Characterization of Sleep During Military Operations and the Impact of Deployment-Related Factors: The Behavioral Health Needs Assessment Survey

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EXECUTIVE SUMMARY

Sleep disruption is a growing concern among military personnel. Very little is known, however, regarding sleep characteristics of military members serving in combat environments. We sought to quantify the prevalence and cognitive correlates of sleep disruption among military personnel serving in a combat zone during Operation Enduring Freedom, utilizing a cross-sectional survey of active duty and reserve U.S. Navy personnel in the Afghanistan combat theater (N = 6,118). Survey sleep measures included total hours of sleep per day, total hours of sleep required to feel well-rested, difficulty falling asleep, and difficulty staying asleep. The survey also measured outcomes such as accidents related to the mission. Participants reported an average of 5.9 hours of sleep per night, despite requiring on average 6.8 hours to feel well-rested. Fifty-seven percent reported getting insufficient sleep, and this interacted with mission type. Sleep disruption was associated with number of deployments, as well as number of months in a combat zone. Further, those with more sleep difficulty and disruption were more likely to have caused an accident or error that affected the mission. This study documents sleep characteristics, deployment-related correlates, and potential cognitive outcomes of sleep disruption among military members in a combat zone.

INTRODUCTION

Sleep disruption has been linked to a host of physiological (Grandner, Jackson, Pak, & Gehrman, 2012) and psychological (Pigeon, Pinquart, & Conner, 2012) health problems. Additionally, sleep deprivation directly impairs cognitive function, negatively affecting performance accuracy (Drummond, Paulus, & Tapert, 2006), decision-making (McKenna, Dickinson, & Drummond, 2007), and attention and response time (Lim & Dinges, 2010). Moreover, these neurocognitive effects appear to accumulate over successive days of disruption (Durmer & Dinges, 2005). Perhaps surprisingly, even chronic partial sleep restriction (6 hours/night) produces serious deficits in working memory and attention, equivalent to those observed after 24 hours of sleep deprivation (Van Dongen, Maislin, Mullington, & Dinges, 2003) or with a blood alcohol content of 0.1% (Williamson & Feyer, 2000). Importantly, these deficits are not reflected in subjective sleepiness scores, indicating that individuals tend to underestimate the effect that sleep deprivation has on their own level of functioning (Van Dongen et al., 2003). Certain populations, such as those working extended, night, or rotating shifts, are at an increased risk for sleep and health disorders (Drake, Roehrs, Richardson, Walsh, & Roth, 2002; Harrington, 2001). During deployment, service members are often required to be alert and functional for irregular or long periods of time under demanding circumstances. Therefore, it is important to characterize the sleep of deployed service members and to determine what, if any, deployment-related factors might mitigate the myriad negative consequences of disturbed sleep.

OBJECTIVES AND HYPOTHESES

Previous reports from our lab have indicated that ~56% of deployed service members are sleep deprived (Taylor et al., 2014). Given the reluctance to seek help and report psychological problems found in expeditionary sailors (Greene-Shortridge, Britt, & Castro, 2007), we hypothesized that service members would underestimate their sleep need more so than civilians. Further, in view of the known relationships between stress (Baglioni, Spiegelhalder, Lombardo, & Riemann, 2010; Maggio et al., 2013; Tworoger, Davis, Vitiello, Lentz, & McTiernan, 2005; Winzeler et al., 2014), posttraumatic stress disorder (PTSD), and sleep (Taylor et al., 2014), we hypothesized that mission type, deployment history, and combat zone exposure would be related to sleep health in deployed service members. Finally, we hypothesized that sleep health would also be related to rates of reported accidents or mistakes that affect mission outcomes.

METHODS

Survey data were collected from Navy personnel as part of the Behavioral Needs Assessment Survey (BHNAS) between 2008 and 2012. Administration and consent procedures are described in detail elsewhere (Taylor et al., 2014). As a part of the survey, the sleep of all participants was assessed using several sleep items from the Army MHAT surveys (Mental Health Advisory Team, 2008, 2009; Joint Mental Health Advisory Team, 2011). Participants were asked about the average duration of sleep per day during the current deployment as well as the amount needed to feel “well-rested” (in hours, reported as whole numbers). They were also asked to rate the degree of difficulty they experienced falling or staying asleep over the previous 2 weeks on a scale ranging from 1 (*none*) to 4 (*very severe*). Other survey variables included the number of deployments prior to the current one, the number of cumulative months spent in a combat zone, and the current mission type. A subset of the sample was also asked whether their sleepiness had caused any accidents or mistakes that affected the mission. Data analyses were performed using two statistical software programs, SPSS (IBM, Armonk, NY) and GraphPad Prism (GraphPad Software, Inc., La Jolla, CA). Where appropriate, Welch's *t*-tests or analyses of variance with Games–Howell post hoc tests were performed to correct for unequal variances. All statistical tests were evaluated at the $p < 0.05$ alpha level.

