2018

An Initial Report of Sleep Disorders in Women in the U.S. Military

Capener, Dale C.; Brock, Matthew S.; Hansen, Shana L.; Matsangas, Panagiotis; Mysliwiec, Vincent

Oxford University Press

Capener, Dale C., et al. "An initial report of sleep disorders in women in the US Military."Military medicine, 183.9-10 (2018): e266-e271.
http://hdl.handle.net/10945/70872

An Initial Report of Sleep Disorders in Women in the U.S. Military

Lt Col Dale C. Capener, MC, USAF; Maj Matthew S. Brock, MC, USAF*; Lt Col Shana L. Hansen, MC, USAF*; Panagiotis Matsangas, DrPH†; COL Vincent Mysliwiec, MC, USA**

ABSTRACT Introduction: Sleep disorders are increasingly recognized in active duty service members (ADSM). While there are multiple studies in male ADSM, there are limited data regarding sleep disorders in women in the military. The purpose of this study was to characterize sleep disorders in female ADSM referred for clinical evaluation to provide a better understanding of this unique population. Materials and Methods: We conducted a retrospective review of female ADSM who underwent a sleep medicine evaluation and an attended polysomnogram (PSG). Demographic and polysomnogram variables, as well as medical records, were reviewed. Associated illnesses to include post-traumatic stress disorder, pain disorders, anxiety, and depression, were recorded. Results: The cohort consisted of 101 women. The average age was 33.9 ± 9.0 years and body mass index was 27.3 ± 4.5, with an average Epworth Sleepiness Scale score of 12.9 ± 5.2, and Insomnia Severity Index score of 17.6 ± 5.7. Overall, 36.6% were diagnosed with insomnia only, 14.9% with obstructive sleep apnea (OSA) only, and 34.7% met diagnostic criteria for both insomnia and OSA. The average apnea-hypopnea index for the entire cohort was 5.37 ± 7.04/h whereas it was 10.34 ± 3.14/h for those meeting diagnostic criteria for OSA. The women referred for sleep evaluations had the following rates of associated illnesses: pain disorders (59.4%), anxiety (48.5%), depression (46.5%), and post-traumatic stress disorder (21.8%). For patients with OSA, the relative risk of having post-traumatic stress disorder was 2.72 (95% confidence interval 1.16–6.39). Conclusions: Women in the U.S. military who have sleep disorders have a high rate of behavioral medicine and pain disorders. Interestingly, nearly 50% of active duty females referred for a sleep study have OSA while not necessarily manifesting the typical signs of obesity or increased age. The reasons for this finding are not completely understood, though factors related to military service may potentially contribute. The findings from our study indicate a need for increased awareness and evaluation of sleep disorders in women in the military, especially those with behavioral medicine disorders.

INTRODUCTION

The prevalence of disturbed sleep and sleep disorders is increasingly recognized in the military. According to the Department of Defense, the number of females in the U.S. military constituted 15.1% of the total force in 2014.[1] However, there is limited understanding of sleep and sleep disorders in this population. The RAND Report, Sleep in the Military, reported that 48.6% of active duty service members (ADSM) surveyed met criteria for a clinically significant sleep disorder as assessed by the Pittsburgh Sleep Quality Index (PSQI).[2] Yet, even in this large epidemiologic study, there were limited data regarding sleep disturbances in female ADSM who only constituted 8.4% of the study population. The Millennium Cohort Study analyzed sleep in 2,790 female ADSM, which included pregnant female ADSM and mothers with young children.[3] They reported a mean sleep duration of 5.45–5.84 h per night, which was markedly lower than their male counterparts.[1,4,5] A potential reason for this difference is that female ADSM face unique stressors related to family responsibilities and military duties; however, it is unknown if underlying sleep disorders contributed to these findings.

