



# *Prevalence and Mental Health Correlates of Sleep Disruption Among Military Members Serving in a Combat Zone*

*Marcus K. Taylor  
Susan M. Hilton  
Justin S. Campbell  
Shiloh E. Beckerley  
Katharine K. Shobe  
Sean P. A. Drummond*

*For the Behavioral Health Needs Assessment Team*



***Naval Health Research Center***

---

*Report No. 13-14*

*The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, nor the U.S. Government. Approved for public release: distribution is unlimited.*

*This research has been conducted in compliance with all applicable federal regulations governing the protection of human subjects in research.*

*Naval Health Research Center  
P.O. BOX 85122  
San Diego, California 92186-5122*

## Prevalence and Mental Health Correlates of Sleep Disruption Among Military Members Serving in a Combat Zone

Marcus K. Taylor, PhD\*†; Susan M. Hilton, MS‡; LCDR Justin S. Campbell, MSC USN§; Shiloh E. Beckerley, PhD\*; CDR Katharine K. Shobe, MSC USN||; Sean P.A. Drummond, PhD¶\*\*;  
For the Behavioral Health Needs Assessment Team

**ABSTRACT** Sleep disruption is an emergent military health issue, but remarkably little is known of its prevalence or comorbidities in the combat zone. This study was designed to quantify the prevalence and mental health correlates of sleep disruption among military personnel serving within a ground combat zone during Operation Enduring Freedom. This was a large, cross-sectional survey of active duty and reserve U.S. Navy personnel ( $N = 3,175$ ). Self-reported 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 mental health symptoms, including post-traumatic stress symptoms, anxiety, and depression. Participants reported an average of 5.9 hours of sleep per day despite requiring on average 6.8 hours to feel well rested. More than half (56%) were classified as sleep deficient, and 67% reported 6 or fewer hours of sleep per day. Adjusted for covariates, individuals endorsing sleep disruption were at substantially elevated risk of meeting criteria for post-traumatic stress disorder, generalized anxiety disorder, and major depressive disorder. This study documents the prevalence of sleep disruption in a very large and difficult-to-access sample of military members serving in a combat zone, and details robust associations with mental health.

### INTRODUCTION

Although the National Sleep Foundation recommends that adults receive 7 to 9 hours of sleep per night,<sup>1</sup> the average American reports receiving just under 7 hours.<sup>2</sup> Accumulating evidence suggests profound health consequences of chronic sleep disruption, such as neurocognitive deficits,<sup>3</sup> metabolic dysregulation,<sup>4</sup> weight gain,<sup>5</sup> obesity,<sup>6</sup> and heart disease.<sup>6</sup> With respect to behavioral health, sleep disruption is also consistently linked to psychiatric symptoms,<sup>7</sup> post-traumatic stress disorder (PTSD),<sup>8</sup> substance abuse,<sup>9</sup> and suicidal ideation.<sup>10</sup>

Military environments pose numerous threats to normal and sufficient sleep, including long or erratic work hours, noise, environmental exposure, and psychological stress.<sup>11</sup>

Accordingly, sleep disruption has emerged as a salient concern among military leadership for both service members and veterans. Available evidence suggests that sleep disruption is prevalent in these populations.<sup>12-18</sup> For instance, Neylan et al<sup>12</sup> reported that 91% of Vietnam veterans with PTSD had difficulty maintaining sleep sometimes or very frequently, compared with 63% of era veterans (veterans who served during the Vietnam era, but not in Vietnam) without PTSD, and relative to 53% in a civilian comparison group. Studies also show that clinically significant sleep disruption is common across veterans of the conflicts in Iraq and Afghanistan, irrespective of PTSD involvement.<sup>15</sup> Other work documents substantial sleep disruption in military training environments.<sup>13,14</sup> Miller and Shattuck,<sup>13</sup> for example, showed that U.S. Military Academy cadets slept less than 5 hours per night during the week and less than 7 hours on the weekend.

Despite this evolving picture of sleep disruption in some military populations, remarkably little is known about sleep in individuals deployed to a combat zone. This signifies a crucial gap in our understanding of sleep characteristics in military members across the deployment trajectory. Accordingly, a few studies of deployed military members warrant review. Peterson et al<sup>11</sup> quantified sleep characteristics of 156 Air Force personnel deployed to an undisclosed location in southwest Asia, showing a mean of 6.7 hours of self-reported total sleep time. They also found that 74% rated their sleep quality as significantly worse in the deployed environment, 40% had a sleep efficiency of less than 85%, and 42% had a sleep latency exceeding 30 minutes. In other work, Seelig et al<sup>19</sup> studied sleep patterns in a large sample of military members of all services including active, reserve,

\*Warfighter Performance Department, Naval Health Research Center, 140 Sylvester Road, San Diego, CA 92106.

†Department of Exercise and Nutritional Sciences, San Diego State University, ENS Building, Room 351, 5500 Campanile Drive, San Diego, CA 92182.

‡Behavioral Sciences and Epidemiology Department, Naval Health Research Center, 140 Sylvester Road, San Diego, CA 92106.

§Space and Naval Warfare Systems Center, Pacific, 53560 Hull Street, San Diego, CA 92152.

||Office of Naval Research, 875 N. Randolph Street, Arlington, VA 22217.

¶Veterans Affairs San Diego Healthcare System, 3350 La Jolla Village Drive, San Diego, CA 92161.

\*\*Department of Psychiatry, University of California, 9500 Gilman Drive, San Diego, CA 92093.

Approved for public release; distribution is unlimited. This research has been conducted in compliance with all applicable federal regulations governing the protection of human subjects in research.