FINDINGS

Sleep deprivation is pervasive and interacts with mission type.

As reported elsewhere (Taylor et al., 2014), expeditionary sailors reported getting an average of 5.9 hours of sleep (n = 6,118). This is 1 hour and 6 minutes less per night than the minimum recommendation put forth by the National Sleep Foundation (2013). Such levels of chronic partial sleep deprivation are known to cause cognitive deficits, particularly in attention and memory (Van Dongen et al., 2003). While individuals across all groups experienced chronic partial sleep deprivation, the degree varied by mission type (Figure 1). Deployment assignments were categorized as one of the following groups: Provincial Reconstruction Team (PRT), Command/Staff, Medical, Detainee Operations (DETOPS), Supply/Logistics, and Other. Those who worked DETOPS missions reported a significantly greater sleep deficit compared with other mission types, with an average of 5.4 h/night (Welch's $F_{(5,4531)} = 33.45$, $p < 0.001$, Games–Howell post hoc tests all <0.001 for contrasts with DETOPS). Across all mission types, less than one third of individuals surveyed were getting the recommended 7 or more hours of sleep per night. When focusing specifically on DETOPS, this number was markedly reduced, at less than 14% (Figure 2).

Reported sleep need is lower than standard recommendations and still greater than actual reported sleep duration.

Participants reported that the average number of hours of nightly sleep they needed to feel well-rested was 6.8 hours (median response = 7 hours). To provide a measure of sleep deficit, a difference score was obtained for each individual by subtracting the average number of hours of nightly sleep from the amount they reported needing to feel well-rested. Consistent with an earlier report by our group in a subset of this population (Taylor et al., 2014), an overwhelming 57% of service members surveyed here reported getting insufficient sleep, by this measure (Figure 3; n = 6,110). As seen for absolute sleep quantity, though reported sleep deficit is high for all mission types, a larger percentage of individuals working DETOPS report getting insufficient sleep compared with individuals working other mission types ($\chi^2_{(5)} = 56.52$, $p < 0.001$; Figure 3).

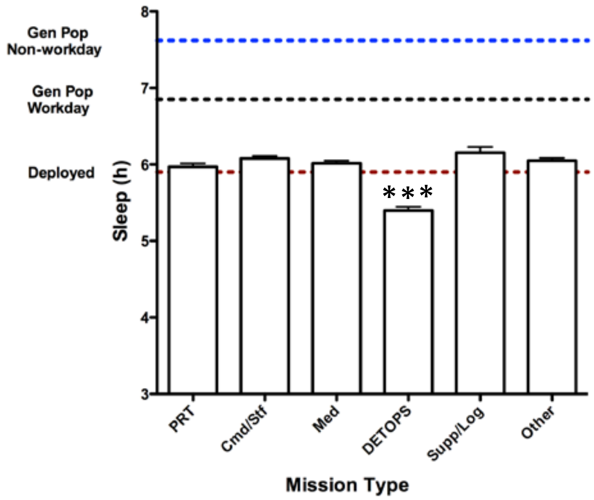

Figure 1. Average nightly sleep in hours reported by expeditionary sailors deployed to Afghanistan (2008–2012), by mission type. Dotted lines represent means for sailors (red), and the general population on workdays (black) and non-workdays (blue).

