



Suicidal ideation among recently returned veterans and its relationship to insomnia and depression



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ARTICLE INFO

Keywords:

Insomnia
Suicide
Veteran
Suicidal ideation
Military
Depression

ABSTRACT

Suicide is a significant public health problem associated with numerous health factors such as insomnia. Suicidal ideation is common among veterans, who often present with multiple comorbidities. The present study examined direct and indirect relationships among suicidal ideation, insomnia, depression, and alcohol use. U.S. veterans ($n = 850$) recently separated from military service completed phone-based interviews covering multiple domains. Tests of indirect effects and bias-corrected confidence intervals were used to conduct a cross-sectional analysis of baseline data from a larger parent study examining relationships among the latent variables of suicidal ideation, insomnia, alcohol use, and depression. In this analysis insomnia did not have direct associations with suicidal ideation ($B = 0.06$, $t = 0.29$, $p = .772$) or alcohol use ($B = 0.07$, $t = 1.73$, $p = .084$). Insomnia severity was, however, significantly and positively related to depression severity ($B = 0.58$, $t = 21.70$, $p < .001$). Additionally, more severe depression was associated with greater intensity of suicidal ideation ($B = 0.59$, $t = 3.64$, $p < .001$). Notably, insomnia's indirect effect on suicidal ideation was driven by depression. In this sample of returning veterans, insomnia appears to indirectly impact suicidal ideation through its relationship with depression. This finding suggests the potential utility of addressing insomnia as part of an overall approach to reducing depressive symptomatology and indirectly, suicidal ideation.

1. Introduction

Veterans returning from military service in Iraq and Afghanistan have reported experiencing a range of physical and mental health difficulties known to be associated with suicide such as substance use disorders and depression (Pietrzak et al., 2010) and die by suicide at a greater rate than the general population (Bruce, 2010). Insomnia has been observed to co-occur with a number of mental health disorders in veteran samples. Sleep is often negatively impacted by deployment due to myriad reasons including: irregular sleep schedules, shift work, exposure to trauma during sleep periods, and the use of stimulants to facilitate wakefulness (Bramoweth and Germain, 2013; Control and Prevention, 2012). Problems with sleep often remain unaddressed and persist as veterans transition to civilian life. Indeed, problems with sleep are among the most frequently reported presenting problems within VHA primary care (Jenkins et al., 2015; Troxel et al., 2015). In a psychological autopsy study of veteran, suicide decedents, the presence of a documented sleep problem in the medical record was significantly

associated with shorter time to death (Pigeon et al., 2012a).

With respect to insomnia specifically, a literature has emerged that suggests a significant, and direct, association between insomnia and suicidal ideation, attempts, and suicide (Bernert and Joiner, 2007; Pigeon et al., 2012b, 2016). Insomnia, however, is often identified as co-occurring with psychopathology often associated with suicidal ideation such as alcohol use disorder (Brower, 2015) and depression (Baglioni et al., 2011a). Thus, insomnia is also thought to indirectly contribute to the development and course of suicidal ideation through its influence on co-occurring psychopathology. For example, insomnia has been linked to new-onset major depression (Ford and Kamerow, 1989; Pigeon et al., 2017a), recurrence of depression (Perلمان et al., 2006), blunted response to treatments for depression (Baglioni et al., 2011b) and increased likelihood of relapse to alcohol (Brower, 2015). Untreated insomnia may reduce one's ability to effectively cope with stressors, increase a sense of loss of control or hopelessness, contribute to maladaptive responses to stress (e.g. alcohol consumption), increase frequency of negative life events, and decrease interpersonal

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<https://doi.org/10.1016/j.psychres.2019.05.019>

Received 19 November 2018; Received in revised form 9 May 2019; Accepted 10 May 2019

Available online 10 May 2019

0165-1781/ Published by Elsevier B.V.

functioning (Pigeon and Perlis, 2007). Therefore, the primary impact of insomnia on suicidal ideation may ultimately be best observed via the its association with co-occurring pathology and maladaptive health behaviors such as depression severity and alcohol consumption.

Treatment studies lend further support to the theory that insomnia may impact the presence and course of suicidal ideation. A small literature examining cognitive behavioral therapy for insomnia (CBT-I), for example, has demonstrated that reductions in insomnia severity are associated with reductions in suicidal ideation (Christensen et al., 2016; Manber et al., 2011; Pigeon et al., 2017b; Trockel et al., 2015). However, apart from Christensen et al., the remaining literature is limited in scope [i.e., single arm designs with clinic data (Manber et al., 2011; Trockel et al., 2015) or underpowered (Pigeon et al., 2017b)]. Relationships among insomnia, depression, and suicidal ideation warrant further examination, including investigations of whether the relationship between insomnia and suicidal ideation remains significant after accounting for key covariates known to be associated with suicide such as depression and alcohol use. Such studies will provide a greater understanding of the interplay between insomnia, depression, and suicide and may help refine the foci of future intervention studies.

Recent analyses by Bryan and colleagues (Bryan et al., 2015) examined relationships among insomnia, suicidal ideation, and co-occurring psychopathology among three military samples consisting of Air Force and Army services members receiving outpatient care and Army soldiers recently discharged from a psychiatric inpatient setting. They reported that in unadjusted analyses insomnia severity was associated with both current and prospective suicidal ideation across all three samples. In subsequent adjusted models, however, depression mediated the relationship between insomnia severity and suicidal ideation (Bryan et al., 2015).

The present project sought to expand on the extant literature in a few important ways. We utilized a sample of recently separated Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), and Operation New Dawn (OND); herein identified as OEF/OIF/OND veterans. The veterans included in the parent study were not necessarily treatment seeking and therefore may be more representative of the average OEF/OIF/OND veteran at separation. For the present analysis we (1) report the prevalence of insomnia and its association with suicidal ideation among a sample of recently returned service members and (2) examine whether depression severity or alcohol use impacted the relationship between insomnia severity and suicidal ideation.

