Drug and Alcohol Dependence 199 (2019) 35–41

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Full length article

Prospective associations between insomnia symptoms and alcohol use problems among former and current military service personnel

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ARTICLE INFO

Keywords:
Insomnia
Sleep
Alcohol
Drinking
Military
Veterans

ABSTRACT

Background: Despite evidence that insomnia symptoms exacerbate alcohol use disorder symptoms, there is a dearth of prospective research testing bidirectional associations between these variables. Furthermore, no studies have prospectively examined these associations among military personnel, a vulnerable population for sleep- and alcohol-related problems. Thus, the current study examined whether insomnia symptoms prospectively predicted increased alcohol use disorder symptoms among a sample of military service members and veterans over a 6-month follow-up period, as well as whether alcohol use disorder symptoms led to increases in insomnia.

Method: Hypotheses were tested among a sample of 274 current and past military service members who participated in a baseline and 6-month assessment using self-report measures.

Results: Path analyses revealed that insomnia symptoms significantly prospectively predicted increased month-6 heavy drinking and alcohol-related problems, but not days drinking or being bothered by drinking. None of the alcohol variables significantly predicted insomnia.

Conclusion: Results support a model in which insomnia symptoms exacerbate alcohol use disorder symptoms, specifically heavy drinking and alcohol-related problems. Future research should seek to examine these findings in diverse populations and test potential mechanisms and clinical implications of these results.

1. Introduction

Alcohol use disorder (AUD) is defined as a persistent and problematic pattern of alcohol use that is associated with clinically significant impairment and distress, such as a loss of control when drinking and failure to fulfill major role obligations due to drinking (American Psychiatric Association, 2013; Volk et al., 1997). AUD is linked with a variety of negative outcomes such as psychiatric symptoms, risk of premature death, and low economic productivity (Bouchery et al., 2011; Fuehrlein et al., 2016). In addition, alcohol related problems represent a large societal and economic burden, with estimates of cost reaching $223.5 billion annually in the United States (Kearney et al., 2012). Within United States military service personnel, the prevalence of problematic alcohol use is even more pronounced. Specifically, prior literature has consistently found that military service in the United States is associated with chronic and problematic alcohol use, and that rates of AUD are higher among this population (Fuehrlein et al., 2016; Teachman et al., 2014). In addition to the prevalence, AUD and associated symptoms within military populations are associated with a variety of deleterious outcomes, such as increased suicide risk, elevated rates of drug use, lower education, and substantially elevated rates of anxiety- and mood-related disorders (Grant et al., 2004; Harwood et al., 1998; Hassija et al., 2012). Given the prevalence and burden of AUD, and the poor treatment prognosis associated with AUD and related conditions (Dutra et al., 2008; Moos and Moos, 2006), identifying malleable factors leading to the development and maintenance of problematic alcohol use within military populations is critical.

One potential malleable risk factor involved in the etiology of AUD symptoms is insomnia. Insomnia symptoms include disturbances in sleep such as difficulties initiating sleep, problems maintaining sleep, and increased sleep fragmentation (American Psychiatric Association, 2013). Insomnia symptoms are common among the civilian population (Breslau et al., 1996; Mai and Buysse, 2008); however, much like AUD, insomnia symptoms are more prevalent among military populations. In

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https://doi.org/10.1016/j.drugalcdep.2019.02.018
Received 20 August 2018; Received in revised form 28 January 2019; Accepted 7 February 2019
Available online 06 April 2019
0376-8716/

fact, insomnia symptoms are one of the most common reasons that deployed military personnel seek mental health services (Germain et al., 2014; Mysliwiec et al., 2013). Further, the majority report clinically significant sleep disturbance post-deployment, with 70% of service members reporting chronic sleep complaints after returning home (Collen et al., 2012). In addition to the personal burden of sleep disturbance, insomnia symptoms are associated with a variety of negative outcomes within military populations. Specifically, the extant literature has found insomnia symptoms to be linked with increased posttraumatic stress disorder (PTSD) symptoms, AUD, and suicidality (Cahill et al., 2004; Lande, 2012; McLay et al., 2010; Wright et al., 2011).