The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, the Department of Defense, or the U.S. Government.

doi: 10.7205/MILMED-D-13-00551

and National Guard personnel. These authors found that adjusted mean sleep duration among deployed personnel was 6.5 hours. They also found that individuals in a deployed or postdeployment status reported slightly shorter mean sleep duration and greater trouble sleeping compared with a group who had not deployed. Irrespective of group inclusion, trouble sleeping was positively associated with mental health symptoms. Also, in Miller et al's<sup>16</sup> retrospective account of a small sample ( $N = 49$ ) of Army officer's combat deployment, 4 hours of sleep per night was endorsed during high operational tempo, which reportedly comprised one-half of their deployment time. Another study found that half (50.2%) of 1,249 combat soldiers and Marines deployed in Afghanistan reported sleeping less than or equal to 5 hours per night.<sup>20</sup>

The purpose of the current study was to assess subjective sleep characteristics of U.S. Navy personnel deployed to the Afghanistan ground combat theater in support of Operation Enduring Freedom (OEF). The second purpose was to examine relationships of sleep to mental health symptoms. Substantial sleep disruption was hypothesized, as well as positive associations with mental health disorders.

## METHODS

### Survey

The Behavioral Health Needs Assessment Survey (BHNAS) is a surveillance instrument designed to assess a diverse population of U.S. Navy personnel deployed to combat zones in Iraq and Afghanistan since 2006 (the current report is focused exclusively on those deployed to Afghanistan). The survey is modeled after the Army's Mental Health Advisory Team surveillance instrument<sup>21</sup> for deployed Army and Marine Corps personnel. In general, the instrument assesses a variety of content areas, including combat exposure, deployment-related stressors, mental health symptoms, morale, unit cohesion, and leadership satisfaction. Most BHNAS items pertain to the current deployment of the respondent. The instrument was reviewed by the Naval Health Research Center Institutional Review Board for the protection of human participants and was classified "exempt" based on its primary surveillance mission and absence of identifiable information.

The BHNAS is administered by small teams of military medical personnel (Mobile Care Teams) that deploy sequentially in 6-month rotations. It is typically administered in group settings at the respondents' primary deployment location. After convening for a briefing regarding the survey, participants are invited to complete the instrument, which takes 30 to 60 minutes. The survey is anonymous and participation is voluntary. Likewise, participants are informed that they can skip questions that they do not want to answer and that they have the right to cease participation at any time. Key measures comprising the present study are described in the following sections.

### Sleep Quality

Hours of sleep and sleep deficit: Participants were asked, "On average, how many hours of sleep do you get per day (during this deployment)?" with 6 response options (from "3 or fewer" to "8 or more"). Responses were then dichotomized by  $<6$  versus  $>6$  hours. Because it is recognized that amount of sleep required may vary with age, activity level, and other individual differences,<sup>22</sup> participants were also asked, "On average, how many hours of sleep do you need per day in order to feel well-rested?" From these responses, a sleep deficit measure was calculated comparing amount of sleep received and amount required to feel well-rested. Participants who reported at least 1 hour less than they require each day to feel well-rested were classified as sleep deficient.

Difficulty falling/staying asleep: Participants were asked, "In the past 2 weeks on deployment, please rate your difficulty falling asleep," and "... difficulty staying asleep" in 2 separate items. The 5 options were "none," "mild," "moderate," "severe," and "very severe." Each item was then dichotomized to distinguish participants who reported a "severe" or "very severe" response from those who did not.

### Mental Health Symptoms

Post-traumatic Stress Disorder Checklist–Civilian Version<sup>23</sup>: This standardized questionnaire is the most widely used measure of post-traumatic stress symptoms in military populations.<sup>24,25</sup> Scores range from 17 to 85. Consistent with prior research, respondents must score at least 50, and they must report moderate or higher levels of at least 1 intrusion symptom, 3 avoidance symptoms, and 2 hyperarousal symptoms to screen positive for probable PTSD, as outlined in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*.<sup>26</sup> Cronbach's  $\alpha$  reliability for this scale was 0.94 for all items, and still 0.94 with 1 sleep-related item removed.

Generalized anxiety disorder (GAD): The anxiety scale in this study was adapted from the Other Anxiety Symptoms module of the PRIME-MD Patient Health Questionnaire (PHQ),<sup>27</sup> as done by Hoge et al.<sup>25</sup> The scale consists of 7 items assessing anxiety symptoms, plus an additional item measuring the extent of functional impairment caused by any reported symptoms. The items are presented with 4 response options: 0 = "not at all," 1 = "few or several days," 2 = "more than half the days," and 3 = "nearly every day." To meet a strict definition of probable GAD, respondents must meet all 3 of the following criteria. First, they must report that they have been "feeling nervous, anxious, on edge, or worrying a lot about different things" with a frequency of at least "more than half the days" during the past 4 weeks. Second, they must report that at least 3 of 6 anxiety symptoms were present at least "more than half the days" during the past 4 weeks. Third, respondents must indicate that their symptoms made it "very difficult" or "extremely difficult" to perform their duties or get along

with other people. Cronbach's  $\alpha$  reliability for this scale was 0.87 for all items, and 0.86 with 1 sleep-related item removed.

**Major depressive disorder (MDD):** The scale used to measure depression was adapted from the PHQ depression scale (PHQ-9),<sup>27</sup> as done by Hoge et al.<sup>25</sup> It involves 9 items that are presented with 4 response options: 0 = "not at all," 1 = "few or several days," 2 = "more than half the days," and 3 = "nearly every day." One additional item assesses the degree of functional impairment caused by any reported symptoms. To meet a strict definition of probable MDD, respondents must meet all 3 of the following criteria. First, respondents must report that they were bothered by either "little interest or pleasure in doing things" or "feeling down, depressed, or hopeless" with a frequency of at least "more than half the days" during the past 4 weeks. Second, respondents must indicate that at least 5 of 9 specific depression items were present during the past 4 weeks. For all but one of these items, a symptom is counted as present if it occurred at least "more than half the days" in the past 4 weeks. Because of its greater severity, 1 of the 9 depression symptoms that assesses suicidal ideation (Thoughts that you would be better off dead or of hurting yourself in some way), is scored as present if it occurred on "few or several days" or more frequently in the past 4 weeks (i.e., any option other than "not at all"). Finally, respondents must indicate (on the functional impairment item) that their symptoms made it "very difficult" or "extremely difficult" to perform their duties or get along with other people. Cronbach's  $\alpha$  for this scale was 0.88 for all items, and 0.87 with the 1 sleep-related item removed.