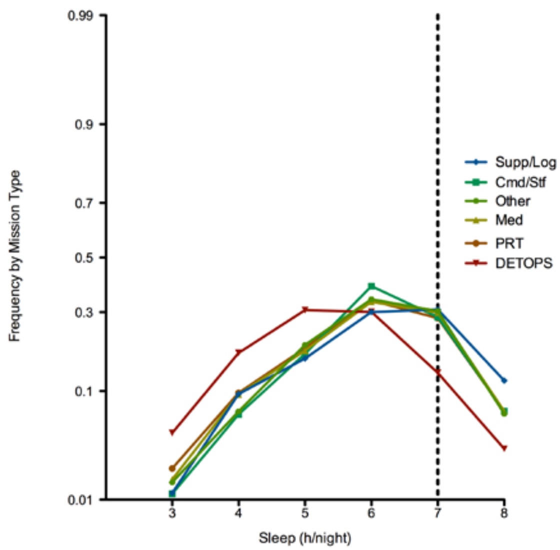

Figure 2. Percentage of expeditionary sailors reporting 3–8 hours of sleep per night, by mission type. The black dotted line represents the minimum recommendation put forth by the National Sleep Foundation.

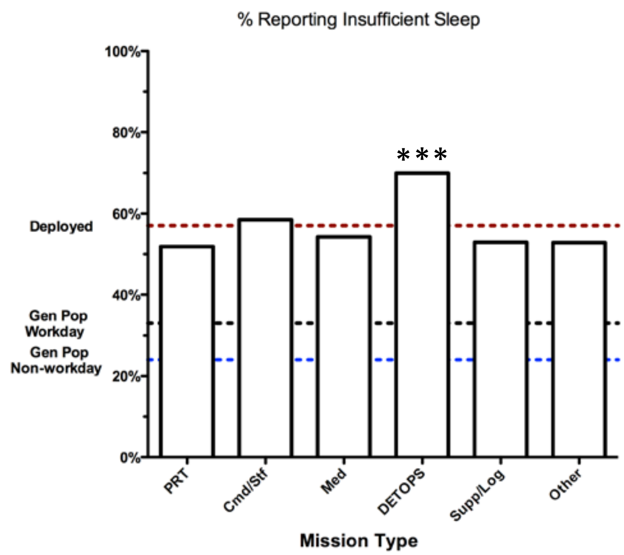

Figure 3. Percentage of individuals reporting insufficient sleep (sleep needed − average sleep duration), by mission type. Dotted lines represent means for expeditionary sailors (red), and the general population on workdays (black) and non-workdays (blue).

Sleep problems interact with deployment and combat history

Expeditionary sailors reported the level of difficulty they had falling and staying asleep over the past 2 weeks on a scale ranging from 1 (*none*) to 4 (*very severe*). As is often done for sleep disturbance questionnaires (Bruni et al., 1996), these two measures were combined for each individual to form a continuous scale of sleep difficulty from 0 to 8, with higher scores reflecting poorer sleep quality. Mean reported sleep difficulty increased with the number of prior deployments (Welch's $F_{(2,2064)} = 3.48$, $p < 0.05$), with those individuals with ≥2 prior deployments reporting significantly higher sleep disturbances than those with no previous deployment history (Games–Howell post hoc test, $p < 0.05$; Figure 4). As a complementary measure, Chi-square analysis revealed an effect of ≥2 deployments on the prevalence of sleep disruption, with fewer individuals deployed twice or more reporting less difficulty and more reporting greater difficulty than nondeployers or those only deployed once ($\chi^2_{(16)} = 133.7$, $p < 0.001$). Related to that finding, the number of hours of nightly sleep decreased with the number of prior deployments ($F_{(2,5983)} = 10.11$, $p < 0.001$), with significantly less sleep reported by those individuals who had been deployed ≥2 times compared with those deployed 1 time and nondeployers (post hoc *t*-tests with Bonferroni adjustment, $t = 3.32$, $p < 0.01$ for 1; $t = 4.46$, $p < 0.001$ for none; Figure 5).

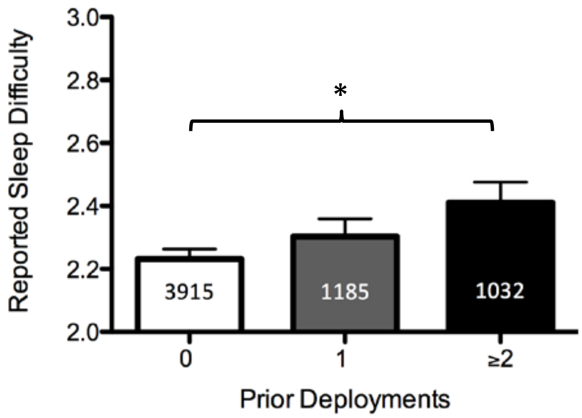

Figure 4. Reported sleep difficulty (0 to 8) increases with number of deployments. Values in each bar represent the sample size for that group.