2. Method

2.1. Procedure

Baseline interview data from the Survey of Experiences of Returning Veterans (SERV) study were utilized for the present analyses. The SERV study sought to examine gender differences in the expression of psychopathology and post-deployment experiences among OEF/OIF/OND veterans. Procedures used for SERV, including recruitment, are described in more detail elsewhere (Smith et al., 2014). To briefly summarize, participants were recruited via media, the internet, and word of mouth. Eligible participants completed a baseline interview which lasted approximately 60 min and was conducted over the telephone. Follow-up interviews were briefer in duration and scheduled to occur at 3, 6, 9, and 12 months, with optional follow-up interviews occurring every 6 months after year 1. In the current study we utilized the SERV baseline data to conduct a cross-sectional analysis of relationships among insomnia, depression, alcohol use, and suicidal ideation.

Individuals were eligible for participation if they: 1) were separated from military service during the previous 5 years, 2) did not anticipate re-deployment, 3) had served in as Iraq, Afghanistan, or surrounding waters, and 4) were willing to participate in phone-based interviews. Participants received \$40 for each completed interview. As SERV sought to explore potential gender differences, an attempt was made to

oversample female veterans.

2.2. Participants

This sample of OEF/OIF/OND veterans ($N = 850$) was predominantly White (75.7%), included a large number of female veterans (41%; $n = 347$), and had a mean age of 35.2 years. Data for 29 participants was incomplete (missing demographics) and not included in the analyses yielding a final sample of 821. As measured by the Insomnia Severity Index (ISI; Morin et al., 2011), Veterans in this sample endorsed elevated rates of insomnia [severe insomnia (14.7%; $n = 120$; score of 22 or more on the ISI), moderate insomnia (28.9%; $n = 237$; 15–21 on the ISI), subthreshold insomnia (19.9%; $n = 163$; 8–14 on the ISI), no clinically significant insomnia (36.5%; $n = 299$; less than 8 on the ISI). A substantial number of veterans reported current suicidal ideation (17.2%; $n = 141$) and suicide planning (1.7%; $n = 13$). A relatively large proportion of the overall sample reported a history of making a suicide attempt during their lifetime (6.2%; $n = 51$).

2.3. Measures

In addition to demographic information, the current study utilized four measures from the SERV study battery to create latent variables for insomnia, alcohol use, depression, and suicidal ideation. As outlined in MacCallum and Austin (2000), “...latent variables are hypothetical constructs that cannot be directly measured.”

2.3.1. Insomnia

Items used to make up the insomnia variable were derived from the Insomnia Severity Index (ISI; Morin et al., 2011): The ISI is a seven item, self-report measure with individual items rated 0–4 and total scores ranging from 0 to 28; the validated cutoff of ≥ 10 for clinically meaningful insomnia (Bastien et al., 2001) was used to help characterize the sample. For purposes of the present analysis, these seven items were individually entered into the model to create the latent insomnia variable (Cronbach's $\alpha = 0.93$ in the current sample).

2.3.2. Alcohol use

The items used for the alcohol use variable were originally included in the Alcohol Use and Associated Disabilities Interview Schedule (AUDADIS; Grant et al., 2015): The latent variable for alcohol use was comprised of three items from the AUDADIS ($\alpha = 0.75$). During the last 12-months, how often did you usually have any kind of drink containing alcohol [response option (weighting); everyday(10), 5–6 times a week (9), 3–4 times per week (8), twice a week (7), once a week (6), 2–3 times a month (5), once a month (4), 3–11 times in the past year (3), 1 or 2 times in the past year (2), I did not drink any alcohol in the past year, but I did drink in the past (1), I have never drank alcohol in my life (0)]? If respondents indicated that they have never consumed alcohol they were not asked the remaining questions regarding alcohol. During the last 12 months, how many alcoholic drinks did you have on a typical day when you drank alcohol [7 or more drinks (5), 5–6 drinks (4), 3–4 drinks (3), 2 drinks (2), 1 drink (1)]? During the last 12 months, how often did you have 5 or more (males) or 4 or more (females) drinks containing any kind of alcohol within a two-hour period [every day (7), 2–6 times a week (6), once a week (5), 2 to 3 times a month (4), once a month (3), 3–11 times in the past year (2), 1 or 2 times in the past year (1), never (0)]?

2.3.3. Depression

The Primary Care Evaluation of Mental Disorders (PRIME-MD) Depression Subscale (Spitzer et al., 1994) was used as the primary basis of the depression latent variable and consists of eleven dichotomous items that mirror criteria for a depressive episode. For the present analyses, the sleep item was not utilized in creating the latent depression variable ($\alpha = 0.93$).

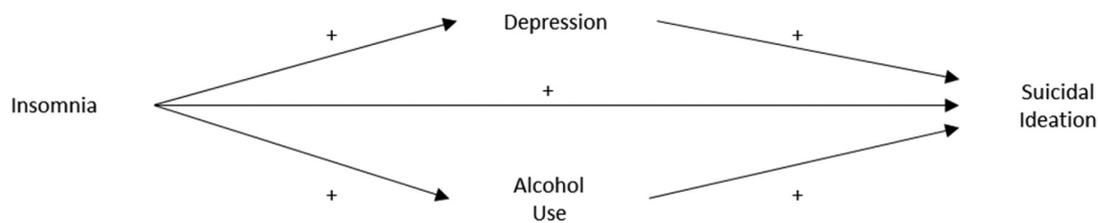


Fig. 1. Theoretical model being tested of insomnia effects on suicidal ideation.

2.3.4. Suicidal ideation

The latent construct for suicidal ideation was created using six items derived from the Columbia-Suicide Severity Rating Scale (C-SSRS; Posner et al., 2006). The C-SSRS is used in both clinical and research settings to measure suicidal ideation and assesses presence of ideation, planning, and intent. Participants were asked to respond to items using the framework of the prior three months and items were dichotomously scored (yes = 1, no = 0). Cronbach's α for the current sample was 0.78.

2.4. Analytic strategy

Fig. 1 presents the theoretical model that was tested. As noted in the figure, it was hypothesized that higher levels of insomnia symptoms would relate positively to suicidal ideation. Moreover, higher levels of insomnia symptoms were anticipated to coincide with both, higher levels of depression and alcohol use. Both depression and alcohol use were also hypothesized to relate positively to suicidal ideation. The bias corrected bootstrap confidence limit (Mackinnon et al., 2004) was used to test the significance of the proposed indirect effects (product of the structural paths). Significance of the indirect effect was assessed by whether or not the 95% confidence interval contained zero. The bias corrected bootstrap approach takes the non-normality of the multiplicative distribution into account (resulting in asymmetric confidence limits) and has been shown to provide the most accurate confidence limits and greatest statistical power when compared with other approaches for detecting effects (Mackinnon et al., 2004).