Insomnia symptoms have been proposed to be not only a correlate, but also a risk factor for the development of AUD. For instance, Brower (2003) proposes a vicious cycle such that insomnia increases risk for alcohol use, which can become problematic, and in turn exacerbate insomnia symptoms. Specifically, those with insomnia may be at risk for alcohol use problems because of issues such as using alcohol as a sleep aid (Roehrs et al., 1999). Although alcohol may initially result in sedation and reduce sleep onset latency, these sedative effects dissipate as tolerance grows, making it necessary to escalate alcohol use to receive benefits for sleep (Brower, 2003). As such, alcohol is not effective as a sleep aid in the long term; however, those with insomnia may *perceive* alcohol to have benefits, including both as to aid sleep and improve mood (Hipson and Fisher, 2016; Roehrs et al., 1999). Unfortunately, this maladaptive alcohol use may paradoxically exacerbate insomnia because chronic alcohol use disrupts sleep, potentially through impacting several of the neurotransmitter systems that regulate sleep (Brower, 2001). The link between insomnia symptoms and AUD may represent a vicious cycle in which insomnia symptoms motivate alcohol use, which then exacerbates or maintains insomnia symptoms.

In addition to theoretical models of the association between insomnia and AUD, empirical research has confirmed a strong concurrent link between these constructs. Up to three-quarters of individuals with AUD report insomnia symptoms (Chaudhary et al., 2015), and several large epidemiological studies have found a cross-sectional link between insomnia symptoms and alcohol problems (Fabsitz et al., 1997; Ford and Kamerow, 1989; Härmä et al., 1998; Janson et al., 2001; Kales et al., 1984; Tachibana et al., 1996). Unfortunately, individuals with comorbid AUD and insomnia have more severe symptoms of AUD (Dolsen and Harvey, 2017; Hartwell et al., 2015), as well as increased psychosocial impairment and decreased quality of life (Chakravorty et al., 2014; Chaudhary et al., 2013, 2015; Cohn et al., 2003; Zhabenko et al., 2012). The cross-sectional connection between insomnia symptoms, worsened AUD severity, and increased functional impairment has also been replicated within military- and veteran-specific samples (Chakravorty et al., 2014; Miller et al., 2017).

Along with cross-sectional studies identifying associations between insomnia and AUD symptoms, there are a small number of prospective studies suggesting insomnia symptoms may precede and predict the development of AUD. Ford and Kamerow (1989), found that individuals with insomnia had up to 2.4 times higher risk of developing alcohol abuse one year later. Further analyses of these data found this association held even when excluding participants with a prior history of psychiatric illness (Weissman et al., 1997). More recent research has demonstrated similar findings, with insomnia symptoms prospectively predicting alcohol dependence over a 10-year period among Swedish men (Janson et al., 2001). Furthermore, emerging research indicates that insomnia symptoms among children and adolescents predict earlier onset of alcohol use, as well as AUD symptoms over 1–10 year follow-up periods (Hasler et al., 2014; Wong and Brower, 2012; Wong et al., 2004).

Research suggests that insomnia symptoms may be a risk factor for AUD, but prospective studies on this relationship are limited. Furthermore, there is limited evidence available to investigate prospective associations between insomnia and AUD symptoms among current and recent military personnel, despite the clinical relevance considering military personnel frequently experience insomnia symptoms as well as alcohol-related problems. The current study prospectively examined insomnia and AUD in a military sample. Specific hypotheses were: 1) elevated insomnia symptoms would prospectively predict increased month-6 heavy drinking; 2) elevated insomnia symptoms would prospectively predict increased month-6 alcohol problems; and 3) considering theoretical models proposing a bidirectional relationship between insomnia and AUD, heavy drinking or alcohol problems would predict month-6 insomnia symptoms. In all analyses, the baseline version of the outcome variables (e.g., baseline heavy drinking in the model testing month-6 heavy drinking), and PTSD symptoms were included as covariates. We selected PTSD symptoms as a covariate because they are common among military personnel and are associated with AUD (Hassija et al., 2012; Vujanovic et al., 2011). Furthermore, assessing PTSD symptoms may also provide a general estimate of negative affectivity, a more generalized risk factor for AUD (Conybeare et al., 2012; Simons et al., 2014; Veilleux et al., 2014).

2. Methods

2.1. Participants

Participants were recruited via social media advertisements and printed flyers as part of a larger study designed to assess the effectiveness of a brief telephone-administered intervention (~1 h) designed to improve behavioral health treatment-seeking behavior in those not currently receiving treatment (W81XWH-13-2-0032; Increasing Treatment Seeking among At-Risk Service Members Returning from Warzones, funded by Department of Defense). Eligibility criteria included serving in the United States Armed Forces following September 11, 2001, not concurrently receiving mental health treatment during screening, and either endorsing suicidal ideation at a baseline screening appointment (via a score > 1 on PHQ-9 item 9; 87.1%) or a prior suicide attempt (61.2%).