Female ADSM are typically between the ages of 18 and 50 yr and based on civilian data, the most common sleep disorder expected in this age group is insomnia.[5,6] Women of all ages typically report more sleep disturbances than men.[7] Yet, women are referred less frequently for evaluation.[8] Similarly, there are limited data on clinical sleep disorders in female ADSM as they constitute less than 5% of the patients in studies on sleep disorders in military personnel.[9]

Combat deployments and exposure to physical and psychological stressors result in increased rates of post-traumatic stress disorder (PTSD), anxiety, depression, and musculoskeletal injuries.[10–12] With the incorporation of female ADSM into combat roles, they are now exposed to physical and psychological stressors previously experienced primarily by male ADSM.[13] Mota et al[14] found that female ADSM reported higher levels of work-related stress than male ADSM. Female ADSM in this study were also more likely than men to have PTSD, depression, or anxiety disorders.

The prevalence of sleep disordered breathing (SDB) among women in the general population is 9%, with 2% of women in the working-age group meeting the diagnostic criteria for sleep apnea syndrome.[15] The symptomatology of SDB differs between men and women. Whereas men commonly present with complaints classically associated with obstructive sleep

*Sleep Disorders Center, Wilford Hall Ambulatory Surgery Center, 2200 Bergquist Dr, Suite 1, JBSA Lackland, TX 78236

†Operations Research Department, Naval Postgraduate School, 1411 Cunningham Road, Monterey, CA 93943

The views expressed are solely those of the authors and do not reflect the official policy or position of the US Army, US Navy, US Air Force, the Department of Defense, or the US Government.

doi: 10.1093/milmed/usx116

apnea (OSA) including daytime sleepiness and snoring, women often present with fatigue and insomnia. Young et al[16] reported that 40% of women with an apnea-hypopnea index (AHI) of greater than 15 did not report any "classic" OSA symptoms. Additionally, women with SDB are often misdiagnosed with depression or other illnesses.[17] Currently, there are no studies reporting on SDB in female ADSM.

As female ADSM represent a unique population subjected to stressors not commonly seen in the general civilian populace (e.g., deployments, moves, shift work, family separation, and work hours) and it is currently unknown what clinical sleep disorders they manifest, the purpose of this study was to characterize sleep disorders in this population. An additional objective was to determine if there was an association between specific sleep disorders and the illnesses of anxiety, pain disorders, depression, and PTSD, which are more commonly associated with military service.

METHODS

We conducted a retrospective review of all female ADSM referred for the evaluation of a sleep concern to an academic military sleep disorders center and who subsequently underwent an attended, in-lab polysomnogram (PSG) from March 2014 to September 2015. All patients were currently on active duty status in the U.S. Army, Air Force, Navy, and Marines referred from several local clinics by primary care and mental health providers. Approximately 20% of the referrals to our sleep disorders center are female. All of the female ADSM referred to the sleep disorders center during this time period who completed our clinic intake questionnaire and received a PSG and were included in this study. The need for a PSG was adjudicated by a sleep physician after review of the patient's intake questionnaire and referral consult. Polysomnographic variables, demographic/biometric parameters, sleep center intake questionnaires, and electronic medical records (EMR) were reviewed. Individuals with previous PSGs, those referred for post-surgical evaluation, or those who did not complete our sleep center intake questionnaire were excluded from the analysis.

Approval for this research was obtained from the Wilford Hall Ambulatory Surgical Center Institutional Review Board. Medical record review was performed using the EMR system. After collection, data were recorded in a de-identified database prior to statistical analysis. One hundred eight patients' records were reviewed with 101 female ADSM from the U.S. Army, Air Force, and Navy meeting inclusion criteria.

The Epworth Sleepiness Scale (ESS) was used to assess patients' sleepiness. A score >10 indicates excessive daytime sleepiness.[18] The Insomnia Severity Index (ISI) was used to assess insomnia symptoms. A score ≥15 is consistent with clinical insomnia.[19]

Level 1 PSG was performed in accordance with the American Academy of Sleep Medicine (AASM) standards within an AASM accredited lab (Embla Systems, Broomfield, CO, Sandman Version 9.3), with a subset undergoing a split-night PSG in accordance with laboratory policy. Studies were scored utilizing the 2012 AASM scoring guidelines.[20] Polysomnographic variables of interest, to include sleep onset latency, sleep efficiency, wake after sleep onset, AHI, and maximal desaturation were analyzed. Biometric parameters of age, body mass index (BMI), branch of service, and deployment experience were obtained.