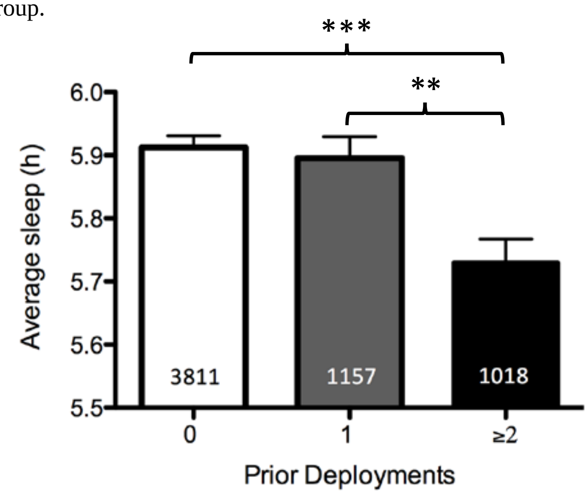

Figure 5. Average hours of sleep per night decreases with 2 or more prior deployments. Values in each bar represent the sample size for that group.

Sleep problems were greater for those individuals who had served 7 or more cumulative months in a combat zone than for those with 6 months or less (Student's *t*-test with Welch's correction, $t_{(770)}$=2.85, $p < 0.01$, Figure 6). Similarly, there was a pattern demonstrating a decrease in the number of hours of sleep with increased combat zone exposure, though it was not statistically significant ($t_{(1075)}$=1.09, $p = 0.28$). Effects of combat zone exposure and number of deployments on sleep were not confounded with age in this sample, since average hours of nightly sleep and age had a small but significant positive correlation ($r = 0.084$, $p < 0.001$).

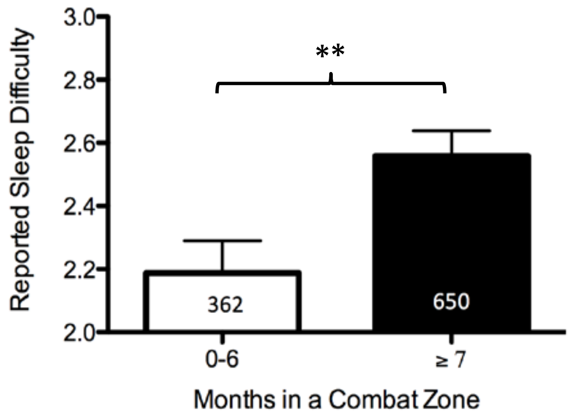

Figure 6. Reported sleep difficulty (0–8) increases after ≥7 months of cumulative deployment in combat zones. Values in each bar represent the sample size for that group.

Sleep-related accidents affecting mission increase as sleep quality and quantity decrease.

A subset of expeditionary sailors surveyed were asked, "During this deployment, have you had an accident or made a mistake that affected the mission because of sleepiness?" The number of individuals reporting such an accident increased as the average number of reported nightly hours of sleep decreased ($\chi^2_{(2)}$ =14.86, p < 0.001, n = 1,157; post hoc for ≥7 vs. 4-6, p < 0.05; for ≥7 vs. ≤3, p < 0.001; for 4-6 vs. ≤3, p < 0.01; Figure 7). More than 13% of those who received ≤3 hours of nightly sleep reported a sleep-related accident, compared with 4% of those who received 4–6 hours and only 1% of those who received the recommended ≥7 hours. Consistent with those findings, an increase in sleep-related accidents was also reported in individuals with a calculated sleep deficit ($\chi^2_{(1)}$ =14.08, p < 0.001, n = 1,149; Figure 8).

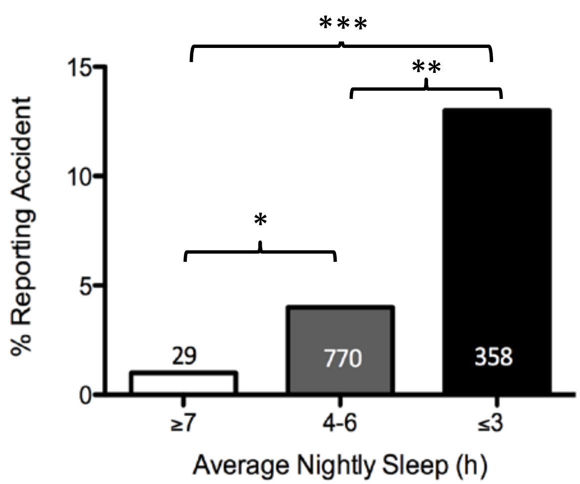

Figure 7. Reported sleep-related accidents affecting the mission increased as the number of average hours of nightly sleep decreased.