The proposed model includes four latent variables: suicidal ideation, depression, insomnia, and alcohol use. The dichotomous suicidal ideation and depressive symptomatology items were modeled as ordinal indicators using the delta parameterization method (Muthen and Asparouhov, 2002), which results in residual variances of the categorical indicators not being identified and are not part of the model. To provide a metric for the latent variables and to identify the measurement model, the first construct loading of each latent variable was set fixed at 1.0. The Mplus statistical software package (Muthen and Muthen, 2017), with probit estimates associated with the dichotomous indicators using a robust weighted least square approach to account for missing data (Asparouhov and Muthen, 2010), was used to test the proposed model. In the model, gender, race, ethnicity, and age effects were entered as important demographic covariates. Due to small cell sizes, race was collapsed into the following categories: White (74.9%; $n = 615$), other race (19%; $n = 156$; includes Black/African-American, 14.3%, $n = 110$; American Indian or Alaska Native, 2.3%, $n = 18$; Native Hawaiian or Other Pacific Islander, 1.0%, $n = 8$; or Asian, 2.6%, $n = 20$), and multi-race (6.1%, $n = 50$). In terms of ethnicity, 10.8% ($n = 83$) of the sample endorsed being Hispanic. The study oversampled female Veterans (41.1%, $n = 317$) and the average age of the sample was 35.2 years ($SD = 8.5$).

Goodness of fit of the model was assessed using the robust chi-square (Flora and Curran, 2004), as well as the root mean square error of approximation (RMSEA) (Browne and Cudeck, 1993) and the comparative fit index (CFI) (Bentler, 1990). Problems with the chi-square test of exact fit are well documented (Hu and Bentler, 1999) and include sensitivity to sample size, nonnormality of the data, and testing of trivial discrepancies between the model-implied covariance matrix and

the sample covariance matrix. For these reasons, we adopted the approximate fit indices above. To account for shared causal relations outside of those hypothesized within the model, the unique relations between depression and alcohol use were allowed to covary.

3. Results

Descriptive statistics and correlations for each of the study variables are presented in Table 1. Examination of Table 1 suggests a fairly high amount of endorsement of depressive symptomatology among the participants (except for the last item regarding doctor labeling, all of the remaining items were endorsed positively by least 30% of the sample). Not surprisingly, correlations among the items within each of the proposed latent constructs were moderate and more strongly related with each other than with items from other constructs. Similar to the doctor labelling with depression, the item assessing intent to carry out a plan also did not relate as strongly to the remaining suicidal ideation items (r 's range from 0.138 to 0.390) in contrast to the correlations among the remaining suicidal ideation items (r 's range from 0.366 to 0.688). Finally, correlations among the depression items and suicidal ideation items tended to be moderately correlated and most were highly significant ($p < .001$).

3.1. Measurement properties

In the model, the demographic covariates of gender, race, ethnicity, and age were treated as observed variables in the model. In terms of race, identifying as White was used as the reference group with other race and multi-race entered as covariates in the model. Table 2 presents results of the measurement parameters for the latent variables of insomnia, depression, alcohol use, and suicidal ideation. As noted in Table 2, the construct loadings for the latent variables were all reasonably high and all were highly significant (standardized loadings ranged from 0.49 to 0.98; $p \leq .001$). Though three loadings were marginal ("During the last 12 months, how often did you usually have any kind of drink containing alcohol?" [$b = 0.57$], "In the past month, did a doctor ever say that you were manic-depressive or bipolar or prescribe lithium or some other mood-stabilizing medication?" [$b = 0.60$]), and the suicidal ideation item "Do you intend to carry out this plan?" [$b = 0.49$]), we chose to include these items which resulted in all items from the original protocol being used as they were intended (we purposefully omitted the sleep item from the depression scale to avoid artificial overlap with the insomnia construct). In sum, these scale items provided reasonable estimates of their respective underlying latent variable.

3.2. Structural effects

Fig. 2 graphically presents the structural findings. As noted, the model explained 41% of the variance in the suicidal ideation latent variable. Though the chi-square was significant (χ^2 (408 df) = 954.73, $p < .001$), both the CFI (0.978) and RMSEA (0.040) indicate reasonable fit of the model to the data. Structurally, the model suggests that insomnia did not have a direct association with suicidal ideation ($\beta = 0.06$, $t = 0.29$, $p = .772$). nor did insomnia have an association

Table 1
Study means, standard deviations, and correlations.

