as underweight (BMI < 18.5), normal weight (18.5 ≤ BMI < 25.0), overweight (25.0 ≤ BMI < 30), and obese (BMI ≥ 30.0). The ESS was used to assess patients’ sleepiness. The total ESS score ranges from 0 (less sleepy) to 24 (more sleepy). A score ≥10 indicates excessive daytime sleepiness (EDS).20 The ISI was used to assess insomnia symptoms and ranges from 0 to 28. A score ≥15 is consistent with clinical insomnia.21

Level 1 PSGs were performed in accordance with American Academy of Sleep Medicine (AASM) standards within an AASM-accredited laboratory (Embla Systems, Broomfield, CO; Sandman Version 9.3), with a subset of patients receiving split-night studies. Our laboratory policy was to perform a split-night study on any patient with an apnea hypopnea index (AHI) of greater than 20 per hour in the first 2 hours of sleep. Polysomnography was performed with 16 channels, including electrooculogram, electroencephalogram, electrocardiogram, electromyogram (submental and bilateral tibial), airflow measurements using both oronasal-thermal sensors and nasal air pressure transducers, transtracheal sounds via microphone, rib cage and abdominal movement by inductance plethysmography using thoracoabdominal belts, and continuous pulse oximetry. Studies were scored using the 2012 AASM scoring guidelines with hypopneas scored as a 30% drop in the nasal pressure from baseline for 10 seconds and associated with either an arousal or drop in oxygen saturation by 3%.22 Polysomnographic variables, to include sleep onset latency (SOL), rapid eye movement (REM) latency, total sleep time, sleep efficiency (SE), sleep stages (stage N1, stage N2, stage N3, stage R), wake after sleep onset (WASO), arousal index, AH1, and maximal desaturation, were analyzed.

Diagnosis of sleep disorders and associated illnesses

The International Classification of Sleep Disorders, Third Edition was used to adjudicate sleep disorders in our patients integrating PSG data, EMR review, ESS, ISI, and our sleep laboratory questionnaire.23 All diagnoses were reviewed and adjudicated by 2 board-certified sleep medicine physicians. The diagnosis of insomnia was rendered in patients with self-reported symptoms of insomnia who had an SOL >30 minutes and a reduced SE (<85%) on the sleep laboratory questionnaire, as well as an ISI score consistent with insomnia (≥15). Patients with a threshold ISI of 11-14 were required to have the same self-reported insomnia symptoms along with at least 1 PSG variable consistent with insomnia, to include SOL >30 minutes, WASO of >30 minutes, and/or SE <85%. Patients with a PSG demonstrating apneas or hypopneas with an AHI >5/h were rendered a diagnosis of OSA. The diagnoses of insomnia and OSA were not mutually exclusive; a diagnosis of comorbid insomnia and OSA was adjudicated when the patient’s sleep and wake complaints were not solely due to sleep disordered breathing or another disorder in accordance with the International Classification of Sleep Disorders, Third Edition. Associated illnesses including depression, anxiety, post-traumatic stress disorder (PTSD), and chronic pain were obtained from the EMR and self-report.

Statistical analysis

Statistical analysis was conducted with a statistical software package (JMP Pro 12; SAS Institute, Cary, NC). Individuals with previous PSGs, those referred for postsurgical evaluation, or those who did not complete our sleep center intake questionnaire were excluded from the analysis. Medical record review was performed using the EMR system. After collection, data were recorded in a deidentified database prior to statistical analysis.

Data normality was assessed with the Shapiro-Wilk test. Most of our data violated the assumption of normality (ie, age, all PSG
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