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The Influence of Veteran Status, Psychiatric Diagnosis, and Traumatic Brain Injury on Inadequate Sleep

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Adequate sleep is essential for health, social participation, and well-being. We use 2010 and 2011 Behavioral Risk Factor Surveillance System data (N = 35,602) to examine differences in sleep adequacy between: non-veterans; non-combat veterans with no psychiatric diagnosis or traumatic brain injury (TBI); combat veterans with no psychiatric diagnosis or TBI; and veterans (non-combat and combat combined) with a psychiatric diagnosis and/or TBI. On average, respondents reported 9.28 days of inadequate sleep; veterans with a psychiatric diagnosis and/or TBI reported the most—12.25 days. Multivariate analyses indicated that veterans with a psychiatric diagnosis and/or TBI had significantly more days of inadequate sleep than all other groups. Findings contribute to a growing literature on the relevance of the military service–psychiatric diagnosis–TBI nexus for sleep problems by using population-representative data and non-veteran and healthy veteran comparison groups. This research underscores the importance of screening and treating veterans for sleep problems, and can be used by social workers and health professionals to advocate for increased education and research about sleep problems among veterans with mental health problems and/or TBI.

Key words: veterans, sleep, mental health, traumatic brain injury

Veterans are a large, diverse, policy-relevant subgroup of the American population that places specific demands on social work, public health, and health care professionals working at micro-, mezzo-, and macro-levels of practice (Bronfenbrenner, 1979) within and outside of the Veterans Administration (Franklin, 2009; Kaplan, Huguet, McFarland, & Newsom, 2007; Peppard & Reichmuth, 2013; Pigeon, Britton, Ilgen, Chapman, & Conner, 2012; Vasterling & Proctor, 2011; Wheeler & Bragin, 2007). In 2010, approximately 82.5% of the 22 million living veterans had served during war time (U.S. Census Bureau, 2010), although not all of them had been exposed to combat or experienced negative consequences as a result of their service (Wilmoth & London, 2013a). The majority of veterans are men; however, in 2010, approximately 1.6 million veterans were women (U.S. Census Bureau, 2010).

Individuals who enter the military are initially selected on good physical and mental health, but a growing body of comparative, social epidemiological and life course research documents heterogeneity in the health consequences of military service (MacLean, 2010, 2013; Teachman, 2011; Wilmoth, London, & Parker, 2010, 2011). Military service may negatively affect health directly through service-connected accidents, exposure to combat, promotion of unhealthy behaviors, and harm resulting from military sexual trauma, or indirectly by affecting subsequent health-related life course outcomes and trajectories through processes of cumulative inequality (Wilmoth & London, 2013a). Over the long term, military service may also be beneficial for health in some circumstances, such as when it leads to higher educational attainment relatively early in the life course, provides training that translates into better opportunities in the civilian labor market, improves access to health care, generates stress-related growth, and stimulates positive health behaviors, such as exercise.

Mental health is a central focus of the literature on the health consequences of military service (Hoge, Auchterlonie, & Milliken, 2006; Milliken Auchterlonie, & Hoge, 2007; Vasterling et al., 2010; Vasterling & Proctor, 2011; Whyman, Lemmon, & Teachman, 2011). Depression, anxiety, and post-traumatic stress disorder (PTSD) are relatively common among veterans (MacLean, 2013; Tanielian & Jaycox, 2008). The etiology and symptoms of these mental disorders overlap considerably with

those of traumatic brain injury (TBI) (Maguen, Lau, Madden, & Seal, 2012), which is an injury of considerable importance among recent veterans (Tanielian & Jaycox, 2008). Poor-quality sleep, including disturbances and low sleep efficiency, are persistent and distressing symptoms of depression, PTSD, and TBI (Mathias & Alvaro, 2012; Mellman, Kumar, Kulick-Bell, Kumar, & Nolan, 1995; Wright, Britt, Bliese, Adler, Picchioni, & Moore, 2011). At the same time, there is growing evidence that sleep problems, including insomnia, may also link negative experiences during military service and the development of mental health problems (Picchioni et al., 2010; Wright et al., 2011). Studies have shown that individuals who already reported nightmares (van Liempt, van Zuiden, Westenberg, Super, & Vermetten, 2013) or other sleep problems prior to exposure to a traumatic event were more vulnerable to developing PTSD (Babson & Feldner, 2010; Gehrman et al., 2013; Germain, 2013), and others have shown that sleep mediates the association between TBI and the development of depression or PTSD (Macera, Aralis, Rauh, & MacGregor, 2013).