		n	Mean	SD	Age	G.	R.1
Demographics							
G.	Age	821	35.23	8.852	1.00		
R.1	Gender (1 = female)	821	0.42	0.493	0.157***	1.00	
R.2	White (1 = white; reference group)	821	0.75	0.434	-0.113**	-0.122***	1.00
R.3	Other race (1 = Other race)	821	0.19	0.393	0.131***	0.115**	-0.837***
E.	Multi-race (1 = multi-race)	821	0.06	0.239	-0.010	0.033	-0.440***
Insomnia	Ethnicity (1 = Hispanic)	821	0.11	0.319	0.009	-0.055	-0.048
I.1	Please rate the SEVERITY of your sleep problems – difficulty falling asleep?	820	2.00	1.274	0.029	-0.030	-0.119***
I.2	Please rate the SEVERITY of your sleep problems – difficulty staying asleep?	819	2.02	1.267	0.059 ^b	-0.026	-0.133***
I.3	Please rate the SEVERITY of your sleep problems – problem waking up too early?	819	1.72	1.366	0.054	-0.084*	-0.182***
I.4	On a scale of 0 to 4, with 0 being very satisfied and 4 being very dissatisfied, how DISSATISFIED are you with your current sleep pattern?	819	2.55	1.245	0.066 ^b	-0.015	-0.127***
I.5	To what extent do you consider your sleep problems to INTERFERE with your daily functioning (e.g., daytime fatigue, ability to function at work/daily chores, concentration, memory, mood, etc.)?	819	1.56	1.543	0.077 ^b	-0.014	-0.162***
I.6	How NOTICEABLE to others do you think your sleeping problem is in terms of impairing the quality of your life?	819	1.16	1.353	0.032	-0.061 ^u	-0.158***
I.7	How WORRIED/distressed are you about your current sleep problems?	819	1.38	1.456	0.092**	-0.031	-0.162***
Depression							
D.1	In the past month, have you been bothered by little pleasure or interest in doing things?	820	0.50	0.500	0.064 ^b	-0.069*	-0.128***
D.2	In the past month, have you been bothered by feeling down, depressed, or hopeless?	819	0.52	0.500	0.011	-0.070**	-0.117***
D.3	In the past month, have you been feeling tired or having little energy nearly every day?	805	0.45	0.498	0.056	-0.029	-0.130***
D.4	In the past month, have you had a poor appetite or been overeating nearly every day?	805	0.36	0.480	0.068 ^b	-0.010	-0.131***
D.5	In the past month, have you had little interest or pleasure in doing things nearly every day?	805	0.39	0.488	0.035	-0.069 ^b	-0.121***
D.6	In the past month, have you been feeling down, depressed, or hopeless nearly every day?	805	0.35	0.477	0.014	-0.072*	-0.101***
D.7	In the past month, have you been feeling bad about yourself or that you are a failure or that you have let yourself or your family down nearly every day?	804	0.29	0.456	0.013	-0.063 ^b	-0.118***
D.8	In the past month, have you had trouble concentrating on things such as reading the newspaper or watching television nearly every day?	805	0.43	0.495	0.045	-0.021	-0.115***
D.9	In the past month, were you being so fidgety or restless that you were moving around a lot more than usual OR moving or speaking so slowly that other people could have noticed nearly every day?	804	0.34	0.473	0.015	-0.059 ^b	-0.055
D.10	In the past month, did a doctor ever say that you were manic-depressive or bipolar or prescribe lithium or some other mood-stabilizing medication?	804	0.10	0.303	0.002	-0.051	-0.014
Alcohol							
A.1	During the last 12 months, how often did you usually have any kind of drink containing alcohol?	820	4.35	2.665	-0.162***	-0.109**	0.185***
A.2	During the last 12 months, how many alcoholic drinks did you have on a typical day when you drank alcohol?	820	2.26	1.307	-0.279***	-0.199***	0.091**
A.3	During the last 12 months, how often did you have 5 or more (males) drinks or 4 or more (females) drinks containing any kind of alcohol within a two-hour period?	819	1.42	1.949	-0.239***	-0.235***	0.086*
Suicidal Ideation							
S.1	In the past 3 months, have you wished you were dead or wished you could go to sleep and not wake up?	820	0.15	0.357	0.057	-0.015	-0.103***
S.2	In the past 3 months, have you actually had any thoughts of killing yourself?	819	0.11	0.317	0.063 ^b	-0.006	-0.094**
S.3	In the past 3 months, have you been thinking about how you might do this?	783	0.06	0.235	0.076*	-0.025	-0.068 ^b
S.4	In the past 3 months, have you had these thoughts and had some intention of acting on them?	783	0.02	0.154	0.025	-0.050	0.015
S.5	In the past 3 months, have you started to work or worked out details of how to kill yourself?	782	0.02	0.128	-0.021	-0.029	-0.040
S.6	Do you intend to carry out this plan?	781	0.00	0.051	0.014	-0.043	0.029

(continued on next page)

Table 1 (continued)

	R.2	R.3	E.	I.1	I.2	I.3	I.4
Demographics							
Age							
Gender							
White (1 = white; reference group)							
Other race (1 = Other race)							
Multi-race (1 = multi-race)							
Ethnicity (1 = Hispanic)							
Insomnia							
I.1	1	0.084*	1				
I.2	-0.123***						
I.3	0.001						
I.4	0.102**	0.048	0.045	1			
I.5	0.118***	0.047	0.054	0.678***	1		
I.6	0.151***	0.082*	0.093*	0.478***	0.642***	1	
I.7	0.119***	0.034	0.071*	0.687***	0.690***	0.532***	1
I.8	0.156***	0.037	0.111**	0.627***	0.641***	0.508***	0.806***
I.9							
I.10							
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I.12							
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Table 1 (continued)

	I.5	I.6	I.7	D.1	D.2	D.3	D.4
I.3	Please rate the SEVERITY of your sleep problems – problem waking up too early?						
I.4	On a scale of 0 to 4, with 0 being very satisfied and 4 being very dissatisfied, how DISSATISFIED are you with your current sleep pattern?						
I.5	To what extent do you consider your sleep problems to INTERFERE with your daily functioning (e.g., daytime fatigue, ability to function at work/daily chores, concentration, memory, mood, etc.)?						
I.6	0.817***	1					
I.7	0.870***	0.787***	1				
Depression							
D.1	0.413***	0.387***	0.419***	1			
D.2	0.359***	0.322***	0.366***	0.627***	1		
D.3	0.498***	0.437***	0.458***	0.702***	0.698***	1	
D.4	0.460***	0.398***	0.435***	0.596***	0.571***	0.684***	1
D.5	0.443***	0.397***	0.425***	0.742***	0.592***	0.692***	0.617***
D.6	0.396***	0.347***	0.364***	0.584***	0.685***	0.650***	0.549***
D.7	0.376***	0.323***	0.368***	0.544***	0.539***	0.554***	0.528***
D.8	0.442***	0.405***	0.433***	0.673***	0.652***	0.686***	0.603***
D.9	0.421***	0.403***	0.410***	0.545***	0.559***	0.578***	0.573***
D.10	0.160***	0.164***	0.152***	0.281***	0.263***	0.254***	0.263***
Alcohol							
A.1	–0.076*	–0.080*	–0.057	–0.061 [†]	–0.019	–0.066 [†]	–0.077*
A.2	0.044	0.018	0.013	0.037	0.065 [†]	0.025	0.006
A.3	0.076*	0.087*	0.069*	0.075*	0.146***	0.076*	0.048
Suicidal Ideation							
S.1	0.241***	0.208***	0.210***	0.323***	0.347***	0.286***	0.279***
S.2	0.203***	0.177***	0.176***	0.265***	0.296***	0.245***	0.269***
S.3	0.185***	0.157***	0.173***	0.215***	0.216***	0.218***	0.217***
S.4	0.129***	0.130***	0.103***	0.163***	0.157***	0.162***	0.182***
S.5	0.104***	0.097***	0.085*	0.095***	0.130***	0.107***	0.116***
S.6	0.048	0.088*	0.057	0.053	0.051	0.006	0.070 [†]
Demographics							
G.							
R.1	Age						
R.2	Gender						
R.3	White (1 = white; reference group)						
E.	Other race (1 = Other race)						
Insomnia	Multi-race (1 = multi-race)						
I.1	Ethnicity (1 = Hispanic)						
I.2	Please rate the SEVERITY of your sleep problems – difficulty falling asleep?						
I.3	Please rate the SEVERITY of your sleep problems – difficulty staying asleep?						
I.4	Please rate the SEVERITY of your sleep problems – problem waking up too early?						
I.5	On a scale of 0 to 4, with 0 being very satisfied and 4 being very dissatisfied, how DISSATISFIED are you with your current sleep pattern?						
I.6	To what extent do you consider your sleep problems to INTERFERE with your daily functioning (e.g., daytime fatigue, ability to function at work/daily chores, concentration, memory, mood, etc.)?						
I.7	How WORRIED/distressed are you about your current sleep problems?						
D.1	In the past month, have you been bothered by little pleasure or interest in doing things?						
D.2	In the past month, have you been bothered by feeling down, depressed, or hopeless?						
D.3	In the past month, have you been feeling tired or having little energy nearly every day?						