### Covariates

Covariates were selected based on theorized relevance to both sleep disruption and mental health symptoms. They included sex,<sup>17,28</sup> age,<sup>22,29</sup> paygrade,<sup>30,31</sup> race,<sup>32,33</sup> marital status,<sup>34,35</sup> presence of traumatic brain injury symptoms,<sup>36,37</sup> combat exposure,<sup>25,38</sup> sleep medication use<sup>39</sup> during deployment, and psychotropic medication use<sup>40</sup> during deployment.

**Traumatic brain injury (TBI) symptoms:** Likelihood to screen positive for mild TBI was assessed as earlier done by Hoge et al.<sup>41</sup> A respondent was considered symptomatic if he or she reported any of the 3 items ("Did any event during this deployment involve...being dazed, confused, or 'seeing stars'?", "...not remembering the injury?," or "...losing consciousness from being knocked out?").

**Combat Exposure Scale:** This 29-item scale addresses aspects of combat experiences.<sup>24</sup> Items are rated on a 5-point scale with anchors "Never" to "10 or More Times." Cronbach's  $\alpha$  for this scale was 0.81.

**Sleep medications:** Participants were asked, "Have you taken any medication for a sleep problem during this deployment?" with options "No" and "Yes." Participants were also given the option to specify medication names.

**Psychotropic medications:** Use of psychotropic medication was assessed with the question, "Have you taken any

medication for a mental health or combat stress problem during this deployment?" with options "No" and "Yes." Participants were also given the option to specify the medication names.

### Analyses

Statistical analyses were performed using IBM SPSS statistical software, release 19.0.0.1 (SPSS, Chicago, Illinois). Descriptive analyses were conducted to establish participant characteristics and to quantify the prevalence of sleep disruption. Univariate logistic regression models explored the unadjusted odds of meeting criteria for PTSD, GAD, and MDD for all predictor variables and covariates. To test the hypothesized relationships of sleep disruption to mental health disorders, multivariable logistic regression models then quantified the covariate-adjusted odds of meeting criteria for PTSD, GAD, and MDD as a function of each sleep disruption index. To attenuate construct overlap when comparing sleep disruption to probable mental health disorders, a single sleep item was removed from the PTSD, anxiety, and depression scales during the hypothesis tests (logistic regression models), but the above-reported standard cut points were left intact. The sleep item was not removed from these scales when calculating overall prevalence rates of probable mental health disorders. Regression diagnostics were used to assess variance inflation factors. Statistical significance for all analyses was set at  $p < 0.05$  (2-sided).

### RESULTS

Table I provides the sociodemographic factors assessed in this study. Participants ( $N = 3,175$ ) were mostly male, white, married, and over age 30. Most were regular active duty, enlisted, had been in the combat theater at least a few months, and were on their first deployment to the OEF region. Regarding occupational mission, 15% were assigned to provincial reconstruction, 24% were command/staff, 23% were medical professionals, 14% performed detainee-guard duties, and 23% performed other occupational missions (e.g., training, construction, supply, logistics). Three percent ( $n = 79$ ) reported taking psychotropic medication during the deployment. Among participants who also specified type of psychotropic medication used ( $n = 45$ ), 80% reported antidepressants and 20% indicated antianxiety medication use. Among participants specifying use of sleep medication, the majority were over the counter. Most participants (70%) were Individual Augmentees (IAs; active or reserve Navy members assigned in a temporary status to in-theater Army or joint military commands), 20% were in either a Global Support Assignment (GSA; officers who received permanent change of station orders to move to a different location after deployment) or an Overseas Contingency Operation Support Assignment (OSA) for enlisted personnel, whereas the remaining 10% served with their

**TABLE I.** Subject Characteristics

Variable	n	%	Range	Mean	SD
Sex					
Male	2,562	82.4			
Female	546	17.6			
Age Range (Years)	3,116	98.1	19–66	34.08	8.74
18–24	488	15.7			
25–29	655	21.0			
30–39	1,088	34.9			
40+	885	28.4			
Paygrade					
Enlisted	2,134	67.5			
Officer	1,027	32.5			
E1–E3	131	4.2			
E4–E6	1,622	51.7			
E7–E9	364	11.6			
WO/O1–O3	446	14.2			
O4+	576	18.3			
Component					
Regular	2,258	71.6			
Reserve	895	28.4			
Race/Ethnicity					
White	1,992	64.8			
Black	414	13.5			
Hispanic	351	11.4			
Other	318	10.3			
Marital Status					
Married	1,916	60.8			
Unmarried	1,234	39.2			
Years in Military	3,131	98.6	0–39	11.57	7.27
0–3	439	14.0			
4–6	549	17.5			
7+	2,143	68.4			
Months in-Theater	3,175	100.0	0–21	3.82	2.00
Assignment Type					
IA	2,174	70.3			
GSA/OSA	624	20.2			
Other	293	9.5			
Sleep Meds					
Yes	431	13.7			
No	2,725	86.3			
Psychotropic Meds					
Yes	79	2.5			
No	3,074	97.5			

GSA, Global Support Assignment; IA, Individual Augmentee; OSA, Overseas Contingency Operation Support Assignment; SD, standard deviation.

home or reserve unit. Demographically, these participants are similar to a sample of Navy expeditionary sailors (IA/GSA/OSA;  $n = 463$ ) recently reported by Granado et al.<sup>42</sup> In one exception, the majority of participants in the current study were active duty, whereas most participants in the aforementioned study were reservists. Clearly, the present sample is not intended to be representative of all combat-deployed military personnel, but rather to reflect a diverse sample of U.S. Navy personnel deployed to a ground combat zone during OEF.