Sleep problems may thus be an important indicator of existing mental health disorders or increased risk for developing them (Macera et al., 2013) and are commonly reported by soldiers returning from combat (Wright et al., 2011). Given that sleep symptoms could help to identify veterans who are reluctant to seek medical attention for mental health concerns, recommendations have been made to increase screening for sleep disorders after deployment (Peppard & Reichmuth, 2013). Additionally, sleep problems are an important focus in their own right. Inadequate sleep has been linked with a greater risk of common health conditions, including diabetes (Knutson, Ryden, Mander, & van Cauter, 2006) and hypertension (Gangwisch et al., 2006), and is associated with a greater risk of accidents (Kling, McLeod, & Koehoorn, 2010) and suicide (Pigeon et al., 2012). Sleep problems may also affect neurobehavioral functioning (Banks & Dinges, 2007), which affects the ability to perform adult roles in ways that could have far-reaching consequences for individual and family well-being.

Adequate sleep is essential for health, social participation, and well-being. Much of the research on the sleep and mental health consequences of military service focuses on

veterans only, and often uses samples derived exclusively from the Veterans Administration health care system. Relatively few studies compare veterans to non-veterans, or veterans with different military service experiences. Thus, we know less than we should about how heterogeneity in military service experiences differentiates the sleep of veterans relative to non-veterans, or subsets of veterans from one another. In this study, we examine levels of and variation in inadequate sleep among non-veterans, non-combat and combat veterans, respectively, with no psychiatric diagnosis or TBI, and veterans with a psychiatric diagnosis and/or TBI.

Methods

Data

Data for this study were obtained from the 2010 and 2011 Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is an annual survey of all 50 states, Washington, D.C., Guam, the U.S. Virgin Islands, and Puerto Rico, with each location fielding a standard core survey that can be supplemented with one or more optional topic modules. In 2011, both landlines and cell phones were included in the sampling frame; however, the optional, locality-specific topic modules were administered only to persons participating via landline. Prior population-representative research on sleep inadequacy has used BRFSS data (Chapman et al., 2012).

The sample includes respondents from Alaska (2011); Nebraska (2010); Nevada (2011); and Tennessee (2010 and 2011) because these were the only states for which data on veterans' health and inadequate sleep were available. Prior to dropping respondents with missing data on analytic variables from the sample, the pooled sample included 35,602 respondents.

Dependent Variable

The question measuring inadequate sleep was identical in 2010 and 2011, although it was asked of all respondents in 2010, but only respondents in those localities that fielded the Inadequate Sleep module in 2011. In both years, the survey asked: "During the past 30 days, for about how many days have you felt that you did not get enough rest or sleep?" The

dependent variable for the analyses presented in this paper ranges from 0 - 30 days.

Focal Independent Variable

We used data from the core and Veterans' Health module to derive the independent variable that is the primary focus of our analyses. In both 2010 and 2011, the core survey included a question about military service: "Have you ever served on active duty in the United States Armed Forces, either in the regular military or in a National Guard or military reserve unit? Active duty does not include training for the Reserves or National Guard, but DOES include activation, for example, for the Persian Gulf War." In both years, those who answered yes to this question were asked the Veteran Health module, which included a yes/no question on combat exposure—"Did you ever serve in a combat or war zone?" The module also included a question that asked: "Has a doctor or other health professional ever told you that you have depression, anxiety, or post-traumatic stress disorder (PTSD)?" Additionally, respondents were asked about whether they had been diagnosed with a traumatic brain injury (TBI). The question read: "A traumatic brain injury may result from a violent blow to the head or when an object pierces the skull and enters the brain tissue. Has a doctor or other health professional ever told you that you have suffered a traumatic brain injury (TBI)?" Using these four indicators, we derive a four-category focal independent variable that identifies: (1) non-veterans; (2) non-combat veterans with no psychiatric diagnosis or TBI; (3) combat veterans with no psychiatric diagnosis or TBI; and (4) veterans (non-combat and combat combined) with a psychiatric diagnosis and/or TBI. We combine non-combat and combat veterans in this final category because of the relatively small number of respondents with at least one diagnosis.