The sample consisted of 274 past (82.9%) and current (17.1%) military service personnel (M age = 31.60, SD = 6.83; 90.3% male, 30.2% married), who completed the Insomnia Severity Index at baseline and completed the 6-month follow-up (N = 533). Self-identified race was as follows: White (76.2%), Black (10.9%), Native American (1.7%) Asian/Pacific Islander (3.0%), and other or mixed race (7.5%); 0.8% of the sample did not report race. In addition, 8.9% self-identified as Hispanic. Within the sample, self-reported military service branch consisted of Army (68.9%), Navy (10.1%), Air Force (8.3%), Marines (16.5%), and Coast Guard (0.2%). The sample was composed mainly of Operation Enduring Freedom/Operation Iraqi Freedom veterans (96.4%). A small minority (19.7%) were still in the military. During the past 90 days, 33.8% reported full-time employment, 9.8% part-time employment, 11.5% retired or on disability, 33.0% unemployed, and 12.0% full or part-time student. Finally, 42.2% of the sample reported having no children.

2.2. Measures

2.2.1. Addiction Severity Index – alcohol and drug scales

The Addiction Severity Index (ASI; McLellan et al., 1985) is a structured clinical interview designed to assess a wide array of problems including medical, employment, alcohol/drug, legal, family/social, and psychiatric difficulties. The present study only assessed for problems in the alcohol/drug domain. Within veteran populations, the ASI has demonstrated sound psychometric properties (McLellan et al., 1985). Participants were asked about their substance use history, problems associated with their substance use, and how troubled they were by problems associated with substance use. The ASI was administered at baseline and six-month follow-up. In the current study, days drinking

(over the past 30 days), days heavy drinking (5 or more drinks), problems with alcohol, and being bothered by problems as alcohol were used as indicators of alcohol use and problems in the current study. Substance use history was examined descriptively.

2.2.2. Insomnia Severity Index

The Insomnia Severity Index (ISI) is a measure composed of seven items designed to assess insomnia symptoms and symptom severity (Morin et al., 2011). The ISI is shown to have a consistent factor structure with good reliability and validity (Bastien et al., 2001). The ISI uses a five-point scale to assess multiple domains including sleep problems, satisfaction with current sleep, current impairment of daily functioning, and distress due to sleep problems, at baseline and month six. The ISI demonstrated good internal consistency at both baseline ($\alpha = 0.82$) and month-six assessments ($\alpha = 0.86$). The total score of the ISI was computed at baseline and month-six to assess insomnia symptoms.

2.2.3. PTSD Checklist-Military Version

The PTSD Checklist-Military Version (PCL-M) is a self-report, 17-item measure assessing DSM-IV PTSD symptoms in military personnel (Weathers et al., 1993). The PCL-M holds strong psychometric properties in samples consisting of military veterans (Wilkins et al., 2011). Individuals were asked to rate severity of PTSD symptoms as well as distress due to symptoms within the past month, on a 5-point scale (i.e., 0 = *Not at all* to 4 = *Extremely*). Participants were assessed at baseline only. The PCL-M demonstrated excellent internal consistency in the current study ($\alpha = 0.94$). The total score of the PCL-M was computed at baseline to assess PTSD symptoms.

2.3. Data analytic plan

Path analysis, within Mplus version 8.0 (1998–2017), was used to examine the longitudinal relations between insomnia and alcohol use and problems over the past 30 days (days drinking, days heavy drinking, days with alcohol-related problems [alcohol problems], and days bothered by alcohol-related problems [bothered by drinking]). The alcohol variables can all be considered count variables. Further, given evidence that the variance exceeds the mean for these variables, negative binomial regression was used to model these variables as outcomes. Incident ratio rates, calculated as the exponential of the unstandardized path coefficient, were provided to quantify any significant effects on these variables. Path analytic models were conducted to examine the effects of insomnia and alcohol variables for each individual alcohol variable separately. Models were conducted as autoregressive models and included PTSD symptoms at baseline as a control variable. Benjamini-Hochberg corrections were applied to each model.