Participants reported an average of 5.9 hours ( $SD = 1.1$ ) of sleep per day despite requiring on average 6.8 hours ( $SD = 1.0$ ) to feel well-rested. More than half (56%) were

classified as sleep deficient, and 67% reported 6 or fewer hours of sleep per day. Participants reported mild trouble falling asleep ( $M = 2.1$  of possible 5;  $SD = 1.0$ ) and staying asleep ( $M = 2.1$  of possible 5;  $SD = 1.1$ ). Nearly 1 in 10 participants (9.2%) reported severe or very severe trouble falling asleep, whereas 10.8% reported severe or very severe trouble staying asleep. Five percent of participants met criteria for probable PTSD, 2% met criteria for probable MDD, and 2% met criteria for probable GAD.

As shown in Table II, every sleep variable and covariate (except for sex and marital status) demonstrated substantial univariate associations to probable mental health disorders. Lower age, lower paygrade, nonwhite race, higher combat exposure, presence of TBI symptoms, use of sleep medications, and use of psychotropic medications each associated with greater unadjusted odds of meeting criteria for nearly every mental health disorder.

Participants endorsing less than 6 hours of sleep per day, classified as sleep deficient, or endorsing severe or very severe trouble falling or staying asleep, demonstrated considerably higher adjusted odds of meeting criteria for probable mental health disorders (Table III). Of the sleep indices, sleep deficit was the most potent risk factor for probable PTSD (odds ratio [OR] = 10.7; 95% confidence interval [CI], 4.3–26.8), GAD (OR = 9.1; 95% CI, 2.8–29.9), and MDD (OR = 7.5; 95% CI, 2.3–25.0).

## DISCUSSION

This is, to our knowledge, the largest study of sleep characteristics in military personnel deployed to a ground combat zone. Two-thirds of respondents reported obtaining an average of less than 6 hours of sleep per day, which is consistent with chronic insufficient sleep. This is supported by the finding that these same respondents reported needing nearly 7 hours per day to feel well-rested. Estimated prevalence rates for PTSD, MDD, and GAD were 5%, 2%, and 2%, respectively. Adjusted for covariates, sleep disruption was a robust and sizeable risk factor for probable mental health disorders, with adjusted odds ratios ranging from 5.2 to 10.7.

Participants in this study endorsed on average less than 6 hours of sleep per day. This is nearly 1 hour less than was reported in a recent study of deployed military members of all services<sup>19</sup> as well as a study of Air Force personnel deployed to an undisclosed location in southwest Asia in support of OEF.<sup>11</sup> These differences may be explained by the fact that, unlike those 2 earlier studies, the entire sample in the current study was definitively assigned to a combat zone in Afghanistan. This likely yielded higher operational tempo, greater security concerns, more hazardous environmental exposures, exaggerated daily operational stressors,<sup>43</sup> and/or greater psychological stress. This sample did not appear to be as sleep deprived, however, as previously studied U.S. Military Academy cadets<sup>13,16</sup> or a cohort of soldiers and Marines deployed within the Afghanistan combat theater.<sup>20</sup> It is known, though, that actual sleep

TABLE II. Univariate Logistic Regression Results for Positive Mental Health Screening

Variable	n	GAD		MDD		PTSD	
		OR	95% CI	OR	95% CI	OR	95% CI
Sex							
Male	2,562	1.00		1.00		1.00	
Female	546	0.98	0.48–2.03	0.96	0.45–2.07	0.86	0.50–1.48
Age Range (Years)							
18–24	488	5.58 <sup>b</sup>	2.02–15.45	17.89 <sup>a</sup>	4.15–77.12	3.60 <sup>a</sup>	1.77–7.30
25–29	655	2.73	0.93–8.02	6.85 <sup>c</sup>	1.49–31.35	3.37 <sup>a</sup>	1.71–6.66
30–39	1,088	3.46 <sup>c</sup>	1.30–9.22	7.01 <sup>b</sup>	1.61–30.41	2.63 <sup>b</sup>	1.37–5.07
40+	885	1.00		1.00		1.00	
Paygrade							
E1-E3	131	6.86 <sup>b</sup>	1.91–24.68	7.58 <sup>b</sup>	1.79–32.13	4.65 <sup>b</sup>	1.81–11.95
E4-E6	1,622	3.25 <sup>c</sup>	1.15–9.16	4.09 <sup>c</sup>	1.25–13.37	2.93 <sup>b</sup>	1.45–5.89
E7-E9	364	0.39	0.04–3.54	1.05	0.17–6.35	0.88	0.29–2.64
WO/O1-O3	446	1.62	0.43–6.07	2.17	0.51–9.11	1.15	0.44–3.01
O4+	576	1.00		1.00		1.00	
Race/Ethnicity							
White	1,992	1.00		1.00		1.00	
Black	414	1.33	0.61–2.94	2.15 <sup>c</sup>	1.05–4.40	2.14 <sup>b</sup>	1.28–3.56
Hispanic	351	2.19 <sup>c</sup>	1.08–4.43	1.60	0.69–3.73	1.70	0.94–3.06
Other	318	0.43	0.10–1.80	0.50	0.12–2.11	1.24	0.62–2.46
Marital Status							
Married	1,916	1.00		1.00		1.00	
Unmarried	1,234	0.55	0.30–1.02	1.07	0.60–1.90	0.91	0.61–1.37
Combat Exposure Score							
29 (None)	649	1.00		1.00		1.00	
30–33	833	1.41	0.47–4.22	1.04	0.36–3.01	2.68	0.98–7.31
34–40	769	1.87	0.65–5.41	1.41	0.51–3.91	3.44 <sup>c</sup>	1.28–9.21
41+	681	4.50 <sup>b</sup>	1.70–11.91	3.24 <sup>c</sup>	1.29–8.13	9.77 <sup>a</sup>	3.86–24.69
TBI Symptoms							
Yes	91	6.36 <sup>a</sup>	2.91–13.90	8.14 <sup>a</sup>	3.83–17.30	5.97 <sup>a</sup>	3.26–10.96
No	3,081	1.00		1.00		1.00	
Sleep Meds							
Yes	431	2.25 <sup>c</sup>	1.22–4.18	3.57 <sup>a</sup>	1.96–6.51	2.58 <sup>a</sup>	1.66–4.02
No	2,725	1.00		1.00		1.00	
Psychotropic Meds							
Yes	79	3.23 <sup>c</sup>	1.14–9.16	2.60	0.79–8.54	4.59 <sup>a</sup>	2.29–9.20
No	3,074	1.00		1.00		1.00	
Hours of Sleep							
≤6	2,136	8.45 <sup>a</sup>	2.63–27.13	11.92 <sup>b</sup>	2.89–49.14	12.84 <sup>a</sup>	4.71–34.98
>6	1,039	1.00		1.00		1.00	
Sleep Deficit							
Yes	1,791	13.49 <sup>a</sup>	4.20–43.32	12.41 <sup>a</sup>	3.85–39.94	11.39 <sup>a</sup>	5.27–24.59
No	1,384	1.00		1.00		1.00	
Difficulty Falling							
Yes	292	10.78 <sup>a</sup>	6.23–18.64	11.64 <sup>a</sup>	6.59–20.57	10.18 <sup>a</sup>	6.79–15.27
No	2,883	1.00		1.00		1.00	
Difficulty Staying							
Yes	342	9.63 <sup>a</sup>	5.57–16.63	10.47 <sup>a</sup>	5.93–18.48	9.81 <sup>a</sup>	6.57–14.65
No	2,833	1.00		1.00		1.00	