Control Variables

The literature identifies numerous social and behavioral factors that can affect the adequacy of sleep (Ailshire & Burgard, 2012; Burgard, 2011; Burgard & Ailshire, 2009, 2013; Chapman et al., 2012). To adjust for other influences on sleep adequacy, we include four sets of control variables that are all

measured the same way in the 2010 and 2011 core surveys. The demographic controls measure exogenous characteristics, including: sex (female = 1); race (White, Black, Asian/Pacific Islander, Native American/Alaskan, other race, and multiracial); Hispanic ethnicity (yes = 1); and age (18 - 29 years, 30 - 39 years, 40 - 49 years, 50 - 59 years; 60 - 69 years, and 70+ years).

The second set of control variables measures socioeconomic attainment and family structure. We treat these as potentially mediating variables because they might be affected by military service, combat exposure, psychiatric diagnosis, and TBI, although with cross-sectional data we cannot be certain of the timing of these status attainments relative to military service. Education is measured as less than high school, high school graduate, some college, and college or more. Employment status is measured as employed, unemployed, not in the labor force, and disabled and unable to work. Income indicates annual household income in categories of \$25,000 or less, \$25,001 to \$75,000, and \$75,001 or more. Because many respondents were missing on income, we include an "income missing" category. Marital status is recoded as married, partnered, separated or divorced, widowed, and never-married. Number of children in the household is categorized as 0, 1, 2, and 3 or more children.

The third set of control variables measure health behaviors that are thought to be related to sleep quality and may also be affected by military service. Thus, we conceptualize them as potentially mediating variables. Alcohol consumption is measured as the number of days in the past 30 days that the respondent drank alcohol; we recode it to 0, 1 - 7, and 8 or more days. Current smoking combines information from two separate questions. The first asks if the respondent had ever smoked 100 cigarettes (i.e., 5 packs) in their life time (yes/no), and those who had were asked whether they now smoke "every day, some days, or not at all." Based on responses to these questions, we coded a three-category current smoking variable: no, some days, every day. Finally, the BRFSS public use data include a set of body mass index (BMI) categories that are derived from self-reported height and weight data. We combined underweight and normal weight, but kept overweight and obese as distinct categories.

The final set of variables serves as methodological controls. Since we pool data from four states and two years of the BRFSS, in all multivariate models, we control for state and survey year.

Analytic Approach

Overall, 4,609 respondents (12.95% un-weighted) were missing data on one or more analytic variables. Approximately 42% (un-weighted) of those missing on any variable were missing on the dependent variable. After dropping respondents with missing data, the sample for all of the analyses that follow includes 30,993 respondents.

We begin by describing the sample, estimating levels of inadequate sleep, and examining variation in inadequate sleep by veteran status and each of the control variables. We then estimate a set of hierarchical ordinary least squares (OLS) regression analyses of variation in inadequate sleep: Model 1 includes the four-category veterans status variable that is the focus of our analysis, plus the methodological controls; Model 2 adds the exogenous demographic controls; Model 3 adds the potentially mediating socioeconomic attainment and family structure variables; and Model 4 adds the potentially mediating health behavior variables.

All analyses are weighted. To adjust the standard errors and statistical tests for the differential weighting and complex sample design, we use the SVY commands in Stata 12.1.

Results

Sample Description

Overall, approximately 11% are veterans: 5.46% are non-combat veterans with no psychiatric diagnosis or TBI; 3.65% are combat veterans with no psychiatric diagnosis or TBI; and 2.00% are veterans with a psychiatric diagnosis and/or TBI (Table 1). A table of descriptive statistics for the sample is available by request. Below, we summarize key characteristics of the sample.

