

Problems With Sleep Are Common and Predict Increased Risk for Alcohol and Drug Use Among Reserve and National Guard Soldiers

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ABSTRACT. Objective: Sleep problems are common among military members and may increase substance use risk. This study examines longitudinal associations between sleep problems and substance use among U.S. Army Reserve and National Guard (USAR/NG) soldiers as well as differences between current and former soldiers. **Method:** Data are drawn from Operation: SAFETY (Soldiers and Families Excelling Through the Years), an ongoing prospective study of the health and well-being of USAR/NG soldiers and their spouses. We used generalized estimating equation models ($N = 485$ soldiers; 79.8% male) to examine residual change in substance use (alcohol problems, heavy drinking, current use of any drug, nonmedical use of prescription drugs [NMUPD], and illicit drugs) associated with sleep problems (globally and particular dimensions) over 3 years, controlling for probable post-traumatic stress disorder, age, sex, and substance use at the prior time

point. Interaction models examined differences by military status (current vs. former soldier). **Results:** Sleep problems were associated with increased risk of heavy drinking ($p < .05$), any current drug use ($p < .05$), current NMUPD ($p < .01$), and current illicit use ($p < .05$). There were significant interactions between sleep quality and military status on any current drug use ($p < .01$) and current illicit use ($p < .05$) and between sleep duration and military status on current NMUPD ($p < .05$), such that the risk of substance use was greater for former compared with current soldiers. **Conclusions:** Sleep problems are prevalent among USAR/NG soldiers and are longitudinally associated with alcohol and drug use. This risk may increase for soldiers who have separated from the military. These findings support routine screening for sleep problems among soldiers and predischARGE education around substance use risks related to unaddressed sleep problems. (*J. Stud. Alcohol Drugs*, 83, 537–545, 2022)

MILITARY SERVICE, and especially deployment, has been associated with sleep problems among current and former military service members (Hunt et al., 2016; Plumb et al., 2014; Seelig et al., 2010; Troxel et al., 2015). Data from the Millennium Cohort study indicate that 23% of service members experience symptoms of insomnia, and nearly 50% report sleeping 6 hours or less per night (Seelig et al., 2016). Further, compared with soldiers who had not deployed, those who deployed to Iraq or Afghanistan were more likely to have shorter sleep and trouble sleeping (Seelig et al., 2010). Another study found that as many as 72% of soldiers in a deployed combat team reported short sleep duration (Luxton et al., 2011), and overall sleep problems among current service members and veterans are worse than for the general U.S. population (Plumb et al., 2014).

Literature suggests that sleep problems may be a risk factor for substance use problems (Taylor et al., 2003). Both insomnia and hypersomnia have been associated with

increased odds of substance use disorders among young adult civilians (Breslau et al., 1996). A longitudinal study of adolescents found that sleep problems predicted substance use over 1 year, including use of alcohol, cigarettes, and marijuana, but that the reverse was not true, indicating that sleep problems may be a contributing factor to the development of substance use problems (Pieters et al., 2015).

Sleep problems among military service members are often comorbid with mental health problems (Hunt et al., 2016; Troxel et al., 2015). Sleep problems are a symptom of posttraumatic stress disorder (PTSD), and sleep problems, PTSD, and substance use are interwoven in complicated ways, which makes determining causal pathways difficult (Vandrey et al., 2014). However, disordered sleep in and of itself is related to coping-oriented use of substances to address sleep problems, regardless of the presence of PTSD (Vandrey et al., 2014), and it is likewise possible that impairment caused by sleep problems may be present among

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individuals who do not meet diagnostic criteria for PTSD (Luxton et al., 2011).

Several studies have demonstrated a relationship between sleep problems and substance use among military populations. Specifically, cross-sectional data from soldiers deployed to Iraq demonstrated that very short sleep duration (<6 hours per night) was associated with a higher risk of alcohol abuse and tobacco use (Luxton et al., 2011). Similarly, cross-sectional data from a Veterans Affairs sample of veterans indicated that those with shorter sleep duration were more likely to misuse drugs and alcohol (Swinkels et al., 2013). UK Armed Forces personnel with new onset or persistent sleep problems were more likely to report alcohol use disorder 4–6 months postdeployment, although this effect was no longer significant after accounting for mental health problems (Hunt et al., 2016). A small longitudinal study ($N = 172$) of National Guard soldiers found that predeployment sleep difficulties predicted alcohol use disorder diagnosis 2–3 months postdeployment, especially among those who drank in higher quantities before deployment, but this did not persist over time (i.e., 1–2 years postdeployment; Koffel et al., 2013).