(continued on next page)

Table 1 (continued)

	D.5	D.6	D.7	D.8	D.9	D.10	A.1
D.4	In the past month, have you had a poor appetite or been overeating nearly every day?						
D.5	In the past month, have you had little interest or pleasure in doing things nearly every day?	1					
D.6	In the past month, have you been feeling down, depressed, or hopeless nearly every day?	0.718***	1				
D.7	In the past month, have you been feeling bad about yourself or that you are a failure or that you have let yourself or your family down nearly every day?	0.606***	0.682***	1			
D.8	In the past month, have you had trouble concentrating on things such as reading the newspaper or watching television nearly every day?	0.666***	0.635***	0.604***	1		
D.9	In the past month, were you being so fidgety or restless that you were moving around a lot more than usual OR moving or speaking so slowly that other people could have noticed nearly every day?	0.518***	0.542***	0.503***	0.652***	1	
D.10	In the past month, did a doctor ever say that you were manic-depressive or bipolar or prescribe lithium or some other mood-stabilizing medication?	0.304***	0.297***	0.297***	0.248***	0.216***	1
Alcohol							
A.1	During the last 12 months, how often did you usually have any kind of drink containing alcohol?	-0.071*	-0.075*	-0.066 ^b	-0.068 ^b	-0.040	-0.070*
A.2	During the last 12 months, how many alcoholic drinks did you have on a typical day when you drank alcohol?	0.010	0.032	0.053	0.026	0.045	-0.054
A.3	During the last 12 months, how often did you have 5 or more (males) drinks or 4 or more (females) drinks containing any kind of alcohol within a two-hour period?	0.051	0.063 ^a	0.081*	0.066 ^a	0.069 ^a	0.020
Suicidal Ideation							
S.1	In the past 3 months, have you actually had any thoughts of killing yourself?	0.348***	0.370***	0.376***	0.310***	0.287***	0.169***
S.2	In the past 3 months, have you wished you were dead or wished you could go to sleep and not wake up?	0.306***	0.344***	0.326***	0.274***	0.222***	0.124***
S.3	In the past 3 months, have you been thinking about how you might do this?	0.245***	0.261***	0.256***	0.221***	0.164***	0.102**
S.4	In the past 3 months, have you had these thoughts and had some intention of acting on them?	0.205***	0.206***	0.179***	0.155***	0.122***	0.145***
S.5	In the past 3 months, have you started to work or worked out details of how to kill yourself?	0.127***	0.163***	0.165***	0.094**	0.103**	0.094**
S.6	Do you intend to carry out this plan?	0.066 ^b	0.072*	0.082*	0.061 ^b	0.074*	0.070 ^b
Demographics		A.2	A.3	S.1	S.2	S.3	S.4
Age							
Gender							
R.1	White (1 = white; reference group)						
R.2	Other race (1 = Other race)						
R.3	Multi-race (1 = multi-race)						
E.	Ethnicity (1 = Hispanic)						
Insomnia							
I.1	Please rate the SEVERITY of your sleep problems – difficulty falling asleep?						
I.2	Please rate the SEVERITY of your sleep problems – difficulty staying asleep?						
I.3	Please rate the SEVERITY of your sleep problems – problem waking up too early?						
I.4	On a scale of 0 to 4, with 0 being very satisfied and 4 being very dissatisfied, how DISSATISFIED are you with your current sleep pattern?						
I.5	To what extent do you consider your sleep problems to INTERFERE with your daily functioning (e.g., daytime fatigue, ability to function at work/daily chores, concentration, memory, mood, etc.)?						
I.6	How NOTICEABLE to others do you think your sleeping problem is in terms of impairing the quality of your life?						
I.7	How WORRIED/distressed are you about your current sleep problems?						
Depression							
D.1	In the past month, have you been bothered by little pleasure or interest in doing things?						
D.2	In the past month, have you been bothered by feeling down, depressed, or hopeless?						
D.3	In the past month, have you been feeling tired or having little energy nearly every day?						
D.4	In the past month, have you had a poor appetite or been overeating nearly every day?						
D.5	In the past month, have you had little interest or pleasure in doing things nearly every day?						
D.6	In the past month, have you been feeling down, depressed, or hopeless nearly every day?						
D.7	In the past month, have you been feeling bad about yourself or that you are a failure or that you have let yourself or your family down nearly every day?						
D.8	In the past month, have you had trouble concentrating on things such as reading the newspaper or watching television nearly every day?						
D.9	In the past month, were you being so fidgety or restless that you were moving around a lot more than usual OR moving or speaking so slowly that other people could have noticed nearly every day?						
D.10	In the past month, did a doctor ever say that you were manic-depressive or bipolar or prescribe lithium or some other mood-stabilizing medication?						
Alcohol							
A.1	During the last 12 months, how often did you usually have any kind of drink containing alcohol?						