About half of the sample is female, 81.30% is White, and approximately 5% report Hispanic ethnicity. The mean age is 47.06 years, with 57% between the ages of 18 and 49 years. Approximately 54% have some college or more education and

slightly more than half are employed. More than one-third have incomes in the \$25,001 - \$75,000 range; more have incomes of \$25,000 or less than have incomes of \$75,001 or more (29.01% versus 19.72%). Approximately 58% are married, 18.9% are never-married, and 14.1% are separated or divorced; the majority has no child in the household (61.61%). Most report that they have not consumed any alcohol in the past 30 days (62.10%) and don't currently smoke (77.75%); 17.5% report smoking every day. About one-third are normal weight or less, overweight, and obese, respectively. Most live in Tennessee (71.66%). About half were surveyed in each year.

Table 1. Sample Description and Bivariate Associations with Mean Number of Days of Inadequate Sleep in the Past 30 Days

Variable	Weighted %	Un-Weighted N	Weighted Mean	P
Total	100	30,993	9.28	---
Veteran Status				
Non-Veteran	88.89	26,983	9.45	***
Non-Combat Veteran, No PTSD	5.46	2,118	7.11	
Combat Veteran, No PTSD	3.65	1,303	6.95	
Veteran with PTSD	2.00	589	12.25	

Note: Significance Levels: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$.

Levels of Inadequate Sleep

Table 1 also presents the mean number of days in the past 30 that respondents reported inadequate sleep overall and by veteran status. On average, respondents reported 9.28 days of inadequate sleep. The mean number of days of inadequate sleep varied significantly by veteran status, with more days reported by veterans with a psychiatric diagnosis or TBI (12.25 days on average) and fewer days reported by non-combat veterans with no psychiatric diagnosis or TBI (7.11 days on average) and combat veterans with no psychiatric diagnosis or TBI (6.95 days on average). On average, non-veterans reported 9.45 days of inadequate sleep. It is noteworthy that a substantial percentage of each group reported 15 or more days of inadequate sleep in the prior 30 days (not shown). Although the percentage reporting 15 or more days of inadequate sleep

was highest among veterans with a psychiatric diagnosis or TBI (39.41%), 30.14% of non-veterans, 22.06% of non-combat and 21.31% of combat veterans, respectively, with no psychiatric diagnosis or TBI, reported 15 or more days of inadequate sleep.

Table 2. Multivariate Ordinary Least Squares Regression Analysis of Days of Inadequate Sleep in the Past 30 Days

Variable (Reference)	Model 1 ^a b (se)		Model 2 ^b b (se)		Model 3 ^c b (se)		Model 4 ^d b (se)		
Veteran Status (Non-Veteran)									
Non-Combat Veteran, No PTSD	-2.432 (0.520)	***	-0.201 (0.570)		0.188 (0.547)		-0.009 (0.549)		
Combat Veteran, No PTSD	-2.586 (0.639)	***	-0.305 (0.667)		0.376 (0.641)		0.292 (0.664)		
Veteran with PTSD	2.695 (1.286)	*	3.725 (1.276)	**	3.185 (1.203)	**	2.952 (1.241)	*	
Intercept	8.659 (0.181)	***	8.297 (0.514)	***	11.535 (0.938)	***	9.786 (1.004)	***	
N	30,993		30,993		30,993		30,993		
R ²	0.01		0.05		0.09		0.11		

Note: ^aIncludes controls for state of residence and survey year. ^bIncludes controls for state of residence, survey year, sex, age, race, and Hispanic ethnicity. ^cIncludes controls for state of residence, survey year, sex, age, race, Hispanic ethnicity, education, employment, income, marital status, and number of children under age 18 in the household. ^dIncludes controls for state of residence, survey year, sex, age, race, Hispanic ethnicity, education, employment, income, marital status, number of children under age 18 in the household, alcohol consumption in the past 30 days, current smoking status, and body mass index (BMI). Significance levels: * = p < 0.05; ** = p < 0.01; *** = p < 0.001.

The mean number of days of inadequate sleep varied significantly by each of the other variables except race, Hispanic ethnicity, and alcohol consumption (table available upon request). Subgroups with notably high mean number of days of inadequate sleep (i.e., 2 days or more above the sample mean) include: Native Americans/Alaskans (11.6 days); multiracial persons (11.5 days); persons who have less than high school education (11.8 days); persons who are disabled and unable to work (15.3 days); persons who are partnered and separated/divorced (12.3 and 11.6 days, respectively); persons with three

or more children in the household (12.2 days); and persons who smoke every day (13.4 days). Subgroups with notably low mean number of days of inadequate sleep (i.e., 2 days or more below the sample mean) include: persons aged 60-69 (7.3 days) and 70+ years (5.2 days); persons who are out of the labor force (7.0 days); and the widowed (7.0 days).