There are several gaps in our knowledge regarding sleep and substance use among military service members. First, most existing studies note a lack of prospective, longitudinal research on the connections between sleep and substance use; the majority of studies conducted among military service members are cross-sectional or assess a limited period specifically around the time of a deployment (e.g., Luxton et al., 2011; Plumb et al., 2014; Swinkels et al., 2013; Wright et al., 2012). As scholars have noted, “while the supposition that disturbed sleep motivates substance use, which can then precipitate substance dependence, makes intuitive sense, prospective validation via empirical data is lacking” (Vandrey et al., 2014, pg. 243). Second, many studies in the military have used limited assessment of sleep, relying on single or limited items (e.g., Hunt et al., 2016, Luxton et al., 2011; Koffel et al., 2013; Seelig et al., 2010); therefore, it is unknown if there are specific aspects of sleep problems that may be particularly important to consider in the relationship to substance use among military service members. Further, many of these studies have focused on alcohol or general substance use and have not examined more nuanced outcomes, such as illicit drug use or nonmedical use of prescription drugs (NMUPD). Last, it is unclear what impact leaving the military may have on these relationships. There is some evidence to suggest that substance use risk increases on leaving the military (Hoopsick et al., 2017; Vest et al., 2018), but it is unclear how sleep patterns might change, or what role sleep might play in substance use for individuals after they leave military service.

Given these gaps, this study examined three research questions using longitudinal data collected annually over 4 years from current and former U.S. Army Reserve and National Guard (USAR/NG) soldiers: (a) Are problems

with sleep associated with substance use, including alcohol use, current use of any drugs, nonmedical use of prescription drugs, and illicit drugs? (b) Are particular aspects of sleep problems associated with greater risk? (c) Does this relationship change based on military status (current soldier vs. separated from the military)?

Method

Participants and procedure

Data were drawn from Operation: SAFETY (Soldiers and Families Excelling Through the Years), an ongoing longitudinal study of USAR/NG soldiers and their spouses. Participants were recruited from units across New York State between summer 2014 and fall 2015, and eligible couples completed annual electronic surveys. Participants each received a \$60 check for participation at baseline and \$70 for each follow-up. The study protocol was approved by the institutional review board at the University at Buffalo, the Army Human Research Protections Office, Office of the Chief, Army Reserve, and the Adjutant General of the National Guard. Retention across the four time points has been excellent, with only six couples (1.5%) lost to follow-up (neither partner remained in the study). More detailed recruitment, eligibility, and procedural information has been published previously (e.g., Devonish et al., 2017; Fillo et al., 2018; Heavey et al., 2017).

The analytic sample for this study consisted of the first four assessments for the 485 participants who indicated current or previous military service at baseline. Demographic characteristics are presented in Table 1. Soldiers were primarily male (79.8%), with a mean age of 31.5 years ($SD = 6.5$). Most participants were non-Hispanic White (80.0%); 5.2% were non-Hispanic Black, and 8.7% were Hispanic. Soldiers served on average 9.2 years ($SD = 6.0$) in the military; 92.4% were currently serving at baseline and 7.6% had separated from the military before baseline. Participants who separated from the military before baseline were partnered with a current USAR/NG soldier at enrollment.

Measures

Sleep problems. The primary predictor, sleep problems, was assessed using the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). The PSQI consists of 19 items that assess sleep across seven components: duration of sleep, overall sleep quality, sleep latency, efficiency of sleep, sleep disturbances, use of sleeping medication, and daytime dysfunction due to sleepiness. Components can be scored individually (range: 0–3 for each component), or all items can be summed to create a global sleep score (range: 0–21; $\alpha = .70$ men, $.72$ women), where higher scores are indicative of greater problems with sleep. Global scores greater than 5 are

TABLE 1. Baseline characteristics of sample and descriptive statistics of time-variant variables