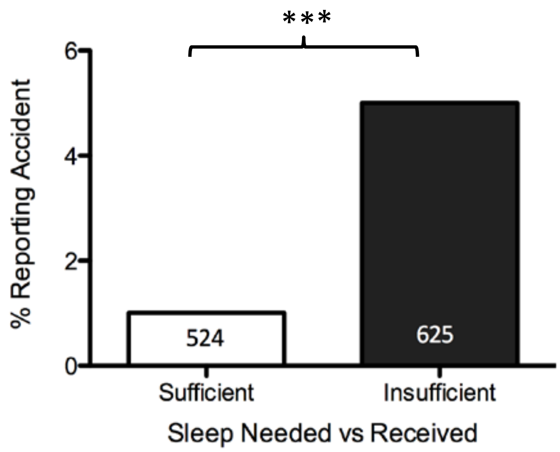

Figure 8. An increased number of sleep-related accidents was observed in individuals who reported getting fewer hours of sleep on average than they needed.

In this subset of our sample, we also obtained a measure of how frequently individuals felt they received less sleep than needed specifically due to work hours on a scale ranging from 1 (*never*) to 4 (*always*). Not surprisingly, as the frequency of this measure increased, so did the number of accidents ($\chi^2_{(4)}$ =44.67, $p < 0.001$, $n = 1{,}156$; post hoc for Always vs. Sometimes, $p < 0.05$; for Always vs. Seldom and Never, $p < 0.001$; Often vs. Seldom and Never, $p < 0.001$; all other *p*s n.s.; Figure 9). Interestingly, those individuals reporting sleep-related accidents that affected the mission also had a higher subjective sleep difficulty score (Student's *t*-test with Welch's correction, $p < 0.001$, $n = 1{,}163$; Figure 10).

Figure 9. An increased number of sleep-related accidents was observed in individuals who reported having work-related sleep deficits more frequently.

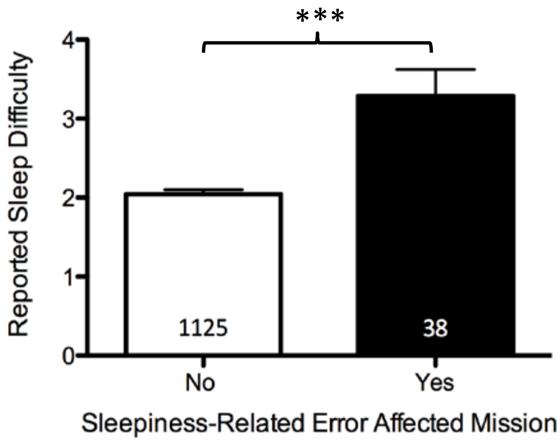

Figure 10. Those individuals reporting a sleep-related accident also reported more sleep difficulty than those reporting no accidents.

DISCUSSION

The present study assessed the relationship between deployment-related factors, such as mission type, length of combat zone exposure, and number of deployments on reported sleep. We found that expeditionary sailors are chronically partially sleep deprived to a degree known to have negative cognitive outcomes (Lim & Dinges, 2010; Van Dongen et al., 2003; Williamson & Feyer, 2000), and further, that the severity varies by mission type. We found that expeditionary sailors working DETOPS were at greatest risk for sleep difficulties and deficits. This finding is consistent with previous reports from BHNAS wherein those on DETOPS missions were at the highest risk for mental health issues, including depression, anxiety, and PTSD (all of which are also associated with sleep disturbance) (Beckerley, Hilton, Booth-Kewley, & Taylor, 2013).

An overwhelming 57% of service members surveyed here reported getting insufficient sleep, in sharp contrast to the national average for the civilian population for the same measure (only 33% for workdays and 16% for non-workdays; National Sleep Foundation Sleep in America Poll, 2013). The large disparity in the percentage of service members with reported sleep deficit is even more striking within the context of their relatively lower estimated sleep need. Participants reported that the average number of hours of nightly sleep they needed to feel well-rested was 6.8 hours. This is approximately 29 minutes less sleep than civilians, and lower than the National Sleep Foundation's recommended 7–9 hours of sleep a night (National Sleep Foundation Sleep in America Poll, 2013). In the civilian population, there is a consensus with these recommendations; using a similar scale, the general population estimates their need to be 7.28 hours (median response = *8 or more*), a value that falls within the lower end of the recommended range (National Sleep Foundation Sleep in America Poll, 2013).