3. Results

3.1. Descriptive statistics and correlations

Descriptive statistics and correlations are provided in Table 1. Insomnia and PTSD symptoms were in the clinical range at baseline (Morin et al., 2011; Weathers et al., 1993). Baseline insomnia symptoms were associated with PTSD symptoms, but not heavy drinking, frequency of drinking, problems related to drinking, or being bothered by drinking. PTSD symptoms were associated with heavy drinking and alcohol problems. All alcohol-related variables were significantly positively correlated with each other. Of the 533 participants with data present at baseline, 274 had data present at month-6. Analyses of variance models were conducted to compare baseline PTSD, insomnia, and drinking variables across month-6 missing data status. There were no significant differences in baseline variables between those who did or did not have data present at month-6. Analyses were conducted on the 274 participants who had both baseline and month-6 data available. Descriptive statistics reflecting the percentage of the sample using alcohol and other drugs over the past 30 days. The majority of the sample (51.8%) consumed more than 5 drinks on at least one day over the past 30 days. The next most commonly used substances were marijuana (33.2%), other opiates (15.3%), and sedatives (10.6%); No other substances were used at least once over the past 30 days by more than 10% of the sample (Table 2).

3.2. Path analytic models examining the longitudinal relations between alcohol use and problems and insomnia symptoms

Panel 1 of Table 3 contains parameter estimates for the model examining the longitudinal relations between days drinking and insomnia symptoms, controlling for PTSD symptoms at baseline. Across all models, applying the Benjamini-Hochberg procedure did not alter which parameter estimates were significant. Therefore, the conventional criteria ($p < .05$) can be heuristically used when judging significance. Baseline insomnia symptoms predicted month-6 insomnia symptoms ($\beta = 0.46$, $p < .001$) as did baseline PTSD symptoms ($\beta = 0.17$, $p = .01$). Baseline days drinking was the only predictor of month-6 days drinking ($B = 0.08$, $p < .001$, IRR = 1.08).

Panel 2 of Table 3 contains parameter estimates for the model examining the longitudinal relations between days heavy drinking and insomnia symptoms, controlling for PTSD symptoms at baseline. Baseline insomnia symptoms predicted month-6 insomnia symptoms ($\beta = 0.46$, $p < .001$) as did baseline PTSD symptoms ($\beta = 0.17$, $p = .01$). Baseline days heavy drinking significantly predicted days heavy drinking at month-6 ($B = 0.11$, $p < .001$; IRR = 1.12) as did insomnia symptoms ($B = 0.05$, $p = .02$, IRR = 1.05; see Fig. 1).

Panel 3 of Table 3 contains parameter estimates for the model examining the longitudinal relations between alcohol problems and insomnia symptoms, controlling for PTSD symptoms at baseline. Baseline insomnia symptoms predicted month-6 insomnia symptoms ($\beta = 0.45$, $p < .001$) as did baseline PTSD symptoms ($\beta = 0.18$, $p = .01$). Baseline alcohol problems significantly predicted alcohol problems at month-6 ($B = 0.09$, $p < .001$; IRR = 1.09) as did insomnia symptoms ($B = 0.12$, $p < .001$, IRR = 1.13; see Fig. 2).

Finally, panel 4 of Table 3 contains parameter estimates for the model examining the longitudinal relations between being bothered by alcohol problems and insomnia symptoms, controlling for PTSD symptoms at baseline. Baseline insomnia symptoms predicted month-6 insomnia symptoms ($\beta = 0.45$, $p < .001$) as did baseline PTSD symptoms ($\beta = 0.18$, $p = .01$). Baseline being bothered by alcohol problems was the only significant predictor of being bothered by alcohol problems at month-6 ($B = 0.28$, $p = .01$, IRR = 1.32).

4. Discussion

The current study adds to a growing body of literature identifying a problematic relationship between insomnia and AUD symptoms. Specifically, results indicated that, among military personnel and veterans, elevated insomnia symptoms prospectively predict increased heavy drinking and alcohol-related problems, above and beyond baseline drinking characteristics and PTSD symptoms. No alcohol-related variables prospectively predicted increased insomnia symptoms.

First, consistent with some prior research, insomnia symptoms prospectively predicted heavy drinking and alcohol-related problems over a 6-month period (Ford and Kamerow, 1989; Janson et al., 2001; Weissman et al., 1997). However, these are the first findings to suggest that this association exists among active duty military personnel and veterans, a population that may be at heightened risk for AUD (Hassija et al., 2012; Ullman et al., 2014). Specifically, insomnia symptoms may predict escalation of heavy drinking, and increased problems related to drinking. These results are consistent with a model in which individuals with insomnia are at risk for problematic drinking for a variety of reasons, including using alcohol to self-medicate problems with

Table 1
Descriptive Statistics and Correlations.