Variable	Baseline, (N = 485) M (SD) or % (n)	Follow-up 1, (n = 453) M (SD) or % (n)	Follow-up 2, (n = 433) M (SD) or % (n)	Follow-up 3, (n = 408) M (SD) or % (n)
Sex				
Male	79.8% (387)			
Female	20.2% (98)			
Age, in years	31.5 (6.5)			
Race/ethnicity				
Non-Hispanic White	80.0% (388)			
Non-Hispanic Black	5.2% (25)			
Hispanic	8.7% (42)			
Other	4.5% (22)			
Education				
High school	13.0% (63)			
Some college	56.3% (273)			
College degree	30.7% (149)			
Median family income	\$40,000–\$59,999			
Military service, years	9.2 (6.0)			
Military status				
Current military service member	92.4% (448)	91.6% (415)	83.1% (360)	70.1% (286)
Former military service member	7.6% (37)	8.2% (37)	16.4% (71)	29.9% (122)
Probable PTSD diagnosis	7.0% (34)	8.0% (36)	8.6% (37)	8.0% (32)
Global PSQI score	6.3 (3.6)	6.1 (3.7)	6.1 (3.7)	6.6 (3.9)
Subjective sleep quality score	1.2 (0.7)	1.2 (0.7)	1.2 (0.7)	1.3 (0.7)
Sleep latency score	1.1 (1.0)	1.0 (1.0)	1.1 (1.0)	1.1 (1.0)
Sleep duration score	0.8 (0.9)	0.8 (0.9)	0.8 (0.9)	0.9 (1.0)
Habitual sleep efficiency score	0.9 (1.1)	0.9 (1.1)	0.9 (1.1)	0.9 (1.1)
Sleep disturbance score	1.2 (0.6)	1.2 (0.6)	1.1 (0.6)	1.2 (0.6)
Use of sleep medications score	0.3 (0.8)	0.4 (0.9)	0.4 (0.9)	0.5 (1.0)
Daytime dysfunction score	0.8 (0.7)	0.7 (0.7)	0.7 (0.7)	0.8 (0.7)
AUDIT score	4.5 (3.7)	4.3 (3.8)	4.3 (4.0)	4.8 (4.7)
Frequent heavy drinking score	2.5 (1.4)	2.5 (1.4)	2.5 (1.5)	2.6 (1.6)
Any current drug use	7.4% (36)	8.2% (37)	9.5% (41)	10.8% (44)
Current NMUPD	4.5% (22)	4.2% (19)	4.2% (18)	3.7% (15)
Current illicit drug use	4.3% (21)	5.7% (26)	6.2% (27)	7.4% (30)

Notes: PTSD = posttraumatic stress disorder; PSQI = Pittsburgh Sleep Quality Index; AUDIT = Alcohol Use Disorders Identification Test; NMUPD = nonmedical use of prescription drugs.

indicative of poor sleep and significant difficulty in at least two of the measured components (Buysse et al., 1989). For these analyses we examined the global score and then each component score separately.

Alcohol problems. Alcohol problems at all time points were assessed using the 10-item Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993). Items are rated on a 5-point scale from 0 (*never*) to 4 (*daily or almost daily*), with scores ranging from 0 to 40 ($\alpha = .76$ men; .80 women). We dichotomized the AUDIT score using a cut point of 8, as scores ≥ 8 are indicative of probable alcohol problems (Babor et al., 2001).

Frequent heavy drinking (FHD). Heavy drinking at all time points was assessed using the maximum report of two items: (a) the reported frequency of getting drunk in the past year, ranging on a 9-point scale from every day to never in the last 12 months, and (b) the frequency in the past year of five or more (for men) or four or more (for women) drinks in a single setting, ranging on a 9-point scale from “never in the past year” to “every day” (Leonard & Homish, 2008). To distinguish more habitual frequent heavy drinkers from those who drink heavily on occasion, we dichotomized FHD into

those who reported drinking heavily at least once per week, compared with those who drank heavily less than 2–3 times a month.

Current drug use. Both illicit drug use and NMUPD were assessed at each time point using the National Institute on Drug Abuse (NIDA) Modified ASSIST (WHO ASSIST Working Group, 2002). This measure assesses lifetime and current (past-3-months) use of illicit drugs, including marijuana, opiates, cocaine, hallucinogens, inhalants, methamphetamines, and other illegal drugs, as well as nonmedical use of prescription stimulants, sedatives or sleeping pills, prescription pain medications, and other prescription medications. For these analyses, current drug use was defined as a positive response to use of any of the listed substances in the past 3 months (1 = *any*, 0 = *none*).

Posttraumatic stress disorder. PTSD symptoms were assessed using the Post-Traumatic Stress Disorder Checklist (PCL-5) (Bovin et al., 2016; Weathers et al., 2013). This 20-item measure assesses symptoms of PTSD over the past month on a 5-point scale, ranging from 0 (*not at all*) to 4 (*extremely*). Items are summed to create a total symptom severity score (range: 0–80; $\alpha = .95$). A dichotomous vari-

able for presumptive PTSD diagnosis was created treating each item rated as 2 (“moderately”) or higher as a symptom endorsed, then following the diagnostic rule in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5; American Psychiatric Association, 2013), that requires at least one B item (Items 1–5), one C item (Items 6–7), two D items (Items 8–14), and two E items (Items 15–20; Bovin et al., 2016). The resulting variable was included as a covariate in the models because of the relationship between PTSD and both sleep problems (Babson & Feldner, 2010; Vandrey et al., 2014) and substance use (Seal et al., 2011).

Military status. Military status was coded as current (reference) or former at each time point.