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Table 1 (continued)

	A.2	A.3	S.1	S.2	S.3	S.4
A.2	During the last 12 months, how many alcoholic drinks did you have on a typical day when you drank alcohol?					
A.3	During the last 12 months, how often did you have 5 or more (males) drinks or 4 or more (females) drinks containing any kind of alcohol within a two-hour period?					
	1	0.609***	1			
Suicidal Ideation						
S.1	0.062 ^a	0.067 ^a	1			
S.2	0.067 ^a	0.055	0.657***	1		
S.3	0.039	0.016	0.638***	0.689***	1	
S.4	-0.018	-0.003	0.420***	0.435***	0.525***	1
S.5	0.029	0.015	0.370***	0.361***	0.478***	0.434***
S.6	-0.010	-0.010	0.145***	0.141***	0.205***	0.321***
				S.5	S.6	
Demographics						
G.	Age					
R.1	Gender					
R.2	White (1 = white; reference group)					
R.3	Other race (1 = Other race)					
E.	Multi-race (1 = multi-race)					
	Ethnicity (1 = Hispanic)					
I.1	Please rate the SEVERITY of your sleep problems – difficulty falling asleep?					
I.2	Please rate the SEVERITY of your sleep problems – difficulty staying asleep?					
I.3	Please rate the SEVERITY of your sleep problems – problem waking up too early?					
I.4	On a scale of 0 to 4, with 0 being very satisfied and 4 being very dissatisfied, how DISSATISFIED are you with your current sleep pattern?					
I.5	To what extent do you consider your sleep problems to INTERFERE with your daily functioning (e.g., daytime fatigue, ability to function at work/daily chores, concentration, memory, mood, etc.)?					
I.6	How NOTICEABLE to others do you think your sleeping problem is in terms of impairing the quality of your life?					
I.7	How WORRIED/distressed are you about your current sleep problems?					
Depression						
D.1	In the past month, have you been bothered by little pleasure or interest in doing things?					
D.2	In the past month, have you been bothered by feeling down, depressed, or hopeless?					
D.3	In the past month, have you been feeling tired or having little energy nearly every day?					
D.4	In the past month, have you had a poor appetite or been overeating nearly every day?					
D.5	In the past month, have you had little interest or pleasure in doing things nearly every day?					
D.6	In the past month, have you been feeling down, depressed, or hopeless nearly every day?					
D.7	In the past month, have you been feeling bad about yourself or that you are a failure or that you have let yourself or your family down nearly every day?					
D.8	In the past month, have you had trouble concentrating on things such as reading the newspaper or watching television nearly every day?					
D.9	In the past month, were you being so fidgety or restless that you were moving around a lot more than usual OR moving or speaking so slowly that other people could have noticed nearly every day?					
D.10	In the past month, did a doctor ever say that you were manic-depressive or bipolar or prescribe lithium or some other mood-stabilizing medication?					
Alcohol						
A.1	During the last 12 months, how often did you usually have any kind of drink containing alcohol?					
A.2	During the last 12 months, how many alcoholic drinks did you have on a typical day when you drank alcohol?					
A.3	During the last 12 months, how often did you have 5 or more (males) drinks or 4 or more (females) drinks containing any kind of alcohol within a two-hour period?					
Suicidal Ideation						
S.1	In the past 3 months, have you actually had any thoughts of killing yourself?					
S.2	In the past 3 months, have you wished you were dead or wished you could go to sleep and not wake up?					
S.3	In the past 3 months, have you been thinking about how you might do this?					
S.4	In the past 3 months, have you had these thoughts and had some intention of acting on them?					
S.5	In the past 3 months, have you started to work or worked out details of how to kill yourself?					
S.6	Do you intend to carry out this plan?					
				1	0.406***	1

Note:
 *** $p < .001$.
 ** $p < .01$.
 * $p < .05$.
 a < 0.10 .

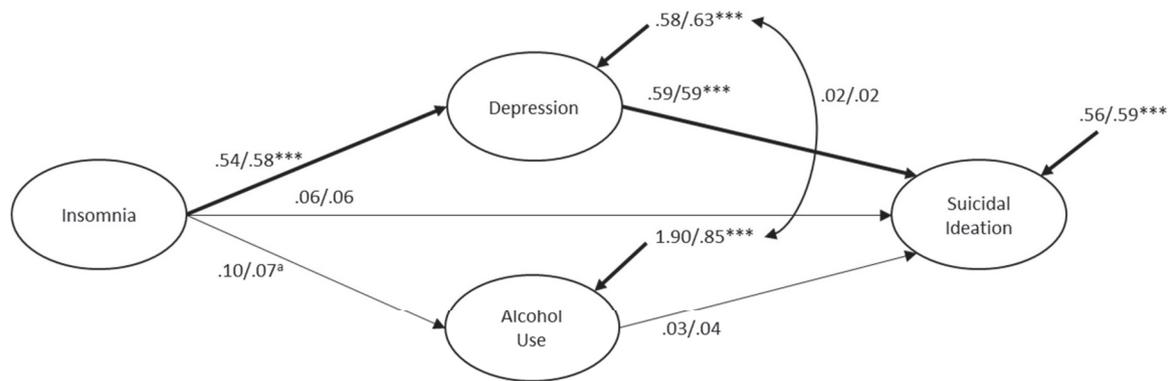
Table 2
Unstandardized measurement results from tested structural equation model (standardized results in parentheses).