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 lab questionnaire.[21] All diagnoses were adjudicated by two board certified sleep medicine physicians. The diagnosis of insomnia was rendered when patients with self-reported symptoms of insomnia had a sleep onset latency >30 min and a reduced sleep efficiency from the sleep lab questionnaire, as well as an ISI score consistent with insomnia (≥15). Patients with a sub-threshold ISI of 11–14 were required to have the same self-reported insomnia symptoms along with at least one PSG variable consistent with insomnia to include: sleep onset latency >30 min, wakefulness after sleep onset of >30 min, and/or sleep efficiency <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 SDB or another disorder in accordance with ICSD-3 and when PSG variables were consistent with insomnia as noted above.[21,22] Associated diagnoses including depression, anxiety, PTSD, and pain disorders were obtained from the EMR. Patients with an EMR and sleep lab questionnaire self-reported diagnosis of: back or neck pain, fibromyalgia, migraines, temporomandibular joint pain, or arthritis who were taking a pain medication at the time of sleep evaluation were determined to have a pain disorder.[23]

Statistical analysis was conducted utilizing statistical software package (JMP Pro 12; SAS Institute; Cary, NC). Data normality was assessed with the Shapiro–Wilk test. Given that our data violated the assumption of normality, statistical analysis was based on nonparametric methods. All variables underwent descriptive analysis to designate our population in terms of demographic characteristics. Participants were then classified into four groups, "Insomnia Only," "OSA Only," "Both Insomnia and OSA" for patients with comorbid insomnia and OSA, and "Other Sleep Disorders" for participants with other sleep-related disorders.

An α-level of 0.05 was used to determine statistical significance. For analysis of multiple comparisons, we used Dunn's method for joint ranking with control accounting for family-wise error. Comparisons between proportions are based on Fisher's exact test. Data are presented as mean (M) ± standard deviation (SD).

RESULTS

Participants' ages ranged from 20 to 65 years (33.9 ± 9.03) (Table I). The BMI ranged from 19.4 to 43.8 kg/m^2 (27.3 ± 4.46),

TABLE I. Sample Demographic Characteristics and Polysomnographic Variables

	Entire sample ($N = 101$)
Demographics, M ± SD	
Age, years	33.9 ± 9.03
BMI	27.3 ± 4.46
Normal weight, % (No.)	34.7% (35)
Overweight, % (No.)	39.6% (40)
Obese, % (No.)	25.7% (26)
BMI 30–34.9, % (No.)	19.8% (20)
BMI 35–39.9, % (No.)	3.96% (4)
BMI ≥40, % (No.)	1.98% (2)
Previously deployed, % (No.)	49.5% (50)
Self-reported measures, M ± SD	
ESS	
Elevated daytime sleepiness, % (No.)	67.3% (68)
Sleep duration, M ± SD	
Weekdays	6.41 ± 2.10
Weekend	7.86 ± 2.76
ISI, M ± SD	17.6 ± 5.66
Primary sleep diagnoses: % (No.)	
Insomnia (overall)	71.3% (72)
OSA (overall)	49.5% (50)
Insomnia only	36.6% (37)
OSA only	14.9% (15)
Both Insomnia and OSA	34.7% (35)
Associated illnesses: % (No.)	
Anxiety	48.5% (49)
Pain disorders	59.4% (60)
Depression	46.5% (47)
PTSD	21.8% (22)
PSG variables, M ± SD	
SOL (min)	21.4 ± 24.5
SE (%)	82.3 ± 13.6
WASO (min)	49.1 ± 40.9
AHI (events/h)	5.37 ± 7.04
Desaturation (%)	89.5 ± 7.02

BMI, body mass index; ESS, Epworth Sleepiness Scale; ISI, Insomnia Severity Index; PTSD, post-traumatic stress disorder; PSG, polysomnogram; SOL, sleep onset latency; SE, sleep efficiency; WASO, wakefulness after sleep onset; AHI, apnea-hypopnea index; desaturation, minimum recorded oximetry value during sleep.

with 65.4% of the cohort either overweight (39.6%) or obese (25.7%). Participants were predominantly U.S. Air Force (54.5%); 41.6% were U.S. Army, and 3.9% were U.S. Navy. Approximately 50% of the participants had previously deployed. The average self-reported sleep duration during weekdays was 6.41 ± 2.10 h and 7.86 ± 2.76 h during days off. The average ESS score was 12.9 ± 5.16, with 67.3% of the patients having an ESS>10.