Analysis

First, we used descriptive statistics to characterize the sample and to describe our time-variant variables at each time point (baseline, year 1, year 2, and year 3). Then we examined the relations between different aspects of sleep problems (i.e., the Global PSQI score, and each of the PSQI subscales: Subjective Sleep Quality score, Sleep Latency score, Sleep Duration score, Habitual Sleep Efficiency score, Sleep Disturbance score, Use of Sleep Medications score, Daytime Dysfunction score) and several measures of substance use (i.e., alcohol problems, heavy drinking, any current drug use, current NMUPD, current illicit drug use) over a 3-year follow-up period. Specifically, we used separate generalized estimating equation (GEE) models to examine the relation between each aspect of sleep problems and each measure of substance use. We used a logit link function for all models because of the dichotomous nature of the outcome variables. Unadjusted models included the effect of the focal predictor (i.e., specific aspect of sleep problems) and Time (baseline, year 1, year 2, year 3). Adjusted models controlled for the effect of the focal outcome at the prior time point. Models examined the relation between aspects of sleep problems at wave i and substance use measures at wave i , statistically controlling for substance use—matched to the outcome—at the prior wave ($i - 1$). Therefore, any significant effects of the predictor (i.e., specific aspect of sleep problems) represent the prediction of residual change in the outcome variables (i.e., specific type of substance use) over the prior year. Controlling for the value of the outcome variable at the prior time point also addresses within-person autocorrelation among substance use values across all time points. Adjusted models also included probable PTSD diagnosis ($yes = 1, no = 0$) as a time-variant covariate, in addition to the soldiers’ age in years and sex ($male = 0, female = 1$), given differences in substance use patterns between men and women (NIDA, 2020).

To examine for differences in these associations on the basis of current versus former military status (referent =

current), we then added an interaction term to each adjusted model with military status as a time-variant variable, as some individuals left the military during the study. Last, we plotted the predictive margins of significant interactions to further examine these effects. To enhance the accuracy of inferences made with these data, all GEE models were bootstrapped with 500 replications. Analyses were completed using Stata Version 15.1 (StataCorp LP, College Station, TX).

Results

Descriptive statistics

Descriptive statistics of key variables are presented in Table 1. At baseline, the mean sleep score was 6.3 ($SD = 3.6$), indicating that study participants had poor sleep quality, and this remained relatively stable across each of the four time points. At baseline, 64.3% of the sample had a global score of 5 or higher, indicative of poor sleep (Buysse et al., 1989).

The mean AUDIT score at baseline was 4.5 ($SD = 3.7$), and 15.1% of the sample had an AUDIT score of 8 or more, indicative of problems with alcohol (Saunders et al., 1993). The mean FHD score at baseline was 2.5 ($SD = 1.4$); 11.3% of participants reported getting drunk or consuming five or more (men) or four or more (women) drinks in a single setting at least once a week. At baseline, 7.4% of the sample reported current drug use, increasing to 10.8% at the third follow-up. Current NMUPD at baseline was reported by 4.5% of participants, and current illicit drug use by 4.3%. Of those participants reporting NMUPD, 55% reported use of prescription opioids, and 32% reported nonmedical use of sedatives and sleep medications. The most commonly reported illicit drug was marijuana (86%). The percentage of participants reporting current illicit drug use increased over time to 7.4% at the third follow-up. Empirical growth models suggest that there were statistically significant increases in alcohol problems ($OR = 1.10, p < .05$), heavy drinking at least once per week ($OR = 1.46, p < .001$), any current drug use ($OR = 1.16, p < .05$), and current illicit drug use ($OR = 1.21, p < .05$) over the 3-year follow-up period. There was no significant change in NMUPD ($OR = 0.96, p > .05$) over the follow-up period.

Approximately 7%–9% of the sample met DSM-5 criteria for a probable diagnosis of PTSD at each time point, a proportion within the range identified in other studies (Richardson et al., 2010; Smith et al., 2008). The proportion of the sample who had left the military increased over time (from 7.6% at baseline to 29.9% by the third follow-up).

Main effects of sleep problems on substance use

Unadjusted models showed that across time points, greater Global PSQI score was associated with higher odds of alcohol