	Construct loading	Depression	Alcohol	Suicidal ideation	Residual
<i>Insomnia</i>					
Please rate the SEVERITY of your sleep problems – difficulty falling asleep?	1.00 ^a (0.81)				0.55 (0.34)
Please rate the SEVERITY of your sleep problems – difficulty staying asleep?	.95 (0.77)				0.63 (0.40)
Please rate the SEVERITY of your sleep problems – problem waking up too early?	.80 (0.61)				1.10 (0.62)
On a scale of 0 to 4, with 0 being very satisfied and 4 being very dissatisfied, how DISSATISFIED are you with your current sleep pattern?	1.02 (0.85)				0.42 (0.28)
To what extent do you consider your sleep problems to INTERFERE with your daily functioning (e.g., daytime fatigue, ability to function at work/daily chores, concentration, memory, mood, etc.)?	1.30 (0.88)				0.52 (0.23)
How NOTICEABLE to others do you think your sleeping problem is in terms of impairing the quality of your life?	1.00 (0.77)				0.71 (0.41)
How WORRIED/distressed are you about your current sleep problems?	1.17 (0.84)				0.60 (0.29)
<i>Depression</i>					
In the past month, have you been bothered by little pleasure or interest in doing things? *		1.00 ^a (0.95)			– (–)
In the past month, have you been bothered by feeling down, depressed, or hopeless? *		1.01 (0.95)			– (–)
In the past month, have you been feeling tired or having little energy nearly every day? *		1.00 (0.95)			– (–)
In the past month, have you had a poor appetite or been overeating nearly every day? *		.94 (0.90)			– (–)
In the past month, have you had little interest or pleasure in doing things nearly every day? *		1.01 (0.96)			– (–)
In the past month, have you been feeling down, depressed, or hopeless nearly every day? *		1.01 (0.96)			– (–)
In the past month, have you been feeling bad about yourself or that you are a failure or that you have let yourself or your family down nearly every day? *		0.94 (0.89)			– (–)
In the past month, have you had trouble concentrating on things such as reading the newspaper or watching television nearly every day? *		0.99 (0.93)			– (–)
In the past month, were you being so fidgety or restless that you were moving around a lot more than usual OR moving or speaking so slowly that other people could have noticed nearly every day? *		0.91 (0.87)			– (–)
In the past month, did a doctor ever say that you were manic-depressive or bipolar or prescribe lithium or some other mood-stabilizing medication? *		0.63 (0.60)			– (–)
<i>Alcohol</i>					
During the last 12 months, how often did you usually have any kind of drink containing alcohol?			1.00 ^a (0.57)		4.76 (0.68)
During the last 12 months, how many alcoholic drinks did you have on a typical day when you drank alcohol?			0.67 (0.78)		0.66 (0.40)
During the last 12 months, how often did you have 5 or more (males) or 4 or more (females) drinks containing any kind of alcohol within a two-hour period?			1.17 (0.89)		0.78 (0.20)
<i>Suicidal Ideation</i>					
In the past 3 months, have you actually had any thoughts of killing yourself? *				1.00 ^a (0.96)	– (–)
In the past 3 months, have you wished you were dead or wished you could go to sleep and not wake up? *				1.00 (0.96)	– (–)
In the past 3 months, have you been thinking about how you might do this? *				1.02 (0.98)	– (–)
In the past 3 months, have you had these thoughts and had some intention of acting on them? *				1.02 (0.98)	– (–)
In the past 3 months, have you started to work or worked out details of how to kill yourself? *				0.94 (0.90)	– (–)
Do you intend to carry out this plan? *				0.51 (0.49)	– (–)

Note:

* Yes/No dichotomous items.

^a Fixed at 1 to establish metric for the construct; all parameters shown significant at $p \leq .001$.



$\chi^2_{(408 \text{ df})} = 954.73, p < .001$
 RMSEA = .040; 90% CI [.037, .044]
 CFI = .978

Note: *** $p < .001$; ** $p < .01$; * $p < .05$; ^a $p < .10$.

Fig. 2. Structural results of tested model (unstandardized estimate/standardized estimate). Significant paths are bolded. Demographic effects omitted for clarity. Note: *** $p < .001$; ** $p < .01$; * $p < .05$; ^a $p < .10$.

with alcohol use ($\beta = 0.07, t = 1.73, p = .084$). Insomnia did, however, have a positive association with depression ($\beta = 0.58, t = 21.70, p < .001$); as insomnia severity increased, depression increased. Further, depression was positively associated with suicidal ideation ($\beta = 0.59, t = 3.64, p < .001$); as depression increased, suicidal ideation increased. The specific indirect effect of insomnia on suicidal ideation being impacted by depression was significant (standardized insomnia indirect effect via depression = 0.337, 95% BCCI [0.137, 0.501]). Alcohol use was not related to suicidal ideation ($\beta = 0.04, t = 0.48, p = .631$) and, not surprisingly, the specific indirect effect of alcohol use on the insomnia-suicidal relationship was also not significant (standardized insomnia indirect effect via alcohol use = 0.003, 95% BCCI [-0.008, 0.020]). While the total effect of insomnia on suicidal ideation was significant (standardized total effect of insomnia on suicidal ideation = 0.401, 95% BCCI [0.168, 0.664]), 85% (0.340/0.401) of this effect was due to the indirect relationship.

3.3. Demographic effects

None of the demographic variables had a direct effect on suicidal ideation. However, age ($\beta = -0.27, t = -7.41, p < .001$), gender ($\beta = -0.19, t = -5.27, p < .001$), and endorsing other race ($\beta = -0.09, t = -2.06, p = .040$) had significant associations with alcohol use; as age increased, alcohol use decreased and females reported less alcohol use than did males and participants from other races reported less use than did participants who were White. In terms of depression, gender ($\beta = -0.09, t = -2.38, p = .017$), Hispanic ethnicity ($\beta = 0.09, t = 2.38, p = .017$), and other race ($\beta = 0.15, t = 3.92, p < .001$) each had an association with depression with females reporting less depression and Hispanics and those endorsing other race reporting higher levels of depression. Being multi-race was not significantly associated with insomnia, depression, alcohol use, or suicidal ideation.

4. Discussion

We utilized cross-sectional survey data gathered from OEF/OIF/OND veterans to examine relationships among insomnia, depression, alcohol use, and suicidal ideation. Of particular interest were the effects

of depression and alcohol use on the insomnia-suicidal ideation link. Here, insomnia was positively associated with depression – as insomnia severity increased, depression increased. However, insomnia was neither directly associated with suicidal ideation nor alcohol use. An indirect relationship between insomnia and suicidal ideation was present and positively impacted by depression. These findings are in line with previous research reporting that depression plays a significant role in the relationship between insomnia and suicidal ideation among currently serving military service members (Bryan et al., 2015). In contrast to that work, this analysis was conducted within a sample of lower risk veterans (i.e., not an entirely clinical sample).