The study sample was characterized by a high rate of insomnia (71.3%) and OSA (49.5%), with 34.7% of the participants having Both Insomnia and OSA, 36.6% with insomnia only, and 14.9% having OSA only. Fourteen patients were diagnosed with other sleep disorders, which included: 4 with idiopathic hypersomnia, 4 with snoring, 2 with shift work disorder, 1 with nightmare disorder, 1 with restless legs syndrome, and 1 with sleepwalking. The diagnostic rate of sleep disorders in the study sample is shown in Figure 1. Polysomnographic variables and demographic characteristics for each primary sleep disorder are shown in Table II. Within our cohort, several illnesses commonly associated with sleep disturbances were present, to include pain disorder (59.4%), anxiety (48.5%), depression (46.5%), and PTSD (21.8%).

The average AHI for the entire cohort was 5.37 ± 7.04/h whereas it was 10.34 ± 3.14/h for those meeting diagnostic criteria for OSA. Correlations between AHI and associated illnesses of interest was also assessed. Patients diagnosed with PTSD had an increased AHI (12.2 ± 13.4 events/h) compared with patients without PTSD (8.2 ± 14.2 events/h; Wilcoxon Rank Sum test, $Z = 2.08$, $p = 0.037$, effect size $r = 0.207$). The relative risk of being diagnosed with PTSD was 2.7 (95% confidence interval, 1.16–6.39) for patients with OSA compared with patients without OSA. In patients with moderate or severe OSA, the occurrence of PTSD was approximately four times higher than patients with "Other Sleep Disorders."

Lastly, we assessed the rate of associated illnesses of interest in our cohort by each primary sleep disorder diagnosis. Analysis showed that patients with both Insomnia and OSA had a 2.39 (95% confidence interval, 1.39–4.09) times relative risk of having three or more associated illnesses (PTSD, anxiety, pain disorder, or depression) compared with patients without both sleep disorders.

DISCUSSION

To our knowledge, this is the first study that describes sleep disorders and associated illnesses in female ADSM referred for the evaluation of sleep disturbances. Although insomnia was the most common sleep disorder in our cohort (>70%), a notable finding was that nearly 50% of relatively young female ADSM had OSA. A previous study[24] evaluating sleep disorders in a primarily male clinical cohort of ADSM whose age and BMI were similar to ours reported OSA in 51.2%, comparable to the 49.6% in our female ADSM study. Our findings differ from civilian data, in which the incidence of OSA in women referred for PSG is 16–21%[25,26] and the male to female OSA diagnostic ratio is 8:1 to 10:1.[27–29] This suggests there are differences in the development and/or presentation of OSA between female ADSM and civilian women.

The high diagnostic rate of OSA may represent an underrecognition of a clinically significant sleep disorder in female ADSM. Specifically, many of the female ADSM in our study had the comorbid illnesses of PTSD,[30] anxiety,[31] depression,[32] and pain disorders,[33] all of which are associated with disturbed sleep. It is likely that the symptoms of disturbed sleep were initially attributed to either these comorbid disorders or only insomnia. Only when their sleep disturbances proved refractory to either behavioral or pharmacologic treatments, were the female ADSM referred for a sleep evaluation. While the basis for this high rate of OSA is unknown, central nervous system alterations, including sympathetic activation resulting in a state of hyperarousal, may accompany psychiatric disease. The resulting sleep fragmentation may lead to upper airway instability and