CI, confidence interval; GAD, generalized anxiety disorder; MDD, major depressive disorder; OR, odds ratio; PTSD, posttraumatic stress disorder; TBI = traumatic brain injury. <sup>a</sup> $p < 0.001$ . <sup>b</sup> $p < 0.01$ . <sup>c</sup> $p < 0.05$ .

need varies by numerous individual factors including age and activity level.<sup>22</sup> With this in mind, this study quantified sleep deficit (reported sleep required minus sleep received), showing that participants reported receiving, on average, approximately 1 hour less sleep per night than required to feel well-rested. It may be useful for future studies of self-reported sleep patterns in service members to

calculate sleep deficit scores to facilitate comparisons across demographically dissimilar samples.

Estimated prevalence rates for probable PTSD, MDD, and GAD in this sample were 5%, 2%, and 2%, respectively. There is a dearth of data on mental health status of military members while serving in a combat zone. In one important and highly publicized exception, the Army's

**TABLE III.** Multivariate Logistic Regression Results for Positive Mental Health Screening Related to 6 or Fewer Hours of Sleep

Variable	n	GAD			MDD			PTSD		
		OR	95% CI	R <sup>2</sup> Δ	OR	95% CI	R <sup>2</sup> Δ	OR	95% CI	R <sup>2</sup> Δ
Hours of Sleep										
≤6	1,816	5.21 <sup>b</sup>	1.58–17.13	2.9%	6.23 <sup>c</sup>	1.47–26.44	2.8%	10.23 <sup>a</sup>	3.19–32.74	4.7%
>6	911	1.00			1.00			1.00		
Sleep Deficit										
Yes	1,527	9.12 <sup>a</sup>	2.78–29.95	5.9%	7.51 <sup>b</sup>	2.25–25.03	4.7%	10.69 <sup>a</sup>	4.27–26.79	7.2%
No	1,200	1.00			1.00			1.00		
Difficulty Falling										
Yes	240	8.33 <sup>a</sup>	4.20–16.52	8.2%	6.71 <sup>a</sup>	3.21–14.02	6.3%	7.57 <sup>a</sup>	4.57–12.52	8.4%
No	2,487	1.00			1.00			1.00		
Difficulty Staying										
Yes	272	6.27 <sup>a</sup>	3.20–12.27	6.4%	5.43 <sup>a</sup>	2.63–11.21	5.1%	6.94 <sup>a</sup>	4.25–11.35	8.1%
No	2,455	1.00			1.00			1.00		

CI, confidence interval; GAD, generalized anxiety disorder; MDD, major depressive disorder; OR, odds ratio; PTSD, post-traumatic stress disorder. R<sup>2</sup> Δ reflects unique variance explained beyond covariates. Nagelkerke method is reported. <sup>a</sup>p < 0.001. <sup>b</sup>p < 0.01. <sup>c</sup>p < 0.05.

Mental Health Advisory Team<sup>21</sup> reported an average in-theater PTSD prevalence of 10.8% among Army personnel serving in Iraq and Afghanistan. Granado et al.<sup>42</sup> prospectively studied a sample of Navy personnel (demographically similar to the participants in the current study) who had served in Iraq and/or Afghanistan and found that 5.4% of the sample reported new-onset PTSD symptoms within 3 years after deployment. The majority of related literature focuses on postdeployment prevalence estimates of individuals who have served in Iraq and Afghanistan.<sup>25,44</sup> Hoge et al.,<sup>25</sup> for example, assessed mental health disorders in combat infantry units, and reported prevalence of respondents meeting criteria for major depression, generalized anxiety, or PTSD of 15.6% to 17.1% after duty in Iraq, 11.2% after duty in Afghanistan, compared with 9.3% before deployment to Iraq. A subsequent meta-analysis of 28 studies<sup>45</sup> estimated the postdeployment PTSD prevalence at 5.5% in population samples (which included a high proportion of personnel from support units and various services branches at much lower risk of engaging in direct combat operations) and 13.2% in operational infantry units (which are at much higher risk of direct combat exposure). Taken together, the estimates derived in the current study are consistent with demographically similar samples that are studied within similar military contexts (i.e., those with less direct combat exposure).<sup>42,45</sup>