It may be the case that through training, selection processes, or some other variable, expeditionary sailors actually do require less sleep than civilians to feel well-rested. It may also be the case, however, that expeditionary sailors are underestimating their sleep need due to a military culture that fosters selflessness, toughness, and a willingness to tolerate discomfort.

Importantly, subjective measures of sleepiness have been shown to be dissociable from actual performance on measures of attention and working memory (Van Dongen et al., 2003). Therefore, while individuals in our sample may report feeling well-rested with an average of 6.8 hours of sleep, we cannot conclude from this subjective rating that objective performance is at its peak with a lower than recommended amount of sleep. In fact, evidence from other studies in nonmilitary populations suggests that it is unlikely (Belenky et al., 2003; Lim & Dinges, 2010; Van Dongen et al., 2003; Williamson & Feyer, 2000).

In our sample, deployment history (the number of deployments and months spent in combat zones) markedly influences both reported sleep quantity and quality. These results are theoretically consistent with data from the Millennium Cohort Study indicating that individuals who have been previously deployed report a significantly shorter sleep time than those who have not; however, the effect of multiple deployments was not explicitly examined in that study (Seelig et al., 2010). It is possible an accommodation response to the negative consequences of sleep deprivation on performance occurs with years of experience, though we have not found evidence to support this. If such a phenomenon does occur, however, it theoretically could help to counter the effects of reduced sleep found with increased deployments observed here. Further studies are necessary to evaluate the influence of sleep debt on performance and readiness across deployments.

Finally, and perhaps most importantly, we found evidence that the sleep deficit observed in this sample may have negative consequences on cognition that affect performance and mission outcomes. Because health problems are known to be underreported in this population, and sleep deprivation and its resultant cognitive impairments are not always subjectively recognized, we venture that this is likely an underestimate of actual sleep-related incidents. Interestingly, sleep deficits in our sample are not attributable to work conditions alone. While we did find that work frequently interfered with sleep, we also found higher subjective sleep difficulty scores in those individuals reporting sleep-related accidents that affected the mission. Taken together, these two findings suggest that a combination of external and internal factors is likely responsible for the sleep deficit and resultant errors observed in this sample.

The chronic partial sleep deprivation in expeditionary sailors of <6 h/night may have various other negative consequences. In a typical nocturnal sleep episode, individuals get more slow wave sleep at the beginning of the night, and more rapid eye movement (REM) sleep at the end (Goldenstein & Walker, 2014). This means expeditionary sailors are not only receiving less sleep overall, but very likely less REM sleep in particular. REM sleep has been linked with emotional memory and “recalibration” (Goldenstein & Walker, 2014). Additionally, REM sleep reduction (Germain, 2013; Lavie, Hefez, Halperin, & Enoch, 1979; Mellman, Nolan, Hebding, Kulick-Bell, & Dominguez, 1997) and disturbances (Breslau et al., 2004; Habukawa, 2007; Mellman, Bustamante, Fins, Pigeon, & Nolan, 2002) have been found in individuals with PTSD. Indeed, based on data from the BHNAS assessment, we found a relationship between PTSD symptoms and length of sleep in the current population (Taylor et al., 2014). These findings highlight the fact that current average nightly sleep duration of expeditionary sailors may therefore pose an increased risk for development of PTSD.

While the extent of sleep problems in our military remains a concern, further education regarding sleep need and sleep hygiene may have a strong positive impact and is a relatively low cost and easily implemented countermeasure. Educational guides could be distributed and briefs could be integrated into curricula in order to provide guidance on optimizing sleep and periodically re-educate individuals about its importance. Topics could include sleep hygiene, the use of stimulants and sleep aids, the physiological effects of light at night, and stress management. In addition, surveillance programs employing objective measures of sleep health should be considered.