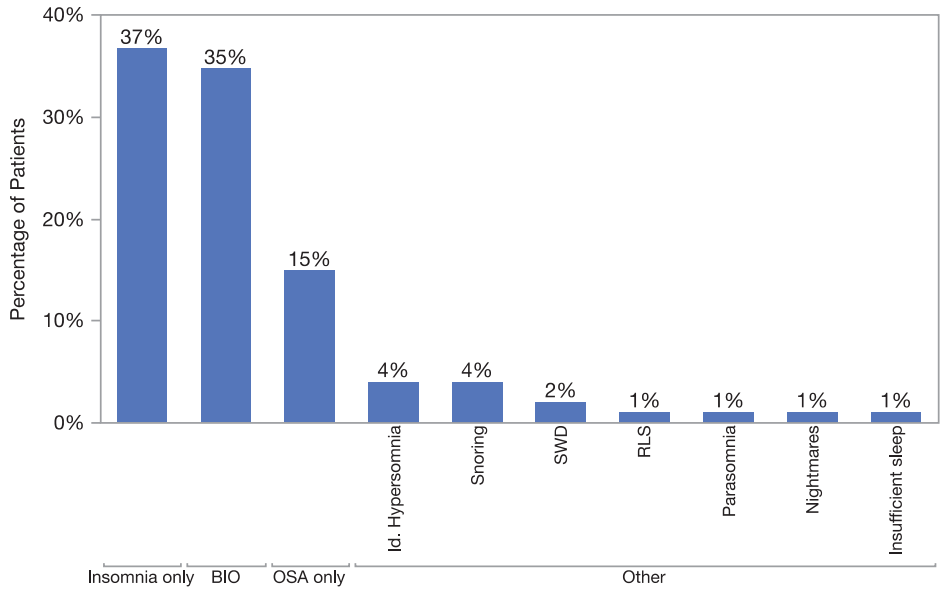

FIGURE 1. Diagnostic rate of primary sleep disorders.

TABLE II. Polysomnographic Variables and Demographic Characteristics by Primary Sleep Disorder.

	Insomnia Only ($n = 37$)	OSA Only ($n = 15$)	Both Insomnia and OSA ($n = 35$)	Other Sleep Disorders ($n = 14$)
Demographics, M ± SD				
Age, years	34.6 ± 9.97	36.1 ± 9.95	33.7 ± 8.04	30.0 ± 7.27
BMI	26.8 ± 4.48	28.3 ± 3.32	27.7 ± 4.87	26.5 ± 4.52
Self-reported measures, M ± SD				
ESS	13.1 ± 5.44	11.9 ± 4.51	11.9 ± 5.30	15.6 ± 4.01
Sleep duration, M ± SD				
Weekdays	6.08 ± 1.87	7.30 ± 1.71	5.66 ± 1.65**	8.11 ± 2.83
Weekend	7.89 ± 2.93	8.87 ± 2.10	6.90 ± 2.63	9.04 ± 2.64
ISI, M ± SD	18.5 ± 4.66	11.2 ± 4.62	20.5 ± 4.16**	14.6 ± 5.94
Associated illnesses: % (No.)				
Anxiety[a]	51.4% (19)	26.7% (4)	57.1% (20)	42.9% (6)
Pain disorders	64.9% (24)	53.3% (8)	57.1% (20)	57.1% (8)
Depression[a]	46.0% (17)	26.7% (4)	57.1% (20)	42.9% (6)
PTSD[a]	13.5% (5)	13.3% (2)	40.0% (14)	7.14% (1)
PSG variables, M ± SD				
SOL (min)	17.6 ± 16.2	21.1 ± 26.5	27.9 ± 33.2	15.5 ± 9.06
SE (%)	82.1 ± 15.0	80.7 ± 14.7	80.5 ± 13.2	87.3 ± 8.69
WASO (min)	53.0 ± 46.2	55.4 ± 58.7	46.6 ± 29.2	39.4 ± 34.3
AHI (events/h)	2.15 ± 1.57	13.7 ± 17.8***	8.91 ± 3.96***	2.38 ± 1.70
Desaturation (%)	91.3 ± 3.82	88.6 ± 7.87	88.1 ± 7.04	87.5 ± 13.1

OSA, obstructive sleep apnea; ESS, Epworth Sleepiness Scale; ISI, Insomnia Severity Index; PTSD, post-traumatic stress disorder; PSG, polysomnogram; SOL, sleep onset latency; SE, sleep efficiency; WASO, wakefulness after sleep onset; AHI, apnea-hypopnea index; desaturation, minimum recorded oximetry value during sleep.