Multivariate Analysis of Days of Inadequate Sleep

Table 2 presents the results of a multivariate OLS regression analysis of the number of days of inadequate sleep in the past 30 days by veteran status and controls; a table showing coefficients for control variables is available by request. Model 1, which includes veteran status, state of residence, and survey year, indicates that non-combat veterans and combat veterans with no psychiatric diagnosis or TBI, respectively, reported significantly fewer days of inadequate sleep than non-veterans. By contrast, the difference between veterans with a psychiatric diagnosis and/or TBI and non-veterans is positive and also statistically significant in Model 1.

It is noteworthy that the pattern of results changes substantially once sex, age, race, and Hispanic ethnicity are included in Model 2. Model 2 indicates that the differences evident in Model 1 between non-veterans and veterans (both non-combat and combat) with no psychiatric diagnosis or TBI are fully explained by demographic differences between the groups; however, the difference between veterans with a psychiatric diagnosis and/or TBI and non-veterans increases and remains statistically significant. Supplemental analyses (not shown) indicate that age, and to a lesser extent sex, are driving the observed changes. Thus, some of the documented group differences in levels of sleep inadequacy reflect compositional differences between the groups. Veterans tend to be older because of higher participation in the military among men in early- to mid-20th century birth cohorts relative to more recent birth cohorts (Wilmoth & London, 2011, 2013b), and older age is associated with fewer days of inadequate sleep. As a result, controlling statistically for age alone reduces some between-group differences to non-significance.

While adding the other, potentially mediating, socioeconomic attainment, family structure, and health behavior variables in Models 3 and 4 reduces the difference between

veterans with a psychiatric diagnosis and/or TBI and non-veterans, the difference remains statistically significant and positive in Model 4. Net of other variables in Model 4, veterans with a psychiatric diagnosis or TBI reported 2.95 days more inadequate sleep than non-veterans.

In supplemental analyses (not shown), we tested for differences in the coefficients for the three groups of veterans. In all four models, non-combat veterans with no psychiatric diagnosis or TBI were not significantly different from combat veterans with no psychiatric diagnosis or TBI. However, in all four models, non-combat veterans with no psychiatric diagnosis or TBI reported significantly fewer days of inadequate sleep than veterans with a psychiatric diagnosis and/or TBI. Combat veterans with no psychiatric diagnosis or TBI also reported significantly fewer days of inadequate sleep than veterans with a psychiatric diagnosis and/or TBI in Models 1-3; however, that difference became marginally non-significant in Model 4 ($p = 0.0501$).

In Model 4, a number of the control and potentially mediating variables were significantly associated with the number of days of inadequate sleep. Specifically, women reported significantly more days of inadequate sleep than men ($b = 1.777$, $p < 0.001$); persons aged 60-69 ($b = -3.425$, $p < 0.001$) and 70+ years ($b = -4.182$, $p < 0.001$), respectively, reported significantly fewer days of inadequate sleep than persons aged 18-29; and African Americans reported significantly fewer days of inadequate sleep than Whites ($b = -1.534$, $p < 0.01$).

Compared to persons with less than high school education, persons with high school education ($b = -1.491$, $p < 0.01$), some college ($b = -1.347$, $p < 0.05$), and college or more ($b = -1.910$, $p < 0.01$), respectively, reported significantly fewer days of inadequate sleep. Persons not in the labor force reported significantly fewer days of inadequate sleep than employed persons ($b = -0.801$, $p < 0.05$), while disabled persons who were unable to work reported significantly more days of inadequate sleep ($b = 4.899$, $p < 0.001$). Persons who earned \$75,001 or more ($b = -1.054$, $p < 0.05$) and persons who were missing on income ($b = -1.701$, $p < 0.001$), respectively, reported significantly fewer days of inadequate sleep than persons with incomes in the range of \$1-\$25,000.