Importantly, our survey data demonstrate lower reported sleep need in active-duty service members compared with that found in the civilian population. While this may be partly due to a lack of understanding of what constitutes good sleep health, there may also be a stigma associated with needing sleep or admitting sleep difficulties. Indeed, previous findings have shown a stigma related to reporting of physical and mental health issues among service members (Greene-Shortridge et al., 2007). Therefore, in addition to reinforcing current standards of sleep need and providing sleep hygiene education, addressing any stigma that may be associated with mental and sleep health may also prove an effective countermeasure. Further, education could be tailored to specifically address the differences in sleep quantity and quality by mission type.

REFERENCES

Baglioni, C., Spiegelhalder, K., Lombardo, C., & Riemann, D. (2010). Sleep and emotions: A focus on insomnia. *Sleep Medicine Reviews, 14*(4), 227–238.

Beckerley, S., Hilton, S., Booth-Kewley, S., & Taylor, M. K. (2013). *Behavioral Health Needs Assessment Survey: In-Theater Survey of U.S. Expeditionary Sailors: Update 2013* (Report No. 13-14). San Diego, CA: Naval Health Research Center.

Belenky, G., Wesensten, N. J., Thorne, D. R., Thomas, M. L., Sing, H. C., Redmond, D. P., Russo, M. B., & Balkin, T. J. (2003). Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: A sleep dose-response study. *Journal of Sleep Research*, *12*, 1–12.

Bruni, O. Ottaviano. S., Guidetti, V., Romoli, M., Innocenzi, M., Cortesi, F., & Giannotti, F. (1996). The Sleep Disturbance Scale for Children (SDSC): Construction and Validation of an Instrument to Evaluate Sleep Disturbances in Childhood and Adolescence. *Journal of Sleep Research, 4,* 251-261.

Breslau, N., Roth, T., Burduvali, E., Kapke, A., Schultz, L., Roehrs, T. (2004). Sleep in lifetime posttraumatic stress disorder: A community-based polysomnographic study. *Archives of General Psychiatry, 61*(5), 508–516.

Drake, L., Roehrs, T., Richardson, G., Walsh, J. K., & Roth, T. (2002). Shift work sleep disorder: prevalence and consequences beyond that of symptomatic day workers. *Sleep, 27*(8), 1453–1462.

Drummond, S. P. A., Paulus, M. P., & Tapert, S. F. (2006). Effects of two nights sleep deprivation and two nights recovery sleep on response inhibition. *Journal of Sleep Research, 15*(3), 261–265.

Durmer, J. S., & Dinges, D. F. (2005). Neurocognitive consequences of sleep deprivation. *Seminars in Neurology, 25*(1), 117–129.

Germain, A. (2013). Sleep disturbance as the hallmark of PTSD. Where are we now? *American Journal of Psychiatry, 170,* 372–382.

Goldenstein, A. N., & Walker, M. P. (2014). The role of sleep in emotional function. *Annual Review of Clinical Psychology, 10,* 679–708.

Grandner, M. A., Jackson, N. J., Pak, V. M., & Gehrman, P. R. (2012). Sleep disturbance is associated with cardiovascular and metabolic disorders. *Journal of Sleep Research, 21*(4), 427–433.

Greene-Shortridge, T. M., Britt, T. W., & Castro, C. A. (2007). The stigma of mental health problems in the military. *Military Medicine, 172*(2), 157–161.

Habukawa, M. (2007). Sleep findings in young adult patients with posttraumatic stress disorder. *Biological Psychiatry, 62*(10), 1179–1182.

Harrington, J. M. (2001). Health effects of shiftwork and extended hours of work. *Occupational Environmental Medicine, 58*, 68–72.

Joint Mental Heath Advisory Team (J-MHAT 7). (2011). *Joint Mental Health Advisory Team 7 (J-MHAT 7) report.* Retrieved from http://www.armymedicine.army.mil/reports/mhat/mhat_vii/J_MHAT_7.pdf

Lavie, P., Hefez, A., Halperin, G., & Enoch, D. (1979). Long-term effects of traumatic war-related events on sleep. *American Journal of Psychiatry, 136*, 175–178.

Lim, J., & Dinges, D. F. (2010). A meta-analysis of the impact of short-term sleep deprivation on cognitive variables. *Psychological Bulletin, 136*(3), 375–389.

Maggio, M., Colizzi, E., Fisichella, A., Valentin, G., Ceresini, G., Dall'Aglio, E., Ruffini, L., … Ceda, G. P. (2013). Stress hormones, sleep deprivation and cognition in older adults. *Maturitas, 76*(1), 22–44.