Statistical significance for differences with the "Other Sleep Disorders" group: $^{**}p < 0.01$; $^{***}p < 0.001$.

[a]Multiple comparison analysis not feasible due to small number of patients.

potentially the development of OSA.[34,35] Another reason for the high rate of OSA diagnoses is that as a tertiary military treatment facility, referral bias may have been present, leading to a higher rate of female ADSM with OSA referred to our sleep disorders center.

Though limited by our small sample size, there was a significant association between OSA and PTSD, with a relative risk of being diagnosed with PTSD of 2.72 for patients with OSA. Lettieri et al[36] recently reported that in a primarily male patient population, 56.6% were diagnosed with OSA. Additionally, a study of male veterans reported a similar finding: those with OSA had an odds ratio of 1.5 for a diagnosis of PTSD compared with veterans without OSA.[37] A separate study reported 28% of male veterans with OSA had PTSD.[38] Thus, the association between OSA and PTSD appears to occur in both male and female ADSM. While this association

is intriguing, the pathophysiologic mechanism linking OSA and PTSD has not been fully elucidated.

A high rate of anxiety, depression, and pain was present in our cohort. The occurrence of these illnesses in female ADSM with sleep disorders is not necessarily unexpected as sleep disorders are common among patients with psychiatric and pain disorders.[39–42] Pain disorders were the most frequent associated illness in our cohort with approximately 55% meeting criteria for OSA. The potential role of chronic pain medications, most notably opioids, to this finding is unknown but requires further study.

In our cohort, insomnia was the most common sleep disorder diagnosed (71.3%). This is consistent with other studies that show a high incidence of insomnia among ADSM and veterans presenting for clinical evaluation.[22,43] Insomnia in ADSM may be related to maladaptive sleep practices related to irregular work hours, deployments, family separation, and working in a high stress environment with inconsistent opportunities for sleep. Importantly, our data revealed that 70% of female ADSM diagnosed with OSA were also diagnosed with comorbid insomnia. The combination of insomnia and OSA leads to greater sleep disruption and increased medical and psychiatric morbidity.[44] This is substantiated by our findings whereby female ADSM with comorbid insomnia and OSA were 2.39 more likely to have three or more associated illnesses.

In addition to the disrupted sleep caused by sleep disorders, insufficient sleep is also an important consideration in this population with patients in our cohort reporting 6.41 ± 2.1 h. Short sleep duration, defined as sleeping less than 7 h per night, is endemic in the military. There is evidence to suggest that female ADSM may sleep less than their male counterparts with post-deployed mothers reporting 5.58 h of sleep per night.[3] Thus female ADSM may face unprecedented challenges to obtain sufficient sleep. This may predispose them to an increased risk of sleep disorders and associated illnesses.

Our study has several limitations. We established the rate of sleep disorders in a relatively small cohort of female ADSM referred with sleep disturbances, and our findings may not be applicable to all female ADSM or women in the general population. Additionally, as this study was retrospective, associated illnesses were determined by patient self-report in combination with the diagnosis in the EMR and do not necessarily represent definitive diagnoses. However, all PSGs and sleep data were obtained in a standardized manner. We also did not assess for pregnancy or child rearing responsibilities that may have impacted sleep quality or duration. Despite the noted limitations, this study provides an initial basis for the diagnostic rates of sleep disorders and associated illnesses in female ADSM with sleep disturbances.

CONCLUSIONS

In conclusion, we found insomnia was the most frequent sleep disorder in female ADSM with sleep disturbances. However, nearly 50% had OSA, suggesting that a sleep medicine evaluation and PSG is indicated in female ADSM with persistent sleep disturbances. Prospective research is needed to validate these findings and further explore potential underlying mechanisms. Ultimately, modification of existing screening methods and guidelines for women with sleep complaints, especially female ADSM and those with similar occupations, are required to ensure appropriate diagnosis and treatment of sleep disorders.

ACKNOWLEDGMENTS

The authors would like to thank Karen Robbins for help with creating spreadsheet databases. She did not receive any compensation for her contributions and has no academic affiliations.