As hypothesized, sleep disruption corresponded substantively with probable mental health disorders. In particular, all measures of self-reported sleep disruption conferred greater risk for GAD, MDD, and PTSD. This coincides with other research demonstrating similar associations in diverse military samples.<sup>19,46–48</sup> Interestingly, sleep deficit appears to confer the greatest risk of self-reported mental health symptoms. This suggests individual differences associated with sleep need may influence the role of sleep impairments in mental health. An obvious question emerges, however, regarding the cross-sectional nature of the present study and likely reciprocating relationships between sleep disruption

and mental health.<sup>46</sup> Recent literature does suggest that sleep disruption is a unique prospective risk factor for subsequent development of PTSD and other mental health symptoms.<sup>47,48</sup> One informative study<sup>48</sup> evaluated insomnia (conceptually related to trouble falling and staying asleep) as a predictor versus outcome of PTSD and depression among Iraq combat veterans. These scientists used 2 post-deployment time points with structural equation modeling to test 2 possible directions of association. Although insomnia and mental health symptoms were associated at and across both periods, insomnia at 4 months postdeployment predicted change in PTSD and depressive symptoms at 12 months postdeployment, whereas PTSD and depressive symptoms at 4 months postdeployment were not significant predictors of change in insomnia at 12 months postdeployment. Thus, it was concluded that insomnia plays a prospective role in the development of additional psychological symptoms in combat veterans. In other work,<sup>46</sup> predeployment sleep disruption because of nightmares prospectively predicted PTSD symptoms at 6 months postdeployment, though insomnia symptoms did not. In sum, although the present study supports substantial associations between sleep disruption and mental health symptoms among military members serving in a combat zone, it is recognized that sleep disruption and mental health symptoms are most likely entangled in a perpetual cycle.<sup>46</sup>

There are some limitations of this study. First, we relied solely on self-report and it is known that the link between self-reported sleep and objectively derived measures (e.g., wrist-worn actigraphy) is tenuous.<sup>49</sup> Also, naps were not accounted for in this study. It is also possible that “need for sleep” may have been under-reported by some respondents because of pride or stigma in light of military cultural norms, which could undermine estimates of sleep deficit (though in that context, it is even more remarkable that sleep deficit was such a strong predictor of mental health symptoms). Moreover, even though steps were

taken to attenuate construct overlap between sleep disruption and mental health disorders, the observed associations in this study could still be exaggerated because of common method variance.<sup>50,51</sup>

Despite these limitations, this study signifies a distinct advancement in that it reports data from a very large and difficult-to-access sample, highlights the prevalence of sleep disruption among military members serving in a combat zone, and details robust associations with mental health. More prospective research is needed to refine our understanding of the temporality and causality of these relationships. There is also a clear need to validate interventions that improve or protect sleep quality in this potentially vulnerable population.

### ACKNOWLEDGMENTS

We appreciate CAPT Barry Adams, Dr. Jerry Larson, Dr. Stephanie Kewley, and Dr. Heidi Kraft for their dedicated scientific and subject matter expertise. We also thank Ms. Michelle LeWark for her editorial expertise.

This study was supported by a grant from the U.S. Navy Bureau of Medicine and Surgery, Wounded, Ill and Injured Program under work unit number 60813.