Compared to the currently married, separated/divorced

persons reported significantly more days of inadequate sleep ($b = 1.137, p < 0.05$), as did persons with 2 ($b = 1.306, p < 0.05$) and 3 or more ($b = 1.714, p < 0.05$) children in the household, respectively, relative to persons with no child in the household. Those who currently smoke some days ($b = 1.371, p < 0.05$) and every day ($b = 3.400, p < 0.001$), respectively, reported significantly more days of inadequate sleep than non-smokers. Persons who were obese also reported significantly more days of inadequate sleep than persons with normal BMI or less ($b = 1.755, p < 0.001$). Respondents in 2011 reported significantly more days of inadequate sleep than respondents in 2010 ($b = 1.826, p < 0.001$). These results are consistent with findings of previous research documenting relationships between sleep and demographic characteristics, socioeconomic attainment, family structure, and health behaviors.

Discussion

Adequate sleep is critical for individual well-being and has implications for the ability to enact socially important roles and promote family well-being. Few well-controlled, population-based studies examine differences in sleep adequacy between non-veterans and veterans, or heterogeneity in sleep adequacy between veterans with different military service experiences. This study provides population-based estimates of levels of inadequate sleep and examines variation in sleep adequacy at the nexus of veteran status, combat exposure, psychiatric diagnosis, and TBI.

Overall, respondents reported 9.28 days of inadequate sleep in the past 30 days, and there was significant variation by veteran status, with the highest number of days of inadequate sleep reported by veterans with a psychiatric diagnosis and/or TBI (12.25 days on average). Multivariate analyses indicated that veteran status differences in sleep adequacy were substantially and substantively affected by the exogenous demographic variables. Controlling for sex, age, race, and Hispanic ethnicity reduced the difference between non-veterans and non-combat veterans and combat veterans, respectively, with no psychiatric diagnosis or TBI. Additionally, controlling for those variables increased the size of the difference between non-veterans and veterans with a psychiatric diagnosis and/or TBI. This difference remained significant even when

additional, potentially mediating controls were introduced into the models. Supplemental analyses indicated that among those with no psychiatric diagnosis or TBI, sleep inadequacy was similar for non-combat and combat veterans, and that both of these groups of veterans differed significantly from veterans with a psychiatric diagnosis and/or TBI.

Taken together, these results demonstrate the importance of taking heterogeneity in military service experiences into account, and suggest that it is veterans with psychiatric diagnoses and/or TBI who experience particularly high levels of sleep inadequacy. Our population-based results add to a few existing studies based on smaller samples without non-veteran comparison groups. One prior study of 152 Australian Vietnam war veterans found very high levels of clinically-significant sleep disturbance among those with and without PTSD, but also showed that those with PTSD exhibited worse symptoms on some components of the overall sleep quality measure that was used (Lewis, Creamer, & Failla, 2009). Another study used sleep laboratory-based measures to compare 20 American veterans with PTSD to 8 with no mental illness and found worse sleep quality among those with PTSD (Mellman et al., 1995).

While using a large-scale study to examine the relationship between veteran status, psychiatric diagnosis, TBI, and sleep inadequacy extends the extant literature, this study has several limitations that warrant mention, at least in part because they point to directions for future research. First, the generalizability of the findings from this study is limited because data were collected in only four states, the response rates for the BRFSS are relatively low, and many respondents are missing data. Replication of these findings in other high-quality, population-representative samples is an important direction for future research.

Second, the measure of psychiatric diagnosis is limited because it is non-specific and does not allow us to identify veterans with a PTSD versus a depression diagnosis, for example. Nevertheless, researchers have noted the similarity in the symptoms of these disorders and TBI with regard to sleep consequences (Peppard & Reichmuth, 2013), making this a useful measure of mental health problems. Importantly, the measure is not available for non-veterans because the questions about psychiatric diagnosis and TBI are only asked in the Veterans'

Health module. Consequently, we are unable to identify psychiatric diagnoses and TBI in the non-veteran population. Thus, our estimate of the difference between non-veterans and veterans with a psychiatric diagnosis and/or TBI must be considered conservative because non-veterans with psychiatric diagnoses are included in the comparison group. The fact that we find a large, statistically significant difference despite this bias toward the null, as well as the fact that military personnel are initially selected on good mental health, highlights the relevance of the military service–psychiatric diagnosis–TBI nexus for sleep problems. Additional research that uses specific measures of psychiatric disorder and measures psychiatric disorder and TBI among veterans and non-veterans would be valuable.