REFERENCES

1. Department of Defense. 2014 Demographics Profile of the Military Community. Available at http://download.militaryonesource.mil/12038/MOS/Reports/2014-Demographics-Report.pdf; accessed February 5, 2017.
2. Troxel WM, Shih RA, Pedersen ER, et al: Sleep in the military: Promoting healthy sleep among US servicemembers. Rand Health Quart 2015; 5(2): 19.
3. Seelig AD, Jacobsen IG, Smith B, et al: Sleep patterns before, during, and after deployment to Iraq and Afghanistan. Sleep 2010; 33: 1615–22.
4. Mindell JA, Jacobson BJ: Sleep disturbances during pregnancy. J Obstetr Gynecol Neonatal Nurs 2000; 29: 590–7.
5. Radecki SE, Brunton SA: Management of insomnia in office-based practice: national prevalence and therapeutic patterns. Arch Fam Med 1993; 2: 1129.
6. Roth T, Coulouvrat C, Hajak G, et al: Prevalence and perceived health associated with insomnia based on DSM-IV-TR; international statistical classification of diseases and related health problems, tenth revision; and research diagnostic criteria/international classification of sleep disorders, criteria: results from the America insomnia survey. Biol Psychiatry 2011; 69: 592–600.
7. Krishnan V, Collop NA: Gender differences in sleep disorders. Curr Opin Pulm Med 2006; 12: 383–9.
8. Larsson LG, Lindberg A, Franklin KA, et al: Gender differences in symptoms related to sleep apnea in a general population and in relation to referral to sleep clinic. CHEST J 2003; 124: 204–11.
9. Mysliwiec V, Gill J, Lee H, Baxter T, et al: Sleep disorders in US military personnel: a high rate of comorbid insomnia and obstructive sleep apnea. CHEST J 2013; 144(2): 549–57.
10. Hoge CW, Castro CA, Messer SC, et al: Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. N Engl J Med 2004; 351: 13–22.
11. Hoge CW, McGurk D, Thomas JL, et al: Mild traumatic brain injury in US soldiers returning from Iraq. N Engl J Med 2008; 358: 453–63.
12. Peterson AL, Good JL, Satterfied WA, et al: Sleep disturbance during military deployment. Mil Med 2008; 173: 230–5.
13. Hoge CW, Clark JC, Castro CA: Commentary: women in combat and the risk of post-traumatic stress disorder and depression. Int J Epid 2007; 36: 327–9.
14. Mota NP, Medved M, Wang JL, et al: Stress and mental disorders in female military personnel: comparisons between the sexes in a male dominated profession. J Psych Res 2012; 46: 159–67.
15. Young T, Palta M, Dempsey J, et al: The occurrence of sleep-disordered breathing among middle-aged adults. N Engl J Med 1993; 328: 1230–5.
16. Young T, Hutton R, Finn L, et al: The gender bias in sleep apnea diagnosis: are women missed because they have different symptoms? Arch Intern Med 1996; 156: 2445–51.