Variables	1	2	3	4	5	6	7	8	9	10	11
1. BL PTSD	–										
2. BL Insomnia	.53**	–									
3. BL Days Drinking	.003	−.03	–								
4. BL Heavy Drinking	.09*	.04	.80**	–							
5. BL Alcohol Problems	.07*	.07	.32**	.37**	–						
6. BL Bothered by Drinking	.04	.04	.34**	.37**	.89**	–					
7. M6 Insomnia	.44**	.56**	−.05	.04	.07	.05	–				
8. M6 Days Drinking	−.06	−.002	.69**	.55**	.26**	.27**	−.05	–			
9. M6 Heavy Drinking	.06	.11t	.54**	.62**	.28**	.27**	.07	.76**	–		
10. M6 Alcohol Problems	.09	.14*	.24**	.29**	.30**	.25**	.17**	.23**	.29**	–	
11. M6 Bothered by Drinking	.08	.11t	.26**	.28**	.24**	.24**	.12*	.22**	.26**	.87**	–
Mean	61.91	18.22	9.29	5.28	2.57	.55	15.38	8.39	4.05	2.00	.40
Standard Deviation	12.29	6.25	10.33	8.21	6.66	1.20	7.11	9.53	7.16	6.08	.99

Note. BL = Baseline. M6 = Month-6. Spearman's rho provided for all correlations involving alcohol variables. PTSD = posttraumatic stress disorder. Days drinking, heavy drinking, alcohol problems, and bothered by drinking were assessed by the Addiction Severity Index. Insomnia was assessed with the Insomnia Severity Index.
** = $p < .001$.
* $p < .05$.
t $p < .10$.

Table 2
Baseline Alcohol and Drug Use.

Categorical Variables Drug Use (past 30 days)	Percentage (%)
Alcohol	75.5
Heavy Alcohol	51.8
Marijuana	33.2
Barbiturates	0.4
Sedatives	10.6
Cocaine/Crack	4.4
Stimulants	4.4
Hallucinogens	2.2
Heroin	1.1
Other Opiates	15.3
Inhalants	0.4

insomnia or other emotional difficulties (Hipson and Fisher, 2016; Roehrs et al., 1999).

Second, contrary to hypotheses, no drinking-related variables prospectively predicted insomnia symptoms. This lack of association is surprising as it is well-documented that both acute and chronic alcohol use disrupt sleep (Brower, 2001). However, there are a variety of reasons that could account for these discrepant findings. First, our analyses controlled for PTSD symptoms, which are strongly linked with insomnia (e.g., Short et al., 2014). It is possible that including PTSD as a covariate may have obscured associations between insomnia and AUD symptoms. Second, this sample already exhibited severe problems with insomnia at baseline (Morin et al., 2011). It may be that alcohol-related problems play a role in the etiology of insomnia, but that, over time, insomnia develops its own maintenance factors. Indeed, this conceptualization is consistent with relationships between insomnia and other forms of psychopathology such as PTSD, in which these disorders can trigger initial difficulties with sleep, but that sleep problems can maintain on their own whether or not the "primary" disorder resolves (Short et al., 2018). Third, it could be that individuals develop a tolerance to the sleep-disrupting effects of alcohol (Roehrs and Roth, 2001).

Third, also contrary to hypotheses, insomnia symptoms did not predict days drinking or being bothered by drinking problems. This could be because days drinking does not necessarily capture pathological drinking, thus insomnia symptoms may only be associated with the problematic aspects of drinking and not drinking frequency itself.

Table 3
Path Analytic Models Examining the Longitudinal Relations between Alcohol Use and Problems and Insomnia Symptoms.