McKenna, B. S., Dickinson, D. L., & Drummond, S. P. A. (2007). The effects of one night of sleep deprivation on known-risk and ambiguous-risk decisions. *Journal Sleep Research, 16*(3), 245–252.

Mellman, T. A., Bustamante, V., Fins, A. I., Pigeon, W. R., & Nolan, B. (2002). REM sleep and the early development of posttraumatic stress disorder. *American Journal of Psychiatry, 159*, 1696–1701.

Mellman, T. A., Nolan, B., Hebding, J., Kulick-Bell, R., & Dominguez, R. (1997). A polysomnographic comparison of veteran with combat-related PTSD, depressed men, and non-ill controls. *Sleep, 20*, 46–51.

Mental Heath Advisory Team (MHAT). (2008). *Mental Health Advisory Team (MHAT-V) report.* Retrieved from http://www.armymedicine.army.mil/reports/mhat/mhat_v/mhat-v.cfm

Mental Heath Advisory Team (MHAT). (2009). *Mental Health Advisory Team (MHAT-VI) report.* Retrieved from http://www.armymedicine.army.mil/reports/mhat/mhat_vi/mhat-vi.cfm

National Sleep Foundation. (2013). *2013 Sleep in America Poll: Exercise & sleep: Summary of findings.* Retrieved from http://sleepfoundation.org/sites/default/files/RPT336%20Summary%20of%20Findings%2002%2020%202013.pdf

Pigeon, W.R., Pinquart, M., & Conner, K. (2012). Meta-analysis of sleep disturbance and suicidal thoughts and behaviors. *Journal of Clinical Psychiatry, 73*(9), e1160–1167.

Seelig, A. D., Jacobson, I. G., Smith, B., Hooper, T. I., Boyko, E. J., Gackstetter, G. D., Gehrman, P., … Smith, T. C. (2010). Sleep patterns before, during, and after deployment to Iraq and Afghanistan. *Sleep, 33*(12), 1615–1622.

Taylor, M. K., Hilton, S. M., Campbell, J. S., Beckerley, S. E., Shobe, K. K., & Drummond, S. P. A. (2014). Prevalence and mental health correlates of sleep disruption among military members serving in a combat zone. *Military Medicine, 179*(7), 744–751.

Tworoger, S. S., Davis, S., Vitiello, M. V., Lentz, M. J., & McTiernan, A. (2005). Factors associated with objective (actigraphic) and subjective sleep quality in young adult women. *Journal of Psychosomatic Research, 59*(1), 11–19.

Van Dongen, H. P. A., Maislin, G., Mullington, J. M., & Dinges, D. (2003). The cumulative cost of additional wakefulness: Dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep, 26*(2), 117–126.

Williamson, A. M. & Feyer, A. M. (2000). Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occupational Environmental Medicine, 57*, 649–655.

Winzeler, K., Voellmin, A., Schäfer, A., Meyer, A. H., Cajochen, C., Wilhem, F. H., & Bader, K. (2014). Daily stress, presleep arousal, and sleep in healthy young women: A daily life computerized sleep diary and actigraphy study. *Sleep Medicine, 15*(3), 359–366.

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14. ABSTRACT

Sleep disruption is a growing concern among military personnel. Very little is known, however, regarding sleep characteristics of military members serving in combat environments. We sought to quantify the prevalence and cognitive correlates of sleep disruption among military personnel serving in a combat zone during Operation Enduring Freedom, utilizing a cross-sectional survey of active duty and reserve U.S. Navy personnel in the Afghanistan combat theater (N = 6,118). Survey sleep measures included total hours of sleep per day, total hours of sleep required to feel well-rested, difficulty falling asleep, and difficulty staying asleep. The survey also measured outcomes such as accidents related to the mission. Participants reported an average of 5.9 hours of sleep per night, despite requiring on average 6.8 hours to feel well-rested. Fifty-seven percent reported getting insufficient sleep, and this interacted with mission type. Sleep disruption was associated with number of deployments, as well as number of months in a combat zone. Further, those with more sleep difficulty and disruption were more likely to have caused an accident or error that affected the mission. This study documents sleep characteristics, deployment-related correlates, and potential cognitive outcomes of sleep disruption among military members in a combat zone.

15. SUBJECT TERMS

sleep, sleep disruption, mental health, military, cognition

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