A third limitation is that we do not have more detailed and nuanced measures of sleep quality available, such as experience of nightmares, which are included in cutting-edge research on trauma and sleep. Such measures are rarely included in large-scale surveys that also include veteran status, military service experience, and psychiatric disorder variables. Efforts to add additional measures of sleep problems into future data collection initiatives are warranted and necessary for researchers to further elucidate how veteran status, military service experiences, psychiatric conditions, and TBI inter-relate.

Finally, the cross-sectional data do not allow us to ascertain the sequencing of psychiatric problems, TBI, and sleep inadequacy or the timing of psychiatric diagnosis and sleep inadequacy in relation to military service, despite the positive health selection that occurs at the point of entry into active-duty service. It is likely that much of the TBI observed in the veteran sample occurred during the active-duty period. However, the association between PTSD and sleep is complex, and even sleep lab studies have found it challenging to untangle causal associations (Germain, 2013; van Liempt et al., 2013). Longitudinal data that aims to document the timing of these occurrences in the life course and in relation to one another would be challenging to collect, but is nevertheless an important direction for future data collection and research.

Despite these limitations, our results provide new and important evidence on the potential consequences of military

service for the health of veterans and the well-being of their families. Not only do we demonstrate that days of inadequate sleep are specifically elevated among veterans who have ever been diagnosed with a psychiatric disorder or TBI, but we also document that more than 20% of veterans who have not ever been diagnosed with a psychiatric disorder or TBI report 15 or more days of inadequate sleep in the past 30 days. A high level of inadequate sleep may be an indicator of an existing, undiagnosed mental health disorder or increase the risk for developing one (Macera et al., 2013). Given that veterans are often reluctant to seek medical attention for mental health problems, it may be that screening for sleep disorders is a mechanism for identifying and engaging veterans who could benefit from mental health care (Peppard & Reichmuth, 2013).

Given that screening for sleep problems may be important for enhancing the well-being of veterans and their families, the results provide information that can inform professional practice at the micro-, mezzo-, and macro-levels (Bronfenbrenner, 1979). At the micro-level, health care, public health, and social work professionals directly interacting with veterans and their family members to facilitate service access need to keep in mind the prevalence of sleep problems among the veteran population with psychiatric diagnosis and/or TBI. The findings of this research underscore the importance of screening and treating veterans for sleep problems, particularly but not exclusively those who already may be dealing with serious mental health issues and/or TBI. Encouragingly, treatment of poor quality sleep may also reduce the consequences of serious conditions like PTSD (Krakow et al., 2001). It may also contribute to the prevention of suicide among veterans (Pigeon et al., 2012).

Given this, professionals working at the mezzo-level of practice, who are coordinating services on the community level, should advocate for appropriate interventions for veterans experiencing sleep inadequacy and empower the veteran population to obtain the evaluations and interventions that they need to address their sleep problem and its consequences. At the macro-level of practice, more needs to be done to inform veterans, their families, and policy makers about sleep inadequacy, to evaluate programs aimed at improving sleep, and

to research the impact of sleep inadequacy. Ultimately, taking a comprehensive, multi-level approach to addressing the sleep problems of veterans has the potential to improve quality of life among former active-duty service members, as well as their family members.

Helping veterans obtain adequate sleep can improve functioning across a variety of domains, including employment, job performance, earnings, interpersonal relationships, family dynamics, and personal well-being. Social work, public health, and health care researchers and practitioners have been at the forefront of efforts to promote health and well-being among veterans. Practitioners in various locations intervene to modify unhealthy behaviors that are linked to their prior military service, such as smoking, drinking, and drug use, and to link veterans to appropriate, needed health care. They also make efforts to mitigate the negative consequences engendered by military service, such as military sexual trauma, mental health problems, disability, homelessness, and suicide. Addressing sleep inadequacy and its consequences among veterans is a critical component of such research, practice, and public policy initiatives.

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