### REFERENCES

1. National Sleep Foundation. How much sleep do we really need? Available at <http://www.sleepfoundation.org/article/how-sleep-works/how-much-sleep-do-we-really-need>; accessed November 15, 2012.
2. National Sleep Foundation. Sleep in America Poll. Available at <http://sleepfoundation.org/sleep-polls-data/sleep-in-america-poll/2008-sleep-performance-and-the-workplace>; accessed April 05, 2014.
3. Drummond SP, Paulus MP, Tapert SF: Effects of two nights sleep deprivation and two nights recovery sleep on response inhibition. *J Sleep Res* 2006; 15(3): 261–5.
4. Buxton OW, Cain SW, O'Connor SP, et al: Adverse metabolic consequences in humans of prolonged sleep restriction combined with circadian disruption. *Sci Transl Med* 2012; 4: 129ra43.
5. Chaput J, Depres J, Bouchard C, Tremblay A: The association between sleep duration and weight gain in adults: a 6-year prospective study from the Quebec Family Study. *Sleep* 2008; 31(4): 517–23.
6. Grandner MA, Jackson NJ, Pak VM, Gehrman PR: Sleep disturbance is associated with cardiovascular and metabolic disorders. *J Sleep Res* 2012; 21(4): 427–33.
7. 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.
8. McLay RN, Klam WP, Volkert SL: Insomnia is the most commonly reported symptom and predicts other symptoms of posttraumatic stress disorder in U.S. service members returning from military deployments. *Mil Med* 2010; 175(10): 759–62.
9. Brower KJ, Wojnar M, Sliwerska E, Armitage R, Burmeister M: PER3 polymorphism and insomnia severity in alcohol dependence. *Sleep* 2012; 35(4): 571–7.
10. Pigeon WR, Pinquart M, Conner K: Meta-analysis of sleep disturbance and suicidal thoughts and behaviors. *J Clin Psychiatry* 2012; 73(9): e1160–7.
11. Peterson AL, Goodie JL, Satterfield WA, Brim WL: Sleep disturbance during military deployment. *Mil Med* 2008; 173(3): 230–5.
12. Neylan TC, Marmar CR, Metzler TJ, et al: Sleep disturbances in the Vietnam generation: findings from a nationally representative sample of male Vietnam veterans. *Am J Psychiatry* 1998; 155(7): 929–33.
13. Miller NL, Shattuck LG: Sleep patterns of young men and women enrolled at the United States Military Academy: results from year 1 of a 4-year longitudinal study. *Sleep* 2005; 28(7): 837–41.
14. Crowley SK, Wilkinson LL, Burroughs EL, et al: Sleep during basic combat training: a qualitative study. *Mil Med* 2012; 177(7): 823–8.
15. Capaldi VF, Guerrero ML, Killgore WD: Sleep disruptions among returning combat veterans from Iraq and Afghanistan. *Mil Med* 2011; 176(8): 879–88.
16. Miller NL, Shattuck LG, Matsangas P: Sleep and fatigue issues in continuous operations: a survey of U.S. Army officers. *Behav Sleep Med* 2011; 9(1): 53–65.
17. Miller NL, Shattuck LG, Matsangas P: Longitudinal study of sleep patterns of United States Military Academy cadets. *Sleep* 2010; 33(12): 1623–31.
18. Mysliwiec V, McGraw L, Pierce R, Smith P, Trapp B, Roth BJ: Sleep disorders and associated medical comorbidities in active duty military personnel. *Sleep* 2013; 36(2): 167–74.
19. Seelig AD, Jacobson IG, Smith B, et al: Sleep patterns before, during, and after deployment to Iraq and Afghanistan. *Sleep* 2010; 33(12): 1615–22.
20. Centers for Disease Control and Prevention. Energy drink consumption and its association with sleep problems among U.S. Service members on a combat deployment—Afghanistan 2010. *Morbidity and Mortality Weekly Report* 2012; 61(44): 895–8.
21. US Department of the Army, Mental Health Advisory Team (MHAT) VI: Operation Iraqi Freedom (OIF 07-09) and Operation Enduring Freedom (OEF 09) MHAT VI Report. Office of the Surgeon Multi-National Corps-Iraq, and Office of US Army Surgeon General; 2009. Available at <http://armymedicine.mil/Documents/MHAT-VI-OEF-Redacted.pdf>; accessed April 05, 2014.
22. Dijk DJ, Groeger JA, Stanley N, Deacon S: Age-related reduction in daytime sleep propensity and nocturnal slow wave sleep. *Sleep* 2010; 33(2): 211–23.
23. Weathers FW, Litz BT, Herman DS, Huska JA, Keane TM: The PTSD Checklist (PCL): reliability, validity, and diagnostic utility. In: *Proceedings of the Annual Conference of the International Society for Traumatic Stress Studies*. 1993 Oct 25, San Antonio, Texas.
24. Cabrera OA, Hoge CW, Bliese PD, Castro CA, Messer SC: Childhood adversity and combat as predictors of depression and posttraumatic stress in deployed troops. *Am J Prev Med* 2007; 33(2): 77–82.
25. Hoge CW, Castro CA, Messer SC, McGurk DM, Cotting DI, Koffman RL: Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N Engl J Med* 2004; 351: 13–22.
26. American Psychiatric Association: *Diagnostic and Statistical Manual of Mental Disorders*, Ed 4. Washington, DC, APA, 2000.
27. Spitzer RL, Kroenke K, Williams JB: Validation and utility of a self-report version of PRIME-MD: The PHQ Primary Care Study. *JAMA* 1999; 282: 1737–44.
28. Inslicht SS, Metzler TJ, Garcia NM, et al: Sex differences in fear conditioning in posttraumatic stress disorder. *J Psychiatr Res* 2013; 47: 64–71.
29. Mulligan K, Jones N, Woodhead C, Davies M, Wessely S, Greenberg N: Mental health of U.K. military personnel while on deployment in Iraq. *Br J Psychiatry* 2010; 197(5): 405–10.
30. Charles LE, Slaven JE, Mnatsakanova A, et al: Association of perceived stress with sleep disruption and sleep quality in police officers. *Int J Emerg Ment Health* 2011; 13(4): 229–41.
31. Larson GE, Booth-Kewley S, Highfill-McRoy RM, Young SY: Prospective analysis of psychiatric risk factors in Marines sent to war. *Mil Med* 2009; 174(7): 737–44.
32. Tomfohr L, Pung MA, Edwards KM, Dimsdale JE: Racial differences in sleep architecture: the role of ethnic discrimination. *Biol Psychol* 2012; 89(1): 34–8.
33. Williams DR, Gonzalez HM, Neighbors H, et al: Prevalence and distribution of major depressive disorder in African Americans, Caribbean blacks, and non-Hispanic whites: results from the National Survey of American Life. *Arch Gen Psychiatry* 2007; 64(3): 305–15.

34. Hartz A, Ross JJ, Noyes R, Williams P: Somatic symptoms and psychological characteristics associated with insomnia in postmenopausal women. *Sleep Med* 2013; 14(1): 71–8.
35. Sanyal C, Asbridge M, Kisely S, Sketris I, Andreaou P: Prevalence and determinants of antidepressant use among Canadian Forces members experiencing major depressive episodes. *J Popul Ther Clin Pharmacol* 2011; 18(1): e54–64.
36. Eitenhofer ML, Melrose RJ, Delawalla Z, Castellon SA, Okonek A: Correlates of functional status among OEF/OIF veterans with a history of traumatic brain injury. *Mil Med* 2012; 177(11): 1272–8.
37. Carlson KF, Nelson D, Orazem RJ, Nugent S, Cifu DX, Sayer NA: Psychiatric diagnoses among Iraq and Afghanistan war veterans screened for deployment-related traumatic brain injury. *J Trauma Stress* 2010; 23(1): 17–24.
38. Luxton DD, Greenburg D, Ryan J, Niven A, Wheeler G, Mysliwiec V: Prevalence and impact of short sleep duration in redeployed OIC soldiers. *Sleep* 2011; 34(9): 1189–95.
39. Richey SM, Krystal AD: Pharmacological advances in the treatment of insomnia. *Curr Pharm Des* 2011; 17(15): 1471–5.
40. Riemann D, Berger M, Voderholzer U: Sleep and depression—results from psychobiological studies: an overview. *Biol Psychol* 2001; 57(1–3): 67–103.
41. Hoge CW, McGurk D, Thomas JL, Cox AL, Engel CC, Castro CA: Mild traumatic brain injury in U.S. soldiers returning from Iraq. *N Engl J Med* 2008; 385: 453–63.
42. Granado NS, Zimmermann L, Smith B, et al: Individual Augmentee deployment and newly reported mental health morbidity. *J Occup Environ Med* 2012; 54(5): 615–20.
43. Booth-Kewley S, Larson GE, Highfill-McRoy RM, Garland CF, Gaskin TA: Correlates of posttraumatic stress disorder symptoms in Marines back from war. *J Trauma Stress* 2010; 23(1): 69–77.
44. Thomas JL, Wilk JE, Riviere LA, McGurk D, Castro CA, Hoge CW: Prevalence of mental health problems and functional impairment among active component and National Guard soldiers 3 and 12 months following combat in Iraq. *Arch Gen Psychiatry* 2010; 67(6): 614–23.
45. Kok BC, Herrell RK, Thomas JL, Hoge CW: Posttraumatic stress disorder associated with combat service in Iraq or Afghanistan: reconciling prevalence differences between studies. *J Nerv Ment Dis.* 2012; 200(5): 444–50.
46. van Liempt S: Sleep disturbances and PTSD: a perpetual circle? *Euro J Psychotraumatol* 2012. Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3464455/>; accessed December 9, 2013.
47. Spoomaker VI, Montgomery P: Disturbed sleep in posttraumatic stress disorder: secondary symptom or core feature? *Sleep Med Rev* 2008; 12(3): 169–84.
48. Wright KM, Britt TW, Bliese PD, Adler AB, Picchoni D, Moore D: Insomnia as predictor versus outcome of PTSD and depression among Iraq combat veterans. *J Clin Psychol* 2011; 67(12): 1240–58.
49. Harvey AG, Tang N: (Mis)Perception of sleep in insomnia: a puzzle and a resolution. *Psychol Bull* 2012; 138(1): 77–101.
50. Conway JM: Method variance and method bias in industrial and organizational psychology. In: *Handbook of Research Methods in Organizational and Industrial Psychology*, pp 344–56. Edited by Rogelberg SG. Malden, NJ, Blackwell Publishers, 2002.
51. Spector PE: Method variance in organizational research: truth or urban legend? *Organ Res Methods* 2006; 9(2): 221–3.