	Alcohol Use				Insomnia			
Predictors	*B*	*SE*	*p*	IRR	*B*	*SE*	*p*	β
Days Drinking	0.08	0.01	< .001	1.08	−0.01	0.03	.67	−.002
Insomnia	0.003	0.02	.86	1.00	0.54	0.07	< .001	0.46
PTSD	−0.003	0.01	.71	1.00	0.10	0.03	.01	0.17
	Heavy Drinking							
Heavy Drinking	0.11	0.02	< .001	1.12	0.01	0.05	.79	0.01
Insomnia	0.05	0.02	.02	1.05	0.54	0.07	< .001	0.46
PTSD	0.003	0.01	.82	1.00	0.10	0.03	.01	0.17
	Alcohol Problems							
Alcohol Problems	0.09	0.02	< .001	1.09	0.004	0.07	.95	0.004
Insomnia	0.12	0.03	< .001	1.13	0.55	0.09	< .001	0.45
PTSD	0.03	0.02	.14	1.03	0.11	0.04	.01	0.18
	Bothered by Problems							
Bothered by Drinking	0.28	0.10	.01	1.32	0.003	0.31	.99	0.001
Insomnia	0.04	0.04	.24	1.04	0.55	0.09	< .001	0.45
PTSD	0.01	0.02	.62	1.01	0.11	0.04	.01	0.19

Note. Days Drinking = Alcohol use over the past 30 days. Heavy Drinking = Heavy alcohol use over the past 30 days. Alcohol Problems = problems with alcohol over the past 30 days. Bothered by Drinking = Days bothered by problems with alcohol use over the past 30 days. Days drinking, heavy drinking, alcohol problems, and bothered by drinking were assessed by the Addiction Severity Index. Insomnia was assessed with the Insomnia Severity Index.

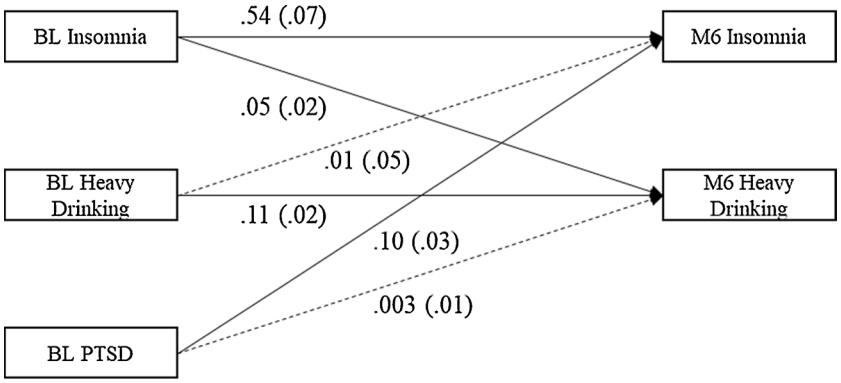

Fig. 1. Longitudinal relations between insomnia and days heavy drinking, controlling for baseline levels of PTSD symptoms.
Notes: All estimates are unstandardized. Solid lines indicate significant paths, dashed lines indicate nonsignificant paths. Heavy drinking was assessed by the Addiction Severity Index. Insomnia was assessed with the Insomnia Severity Index.

Indeed, this is supported by the idea that PTSD symptoms were also not associated with days drinking, despite the well-known link between PTSD and AUD (Debell et al., 2014). In terms of being bothered by drinking problems, this aspect of the ASI requires a certain level of self-awareness that not all individuals with problematic drinking may have (Kim et al., 2007). Similarly to days drinking, PTSD symptoms were not associated with being bothered by drinking problems, indicating this variable may not have adequately captured problematic drinking.

The current study has several important clinical implications. First, given the prevalence of insomnia and its robust role as a predictor of alcohol-related problems, increased focus should be directed toward the assessment of insomnia among military personnel and veterans. Second, these findings demonstrate the significance of targeting insomnia as a treatment opportunity in the prevention and intervention of problematic alcohol use patterns within the military and veteran communities. Insomnia interventions provide promising treatment opportunities given the effectiveness of available web-based treatments that would not require in-person attendance. Further, recent literature supports the finding that veterans are more willing to attend treatment for insomnia symptoms over PTSD and depressive symptoms (Gutner et al., 2018), indicating it may be a helpful avenue for bringing at-risk military personnel into mental health treatment.