TABLE 2. Longitudinal effects of sleep on substance use

Variable	Alcohol problems		Heavy drinking at least once per week		Any current drug use		Current NMUPD		Current illicit drug use	
	OR [95% CI]	Adj. OR [95% CI]	OR [95% CI]	Adj. OR [95% CI]	OR [95% CI]	Adj. OR [95% CI]	OR [95% CI]	Adj. OR [95% CI]	OR [95% CI]	Adj. OR [95% CI]
Global PSQI score	1.06** [1.02, 1.10]	1.04 [0.98, 1.11]	1.06** [1.02, 1.10]	1.06* [1.01, 1.11]	1.09** [1.04, 1.15]	1.08* [1.02, 1.15]	1.17*** [1.09, 1.25]	1.13** [1.04, 1.22]	1.07* [1.01, 1.12]	1.09* [1.01, 1.18]
Subjective sleep quality score	1.29** [1.07, 1.56]	1.39* [1.03, 1.88]	1.19† [0.97, 1.45]	1.30† [1.00, 1.69]	1.27† [1.00, 1.62]	1.45* [1.08, 1.96]	1.67** [1.14, 2.43]	1.82** [1.20, 2.75]	1.10 [0.85, 1.41]	1.16 [0.78, 1.74]
Sleep latency score	1.24** [1.07, 1.42]	1.14 [0.93, 1.40]	1.12 [0.96, 1.30]	1.11 [0.93, 1.34]	1.23* [1.02, 1.49]	1.15 [0.91, 1.45]	1.30† [0.98, 1.72]	1.09 [0.74, 1.59]	1.22† [0.99, 1.51]	1.22 [0.93, 1.61]
Sleep duration score	1.13† [0.99, 1.29]	1.11 [0.89, 1.38]	1.16* [1.01, 1.32]	1.15 [0.97, 1.36]	1.07 [0.88, 1.30]	1.02 [0.80, 1.31]	1.24 [0.95, 1.62]	1.07 [0.75, 1.52]	1.03 [0.83, 1.28]	1.04 [0.74, 1.47]
Habitual sleep score	0.93 [0.84, 1.04]	0.89 [0.74, 1.08]	1.05 [0.94, 1.17]	1.01 [0.87, 1.18]	1.00 [0.88, 1.14]	0.94 [0.78, 1.14]	1.08 [0.89, 1.31]	0.99 [0.76, 1.28]	1.00 [0.86, 1.17]	0.92 [0.71, 1.18]
Sleep disturbance score	1.31** [1.08, 1.60]	1.15 [0.81, 1.63]	1.17 [0.95, 1.45]	1.11 [0.82, 1.50]	1.56** [1.21, 2.02]	1.38† [0.98, 1.92]	2.08** [1.37, 3.16]	1.67† [0.94, 2.97]	1.51** [1.17, 1.94]	1.59* [1.05, 2.42]
Use of sleep medications score	1.22** [1.06, 1.40]	1.12 [0.93, 1.34]	1.25* [1.05, 1.49]	1.32** [1.09, 1.61]	1.56*** [1.28, 1.90]	1.57*** [1.28, 1.92]	1.94*** [1.52, 2.48]	1.82*** [1.41, 2.34]	1.38** [1.12, 1.69]	1.58** [1.21, 2.06]
Daytime dysfunction score	1.39*** [1.19, 1.61]	1.38** [1.09, 1.75]	1.18† [0.99, 1.39]	1.13 [0.90, 1.43]	1.46*** [1.16, 1.84]	1.56** [1.16, 2.11]	1.92*** [1.43, 2.58]	1.74* [1.14, 2.64]	1.22 [0.95, 1.59]	1.31 [0.91, 1.88]

Notes: NMUPD = nonmedical use of prescription drugs; OR = odds ratio; adj. = adjusted; CI = confidence interval; PSQI = Pittsburgh Sleep Quality Index. Unadjusted models included the effect of time. Adjusted models included the effects of time, probable posttraumatic stress disorder (*yes* = 1/*no* = 0), age in years, sex (*male* = 0, *female* = 1), and the focal substance use variable at the previous time point. †*p* < .10; **p* < .05; ***p* < .01; ****p* < .001.

problems (*p* < .01) and heavy drinking at least once per week (*p* < .01), any current drug use (*p* < .01), current NMUPD (*p* < .001), and current illicit drug use (*p* < .05) (Table 2). After we controlled for probable PTSD, soldier age, and sex, as well as substance use at the prior time point (matched to outcome), associations with higher odds of heavy drinking at least once per week (*p* < .05), any current drug use (*p* < .05), any current NMUPD (*p* < .01), and current illicit drug use (*p* < .05) remained statistically significant.

Across time points, Subjective Sleep Quality score was significantly associated with higher odds of alcohol problems (*p* < .01) and current NMUPD (*p* < .01) in unadjusted models. Subjective Sleep Quality score was not associated with current illicit drug use. After adjusting for probable PTSD, soldier age, and sex, as well as substance use at the prior time point, Subjective Sleep Quality was significantly associated with higher odds of alcohol problems (*p* < .05), any current drug use (*p* < .05), and current NMUPD (*p* < .01). Sleep Latency score, Sleep Duration score, and Habitual Sleep Efficiency score were not associated with any substance use outcomes after controlling for probable PTSD, age, sex, and substance use at the prior time point. In unadjusted models, greater Sleep Disturbance Score was associated with higher odds of alcohol problems (*p* < .01), any current drug use (*p* < .01), current NMUPD (*p* < .01), and current illicit drug use (*p* < .05). In adjusted models, greater Sleep Disturbance Score was still associated with higher odds of current illicit drug use (*p* < .01) as well as any current drug use (*p* < .10), but not with alcohol problems or NMUPD. Greater Use of Sleep Medications score was associated with higher

odds of alcohol problems (*p* < .01), heavy drinking at least once per week (*p* < .05), any current drug use (*p* < .001), current NMUPD (*p* < .001), and current illicit drug use (*p* < .01). After controlling for the aforementioned covariates, these findings remained significant with the exception of alcohol problems. Greater Daytime Dysfunction score was significantly associated with higher odds of alcohol problems (*p* < .001), any current drug use (*p* < .01), and current NMUPD (*p* < .001). These findings remained significant after adjustment.