Copyright of Military Medicine is the property of AMSUS and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.

# REPORT DOCUMENTATION PAGE

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB Control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

<b>1. REPORT DATE (DD MM YY)</b> 08 02 13	<b>2. REPORT TYPE</b> Journal	<b>3. DATES COVERED (from – to)</b> 01 01 09–01 01 13
--	----------------------------------	--

<b>4. TITLE</b> Prevalence and Mental Health Correlates of Sleep Disruption Among Military Members Serving in a Combat Zone	<b>5a. Contract Number:</b> <b>5b. Grant Number:</b> <b>5c. Program Element Number:</b> <b>5d. Project Number:</b> <b>5e. Task Number:</b> <b>5f. Work Unit Number: 60813</b>
--	--

<b>6. AUTHORS</b> Taylor, Marcus K., Susan Hilton, Justin S. Campbell, Shiloh E. Beckerley, Katharine K. Shobe, Sean P. A. Drummond, for the Behavioral Health Needs Assessment Team	
---	--

<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b> Commanding Officer Naval Health Research Center 140 Sylvester Rd San Diego, CA 92106-3521	
---	--

	<b>8. PERFORMING ORGANIZATION REPORT NUMBER</b>  13-14
--	--

<b>8. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)</b> Commanding Officer Naval Medical Research Center 503 Robert Grant Ave Silver Spring, MD 20910-7500	Chief, Bureau of Medicine and Surgery 7700 Arlington Blvd Falls Church, VA 22042
--	--

	<b>10. SPONSOR/MONITOR'S ACRONYM(S)</b> NMRC/BUMED
--	---

	<b>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</b>
--	---

<b>12. DISTRIBUTION/AVAILABILITY STATEMENT</b> Approved for public release; distribution is unlimited.
---

<b>13. SUPPLEMENTARY NOTES</b> <u>Military Medicine</u> , 2014, 179(7), 744-751
--

<b>14. ABSTRACT</b>
<p><b>Context:</b> Sleep disruption is a growing concern among military personnel. However, very little is known regarding sleep characteristics of military members serving in combat environments.</p> <p><b>Objective:</b> To quantify the prevalence and mental health correlates of sleep disruption among military personnel serving in a combat zone during Operation Enduring Freedom.</p> <p><b>Design:</b> Cross-sectional survey of expeditionary sailors.</p> <p><b>Setting:</b> U.S. military personnel in Afghanistan combat theater.</p> <p><b>Participants:</b> Active duty and reserve U.S. Navy personnel (N = 3175).</p> <p><b>Main Outcome Measures:</b> 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 mental health symptoms including posttraumatic stress symptoms, anxiety, and depression.</p> <p><b>Results:</b> Participants reported an average of 5.9 hours of sleep per night, despite requiring on average 6.8 hours to feel well-rested. More than half (56%) were classified as sleep deficient, and 67% endorsed 6 or fewer hours of sleep per night. Participants reported mild trouble falling and staying asleep. Adjusted for covariates, individuals endorsing sleep disruption were at substantially elevated risk of meeting criteria for posttraumatic stress disorder, generalized anxiety disorder, and major depressive disorder.</p> <p><b>Conclusions:</b> This study documents sleep characteristics as well as odds of meeting criteria for probable mental health disorders as a function of sleep disruption among military members in a combat zone. Despite its unique strengths, key limitations involve its cross-sectional nature and plausible reciprocal relationships of sleep disruption and mental health.</p>

<b>15. SUBJECT TERMS</b> sleep, mental health, military, PTSD, anxiety, depression
---

<b>16. SECURITY CLASSIFICATION OF:</b>			<b>17. LIMITATION OF ABSTRACT</b> UNCL	<b>18. NUMBER OF PAGES</b> 10	<b>18a. NAME OF RESPONSIBLE PERSON</b> Commanding Officer
<b>a. REPORT</b> UNCL	<b>b. ABSTRACT</b> UNCL	<b>c. THIS PAGE</b> UNCL			<b>18b. TELEPHONE NUMBER (INCLUDING AREA CODE)</b> COMM/DSN: (619) 553-8429