There are several limitations to consider when interpreting the results of this study. First, it is unclear whether these effects are maintained over a longer period of time. Future studies should include longer follow-ups. Second, the current study investigated a sample of non-treatment seeking military personnel and veterans. Whereas this sample is an important and concerning subgroup, these veterans may be more likely than the general population to report sleep problems and problematic alcohol use. Further examination of an inclusive sample not selected for elevated suicidal ideation or excluded for treatment engagement is needed in order to generalize findings to all military personnel and veterans. Furthermore, the current sample combined active duty and veteran populations due to the relatively small number of active duty participants. Future research should recruit adequate samples of both active duty military personnel and veterans as these groups may have different sleep and alcohol use patterns. Third, the current study is limited by the gender imbalance, largely favoring males. Future studies should determine if the findings generalize to women military personnel and veterans. Fourth, the reliance on self-report measures to assess insomnia is a limitation of the study. Subsequent studies would benefit from incorporating additional measures of insomnia. In particular, actigraphy could provide objective information about sleep to complement self-reported insomnia symptoms by determining whether participants had actual vs. perceived deficits in sleep duration and whether each construct predicted alcohol use problems (Morgenthaler et al., 2007). Similarly, prospective sleep diaries are the gold standard self-report measure of insomnia symptoms that may provide a more accurate assessment of severity vs. retrospective self-report, and should be incorporated into future research (Carney et al., 2012). Fifth, the study did not include measures that could serve as mechanisms for the insomnia-alcohol link (e.g., drinking motives, such as drinking to help one's sleep, emotion regulation, and reward system functioning). Future research would benefit from including these potential mechanisms temporally preceding the outcomes of interest. Sixth, we administered the PCL-M, which does not include a specific index trauma as a reference, and we did not otherwise assess trauma exposure. Thus, it is unclear whether the PCL-M as used represents actual PTSD symptoms or is instead a more general measure of negative affect.

In conclusion, this study adds to a bourgeoning line of literature indicating that insomnia symptoms are a risk factor for the development of alcohol and substance use disorders (Brower, 2001; Hasler et al., 2014). Specifically, we found that insomnia symptoms prospectively predicted heavy drinking and drinking-related problems over 6-months, even accounting for well-established AUD risk factors (i.e., PTSD symptoms). These findings support the theoretical notion that insomnia symptoms may confer risk for AUD, and invite future research on potential mechanisms underlying this association, as well as investigations into the impact of treating insomnia on the development of

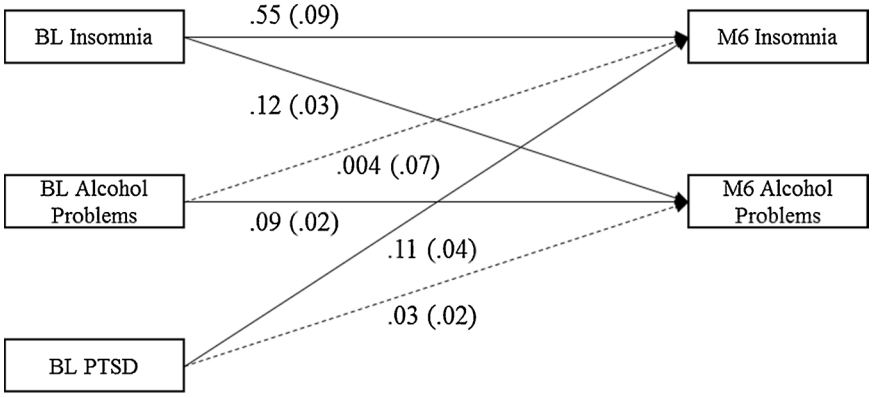

Fig. 2. Longitudinal relations between insomnia and alcohol problems, controlling for baseline levels of PTSD symptoms.
Notes: All estimates are unstandardized. Solid lines indicate significant paths, dashed lines indicate nonsignificant paths. Alcohol problems were assessed by the Addiction Severity Index. Insomnia was assessed with the Insomnia Severity Index.

AUD.

Role of funding source

This work was supported by the Department of Defense Grant W81XWH-13-2-0032(TS), the National Institute on Drug Abuse (Grant no.F31 DA044689-01, NAS), and the Military Suicide Research Consortium (MSRC, NBS), Department of Defense, and VISN 19 Mental Illness Research, Education, and Clinical Center (MIRECC), but does not necessarily represent the views of the Department of Defense, Department of Veterans Affairs, or the United States Government. Support from the MSRC does not necessarily constitute or imply endorsement, sponsorship, or favoring of the study design, analysis, or recommendations.

Contributors

NAS developed the manuscript idea and wrote the majority of the manuscript, NPA conducted data analysis and wrote the results, MEO assisted with the introduction, SM wrote the method, NBS provided feedback on all drafts, TS collected the data and provided feedback on the manuscript. All authors reviewed and approve of the final draft of the manuscript for submission.

Conflict of interest

The authors have no other conflicts of interest to disclose.

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