Ultimately, the direct relationship between insomnia and suicidal ideation was not statistically significant. One potential explanation lies in the strength of depression as a predictor of suicidal ideation. Depression has long been considered one of the major drivers of suicidal ideation and suicide risk. Thus, it is not wholly surprising that depression would be directly related to suicidal ideation in the present sample and that it would influence the effect of any number of covariates, including insomnia. Further, it stands to reason that covariates that may influence the development, course, or severity of depression, such as insomnia, would also have an indirect effect on suicidal ideation. For example, it may be that the cognitive and emotional functioning decrements associated with insomnia (e.g., impaired frontal lobe functioning; increased impulsivity) are not directly related to suicidal ideation, but rather contributes to ideation through increased severity of depression. Further, the nature of the data did not allow for more specific analyses of temporal relationships between insomnia and suicidal ideation. For example, a recent study by Littlewood et al. (2018) suggests a relationship between prior night sleep duration and next day suicidal ideation.

While the mechanism or mechanisms by which insomnia impacts suicidal ideation remains to be empirically established, sleep may prove to be an important, upstream factor for addressing a range of psychopathology associated with suicide. Sleep represents a treatment target that is potentially lower in stigma than directly targeting depression or suicidal ideation. Therefore, veterans may be more likely to engage in treatment for sleep, as it can be framed as a physical or overall health concern. This also makes the screening and treatment of insomnia potential segues to discussing or screening for other mental health

concerns. In addition, some research has shown that sleep may be related to the course of treatment of other disorders. For example, presence of untreated insomnia has been associated with both blunted response to treatments for depression (Baglioni et al., 2011b; Pigeon et al., 2008) and increased likelihood of relapse to alcohol (Brower, 2015).

We also hypothesized that alcohol use would impact the relationship between insomnia and suicidal ideation. In this sample of recently returning veterans, however, alcohol use had neither direct or indirect associations with suicidal ideation. Further, alcohol use was not directly associated with insomnia in this sample. There are several possible reasons for the failure to observe this relationship. In these analyses, depression, as is the case with much of the literature that examines suicide, accounted for a significant portion of the variance associated with suicidal ideation, making it more difficult to observe significant relationships among alcohol use and other covariates. Thus, it may be that the study was simply underpowered to observe such an effect. Regarding the alcohol use variable itself, it is important to note that as measured in this protocol, alcohol use does not necessarily correspond to constructs that have in the past been linked to suicide attempts such as the presence of an alcohol use disorder (Nock et al., 2010) and the acute use of alcohol (Kaplan et al., 2013). An individual's global alcohol use patterns over the course of a given year may not be as significant a factor in the development and course of suicidal ideation than the acute use of alcohol or the presence of an alcohol use disorder. Lastly, findings are also likely to differ when examining suicidal ideation as an outcome versus suicide attempt.

There are several limitations to the present analysis that should be acknowledged and that may provide guidance for future analyses. First, the data used for the present manuscript was cross-sectional in nature, limiting any causal interpretations. Second, while it is unlikely that this impacted the analyses in significant ways, participants self-selected in response to advertisements to participate in research. Third, the present analysis was limited to an examination of suicidal ideation. While suicidal ideation is a risk factor and an important clinical indicator for suicide, research using suicide attempt and suicide as outcome variables would enhance the clinical utility of the findings. Fourth, the generalizability of the findings is somewhat limited to military/veteran populations, as the sample is exclusively comprised of recently separated veterans. Lastly, a more complete model would have included other established risk factors for suicide. The model that we tested, however, was not intended to be inclusive of all potential risk factors for suicide, but rather sought to serve as a provisional examination of the relationship between insomnia, depression, alcohol use, and suicidal ideation.

The findings and supporting literature suggest multiple future directions for inquiry. First and foremost, future studies would contribute to the field by using longitudinal methodology to examine relationships among insomnia and suicidal ideation. Examinations of how insomnia and suicidal ideation covary over time would greatly enhance our understandings of how insomnia may contribute to the clinical course of suicide. However, both insomnia and suicidal ideation can be highly variable in their frequency and intensity and we should interpret self-report measures that use long time periods (e.g., monthly) to characterize either phenomena with caution. Thus, an additional advance would be to leverage ecological momentary assessment methodology to examine these relationships on a daily basis as a research team from the United Kingdom has recently done (Littlewood et al., 2018). An additional area of future inquiry should be to examine the relationship between other sleep disorders and suicide. Some work now suggests that obstructive sleep apnea, for example, while etiologically distinct from insomnia, may be associated with suicidal ideation (Bishop et al., 2017).

Beyond research, these findings also have potential clinical implications. The findings of multiple studies support the treatment of insomnia as part of an overall strategy to reduce psychopathology (e.g.,

depression severity), and indirectly, suicide risk (Christensen et al., 2016; Manber et al., 2011; Pigeon et al., 2017b; Trockel et al., 2015). Further, the literature suggests that changes in sleep, such as new onset insomnia (Pigeon et al., 2017a), should be considered as an early warning sign and warrants further clinical assessment.

In conclusion, among this sample of returning veterans, insomnia appears to indirectly impact suicidal ideation through its relationship with depression. This finding suggests the potential utility of addressing insomnia as part of an overall approach to reducing depressive symptomatology and indirectly, suicidal ideation.

Study sites

VISN 1 MIRECC, VA Connecticut Healthcare System; VISN 2 Center of Excellence for Suicide Prevention, Canandaigua VA Medical Center.

Funding

This study was funded by Department of Veterans Affairs, Clinical Science Research & Development grant ZDA-01 (Hoff). This work was also supported, in part, by the VA Advanced Fellowship Program in Mental Health Illness Research and Treatment (Bishop), and the VISN 2 Center of Excellence for Suicide Prevention at the Canandaigua VA Medical Center, Canandaigua, NY (Bishop & Pigeon).

Conflict of interest

The authors do not have any conflicts of interest to report.

Disclaimer

The authors' views or opinions do not necessarily represent those of the Department of Veterans Affairs or the United States Government.

Acknowledgments

This study was funded by Department of Veterans Affairs, Clinical Science Research & Development grant ZDA-01 (PI: Hoff) and supported by the U.S. Department of Veterans Affairs' Center of Excellence for Suicide Prevention. The content does not necessarily represent the views of the U.S. Department of Veterans Affairs or the United States Government. The authors would like to acknowledge the support of Constance Cass, M.S. in the completion project SERV.

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