Interaction effects of sleep problems and military status on substance use

Adjusted models showed significant interactions between Subjective Sleep Quality score and military status on any current drug use (*p* < .05) and current illicit drug use (*p* < .05). There were no interactions between Subjective Sleep Quality score and military status on either of the alcohol-related outcomes. Sleep Duration had a significant interaction with military status on current NMUPD (*p* < .05), but not with any of the other substance use outcomes. In all significant interactions, greater problems with sleep were associated with a greater likelihood of substance use for former military members, but not for current military members (Figures 1–3). There were no significant interactions with military status on any of the substance use outcomes for Global PSQI score, Sleep Latency score, Habitual Sleep Efficiency score, Sleep Disturbance score, Use of Sleep Medications score, and Daytime Dysfunction score.

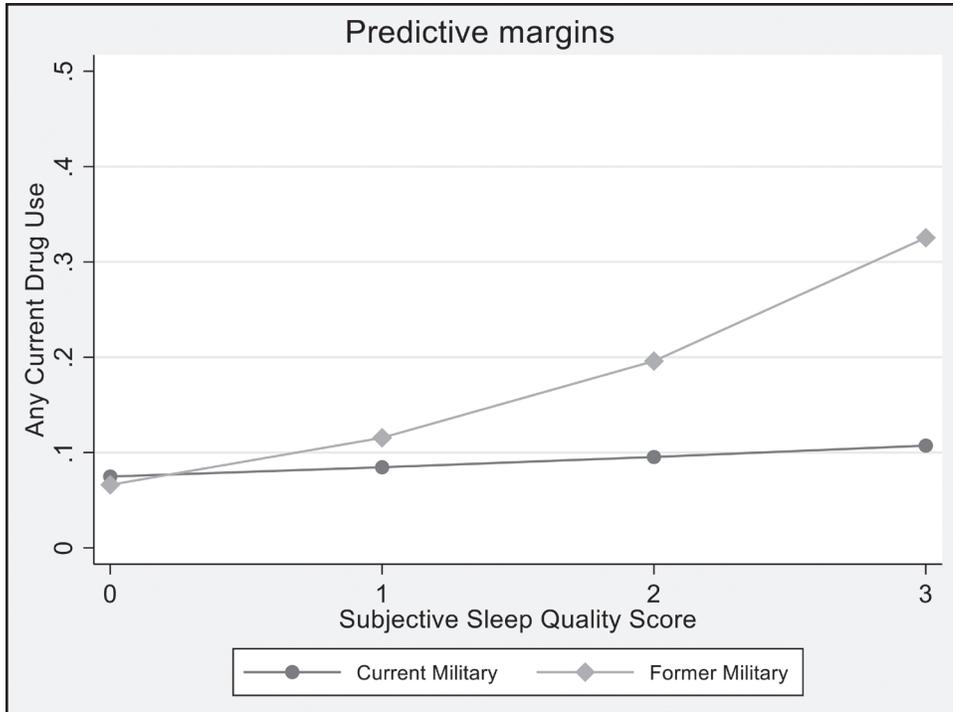


FIGURE 1. Predicted probability of any current drug use by subjective sleep quality score and military status. *Note:* Greater subjective sleep quality scores indicate more frequent problems with sleep quality.