17. Lin CM, Davidson TM, Ancoli-Israel S: Gender differences in obstructive sleep apnea and treatment implications. Sleep Med Rev 2008; 12: 481–96.
18. Johns MW: Reliability and factor analysis of the Epworth Sleepiness Scale. Sleep 1992; 15: 376–81.
19. Morin CM, Belleville G, Bélanger L, et al: The Insomnia Severity Index: psychometric indicators to detect insomnia cases and evaluate treatment response. Sleep 2011; 34: 601–8.
20. Berry RB, Brooks R, Gamaldo CE, et al: The AASM Manual for the Scoring of Sleep and Associated Events. Rules, Terminology and Technical Specifications, Ver 2.2;7-56. Darien, IL, American Academy of Sleep Medicine, 2015.
21. ICSD-3: The International Classification of Sleep Disorders. Darien, IL, American Academy of Sleep Medicine, 2014.
22. Mysliwiec V, Matsangas P, Baxter T, et al: Comorbid insomnia and obstructive sleep apnea in military personnel: correlation with polysomnographic variables. Mil Med 2014; 179: 294–300.
23. ITFo T, Part III: Pain Terms: a current list with definitions and notes on usage. Classification of Chronic. Pain 1994; 2: 209–14.
24. Mysliwiec V, McGraw L, Pierce R, et al: Sleep disorders and associated medical comorbidities in active duty military personnel. Sleep 2013; 36: 167–74.
25. Redline S, Kump K, Tisler PV, et al: Gender differences in sleep disordered breathing in a community-based sample. Am J Respir Crit Care Med 1994; 149: 722–6.
26. Wahner-Roedler DL, Olson EJ, Narayanan S, et al: Gender-specific differences in a patient population with obstructive sleep apnea-hypopnea syndrome. Gender Med 2007; 4: 329–38.
27. Young T, Hutton R, Finn L, et al: The gender bias in sleep apnea diagnosis: are women missed because they have different symptoms? Arch Intern Med 1996; 156: 2445–51.
28. Quintana-Gallego E, Carmona-Bernal C, Capote F, et al: Gender differences in obstructive sleep apnea syndrome: a clinical study of 1166 patients. Respir Med 2004; 98: 984–9.
29. Guilleminault C, Quera-Salva MA, Partinen M, et al: Women and the obstructive sleep apnea syndrome. Chest J 1988; 93: 104–9.
30. Germain A: Sleep disturbances as the hallmark of PTSD: where are we now? Am J Psychiatry 2013; 170(4): 372–82.
31. Papadimitriou GN, Linkowski P: Sleep disturbance in anxiety disorders. Int Rev Psychiatry 2005; 17(4): 229–36.
32. Breslau N, Roth T, Rosenthal L, Andreski P: Sleep disturbance and psychiatric disorders: a longitudinal epidemiological study of young adults. Biol Psychiatry 1996; 39(6): 411–8.
33. Smith MT, Jennifer AH: How do sleep disturbance and chronic pain inter-relate? Insights from the longitudinal and cognitive-behavioral clinical trials literature. Sleep Med Rev 2004; 8(2): 119–32.
34. Sériès F, Roy N, Marc I: Effects of sleep deprivation and sleep fragmentation on upper airway collapsibility in normal subjects. Am J Respir Crit Care Med 1994; 150: 481–5.
35. Krakow B, Haynes PL, Warner TD, et al: Nightmares, insomnia, and sleep-disordered breathing in fire evacuees seeking treatment for posttraumatic sleep disturbance. J Trauma Stress 2004; 17: 257–68.
36. Lettieri CJ, Williams SG, Collen JF: OSA syndrome and posttraumatic stress disorder: clinical outcomes and impact of positive airway pressure therapy. Chest 2016; 149(2): 483–90.
37. Babson KA, Del RAC, Bonn-Miller MO, et al: The comorbidity of sleep apnea and mood, anxiety, and substance use disorders among obese military veterans within the Veterans Health Administration. J Clin Sleep Med 2013; 9: 1253–58.
38. Sharafkhaneh A, Giray N, Richardson P, et al: Association of psychiatric disorders and sleep apnea in a large cohort. Sleep 2005; 23: 1405–11.
39. Spoormaker VI, Montgomery P: Disturbed sleep in post-traumatic stress disorder: secondary symptom or core feature? Sleep Med Rev 2008; 12: 169–84.
40. Spoormaker VI, van den Bout J: Depression and anxiety complaints; relations with sleep disturbances. Eur Psychiatry 2005; 20: 243–5.
41. Morphy H, Dunn KM, Lewis M, et al: Epidemiology of insomnia: a longitudinal study in a UK population. Sleep 2007; 30: 274–80.
42. Staedt J, Windt H, Hajak G, et al: Cluster arousal analysis in chronic pain-disturbed sleep. J Sleep Res 1993; 2: 134–7.
43. Jenkins MM, Colvonen PJ, Norman SB, et al: Prevalence and mental health correlates of insomnia in first-encounter veterans with and without military sexual trauma. Sleep 2014; 38: 1547–54.
44. Bjornsdottir E, Janson C, Gislason T, et al: Insomnnia in untreated sleep apnea patients compared to controls. J Sleep Res 2012; 21: 131–8.