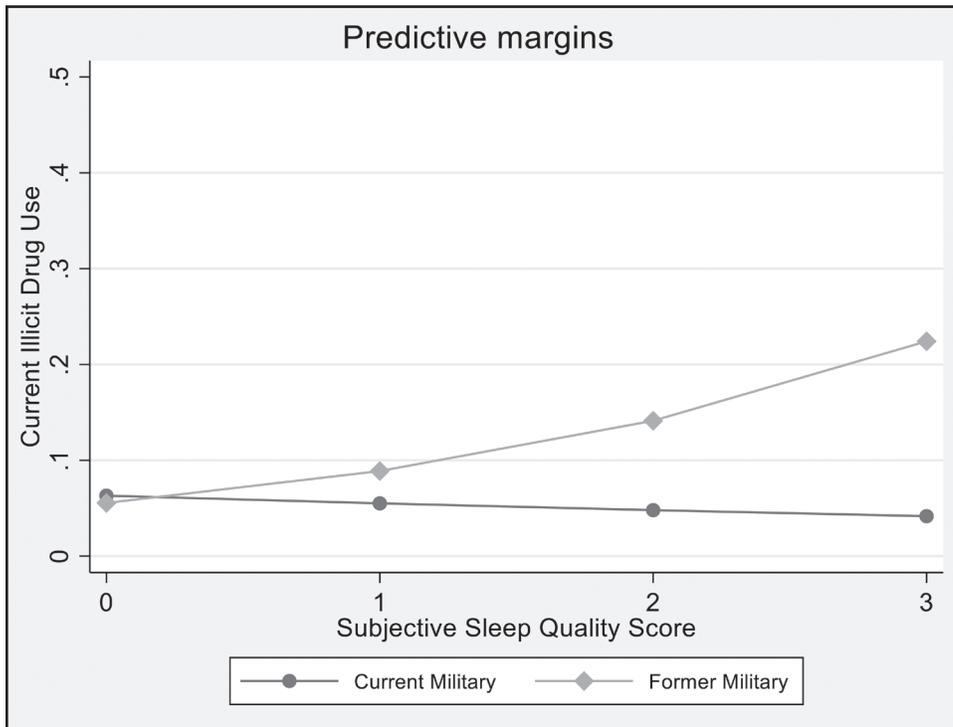


FIGURE 2. Predicted probability of current illicit drug use by subjective sleep quality score and military status. *Note:* Greater subjective sleep quality scores indicate more frequent problems with sleep quality.

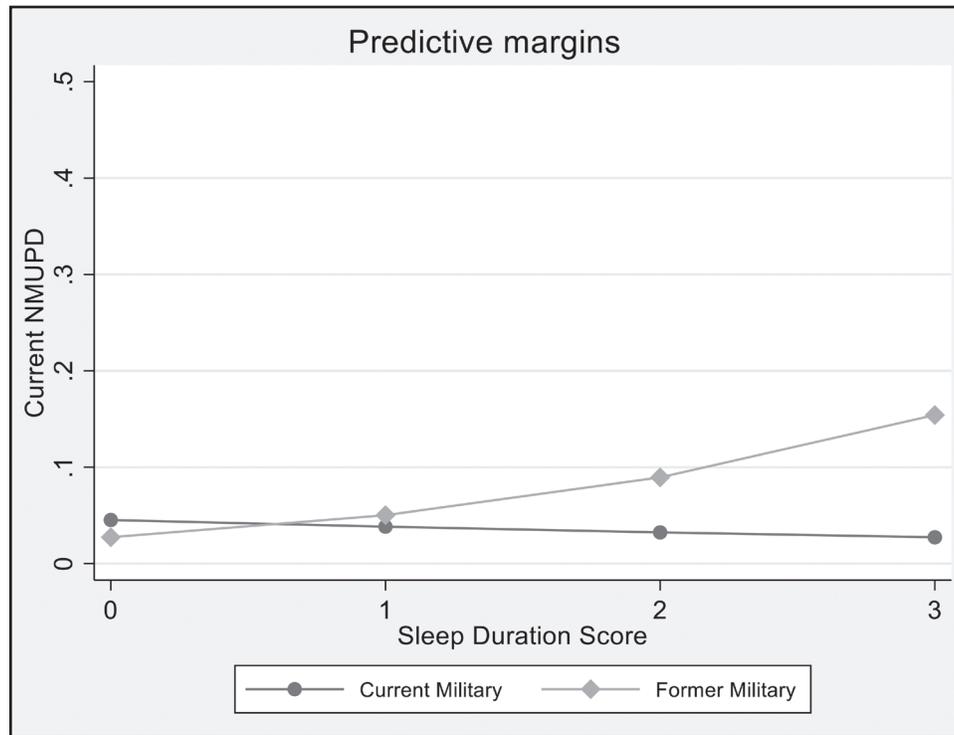


FIGURE 3. Predicted probability of current NMUPD by sleep duration score and military status. *Note:* Greater sleep duration scores indicate more frequent problems with sleep duration. NMUPD = nonmedical use of prescription drugs.

Discussion

The present research aimed to fill important gaps in the literature on sleep and substance use among military service members and veterans by using a large prospective longitudinal study, more comprehensive and nuanced measures of sleep, and a wider range of indicators of alcohol and drug use. Further, we examined differences in these relations between current and former service members. Results indicate significant problems with sleep among this sample of current/former USAR/NG soldiers; 64% indicated significant sleep problems. This is slightly lower than the findings of other military studies, which also assessed sleep with the PSQI (70%–89%; Plumb et al., 2014; Swinkels et al., 2013). These other studies do not provide information on important sample characteristics, which would help understand what proportion of participants were active duty versus USAR/NG. Differences in the nature of reserve and active duty military service and other factors (e.g., time since last deployment) may affect the prevalence of sleep problems in the various samples.

Across time points, after controlling for soldier age, sex, clinically significant PTSD symptoms, and prior wave substance use, sleep problems were related to increased risk for substance use. Although the level of sleep problems remained consistent in our sample over time, the mean

scores are indicative of persistent problems with sleep. Furthermore, the risk of problematic alcohol consumption and drug use (illicit drug use in particular) increased among the sample over the 3 years. Health care providers and/or military unit leaders should regularly screen for sleep problems among military service members in order to promptly address identified problems, thereby limiting risk for adverse outcomes.

This pattern of findings suggests that persistent unaddressed sleep problems may contribute to greater likelihood that individuals will seek the use of substances as a means of addressing sleep difficulties. Indeed, some prior evidence supports this possibility; compared with those who had no or remitted sleep problems, deployed soldiers with persistent sleep problems (over 1–6 months postdeployment) had higher odds of alcohol use disorder (Hunt et al., 2016), although this study did not examine drug use. In addition, most of the illicit drug use in our sample is marijuana. Other studies have examined sleep problems as motivation for marijuana use (Bonn-Miller et al., 2010, 2014), finding in particular that sleep problems were related to use of marijuana for coping reasons, regardless of low or high levels of PTSD, indicating that sleep may be a driving factor (Bonn-Miller et al., 2010). Veterans in a qualitative study also reported using marijuana to help them “shut off their brain” and enable sleep (Vest et al., 2021). Although this suggests that

there may be similar motivations among our participants, additional research is needed to examine these relations in greater detail and determine causality.

Further, subjective sleep quality, sleep disturbance, use of sleep medications, and daytime dysfunction appear to be particularly problematic aspects of sleep problems that relate to increased risk for alcohol problems and drug use over time. Among the subscales, the use of sleep medication was consistently related to substance use risk over time, across all categories of substances examined. This indicates that individuals who use medications for sleep may be at increased risk for problems with substance use and should be closely monitored. Health care providers should consider asking patients about sleep medication usage and conducting regular screening for alcohol use, illicit drugs, and misuse of prescription medications among those who endorse sleep medication.

Use of sleep medications was related to a nearly two times greater risk for current NMUPD. Among study participants, misuse of prescription opioids was the most commonly endorsed nonmedical use. Further, reported misuse of sedatives (including benzodiazepines) or sleep medication was endorsed by nearly one third of nonmedical users, indicating that the relationship between sleep problems and misuse of prescription medications is not limited to misuse of medications specifically for sleep. Misuse of prescription opioids and benzodiazepines is especially problematic, given an increased risk for overdose.

There is some evidence of increased risk after separation from the military, such that former soldiers who expressed difficulties with subjective sleep quality were at greater risk for current use of any drug and current illicit drug use compared with current soldiers. There was also a relationship between sleep duration scores and increased risk for NMUPD among former soldiers, as compared with current. These findings are consistent with previous research demonstrating potential increases in risk for use of substances upon military separation (Hoopsick et al., 2017; Vest et al., 2018, 2020). This may be especially true for the use of illegal drugs, once the constraints of random drug testing during military service are removed. However, ongoing attention should be paid to sleep among veterans, regardless of time since deployment or leaving the service, as our data indicate that problems with sleep may be persistent over many years.

Limitations

These findings are subject to limitations. Study participants were drawn from units in a single state and all participants had to be married or partnered at baseline, which may limit generalizability of the findings. However, it is important to note that our sample had broad representation in terms of types of units included, and approximately half of U.S. service members are married (Office of the Deputy

Assistant Secretary of Defense, 2016). In addition, data were self-reported by participants and may be subject to bias, although our study included widely used and accepted robust, validated measures. Because of the way questions are asked on both the ASSIST and the PSQI, we were unable to assess the extent to which individuals' NMUPD was of their own prescribed sleep medications. Future studies are needed to tease this out in greater detail. Last, there is an increased potential for type II errors, as a result of running multiple GEE models; however, we are reassured that the PSQI, and in particular the Global score, demonstrated relatively consistent associations with our outcomes.

Conclusions

Overall, we found that, over time, sleep problems are highly prevalent and persistent among U.S. Reserve and National Guard soldiers and are associated with increased risk for a range of substance use outcomes. Further, results indicate that this risk may increase for soldiers who have separated from the military, compared with those who are currently serving. These findings suggest that military units and health care providers should consider routine screening for sleep problems and use of sleep medications among service members. Furthermore, soldiers preparing to leave the military should be screened for sleep problems, referred for treatment as needed, and provided education on the health risks, including substance use, related to unaddressed sleep problems.

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