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Traumatic Brain Injury, Sleep Quality, and Suicidal Ideation in Iraq/Afghanistan-Era Veterans

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Abstract

The objective of this study was to test the hypothesis that sleep quality mediates the association between traumatic brain injury (TBI) history and current suicidal ideation. Measures of TBI history, sleep quality, and suicidal ideation were administered to 130 Iraq/Afghanistan veterans. As expected, sleep quality mediated the effect of TBI history on current suicidal ideation (indirect effect = .0082, 95% CI: 0.0019–0.0196), such that history of TBI was associated with worse sleep quality, which was, in turn, associated with increased suicidal ideation. These findings highlight the importance of assessing TBI history and sleep quality during suicide risk assessments for veterans.

Keywords

sleep; suicide; traumatic brain injury; veterans

Veterans are at increased risk for suicide attempts and death by suicide (e.g., Bullman & Kang, 1994; Department of Veterans Affairs, 2013; Kaplan, Huguet, McFarland, &

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Newsom, 2007; Kimbrel et al., 2014). One of the strongest and most proximal risk factors for death by suicide is suicidal ideation (Angst, Stassen, Clayton, & Angst, 2002; Schneider, Philipp, & Muller, 2001). Thus, it is logical to study suicidal ideation in order to elucidate risk factors for suicide. In addition, posttraumatic stress disorder (PTSD), major depressive disorder (MDD), problematic alcohol use, psychosocial problems, low resilience, low social support, and traumatic brain injury (TBI; Angst et al., 2002; Jakupcak et al., 2009; Kimbrel et al., 2014; Pietrzak et al., 2010; Brenner, Ignacio, & Blow, 2011; Lemaire & Graham, 2011) have all been implicated as potential risk factors for suicidal ideation. TBI is of particular relevance to the Iraq and Afghanistan veteran population, as changes in warfare tactics have resulted in frequent improvised explosive device attacks and a greater number of TBIs among Iraq/Afghanistan veterans compared to rates from previous conflicts (Hoge et al., 2008). Indeed, prior research suggests that the rates of TBI among military personnel returning from Iraq and Afghanistan range from 15% to 75% (Hoge et al., 2008; Terrio et al., 2009; Morissette et al., 2011).

There is a substantial literature indicating that a history of TBI is associated with higher risk for suicidal ideation, attempts, and death by suicide (Bahraini, Simpson, Brenner, Hoffberg, & Schneider, 2013; Bryan & Clemans, 2013; Teasdale, & Engberg, 2001; Jorge et al., 1993; Kishi, Robinson, & Kosier, 2001; Anstey et al., 2004; Silver, Kramer, Greenwald, & Weissman, 2001; Simpson & Tate, 2007; Wall, 2012). For example, Anstey et al. (2004) conducted a study to determine whether self-reported TBI was associated with current suicidal ideation in a community sample of individuals ages 20 through 60. They found that history of TBI was associated with increased depression, anxiety, and suicidal ideation and that these effects persisted for decades (Anstey et al., 2004). Clinically significant levels of suicidal ideation have been identified in over 20% of individuals with a history of TBI (Simpson & Tate, 2007). Suicide rates among individuals with a history of head injury are three to four times higher when compared to individuals without a prior history of head injury (Simpson & Tate, 2007).

In addition to higher suicide risk, those who have sustained a TBI may also experience long-term post-concussive symptoms, including memory problems, ringing in the ears, balance problems or dizziness, irritability, headaches, and sleep problems (Hoge et al., 2008; Terrio et al., 2009; Morissette et al., 2011). Sleep problems are the most commonly reported somatic complaint following a TBI and can complicate or delay recovery from TBI (Zeitler, Friedman, & O'Hara, 2009). Among civilian populations, reported rates of sleep disturbances following TBI range from 30% to 80% (Fichtenberg, Zafontes, Putnam, Mann, & Millard, 2002; Ouellet, Beaulieu-Bonneau, & Morin, 2006; Zeitler et al., 2009). Half of Iraq/Afghanistan combat veterans who experienced a TBI also reported sleep disturbances, with rates of insomnia increasing with the number of TBIs sustained (Hoge et al., 2008).

TBI is also associated with commonly-occurring disorders such as PTSD and depression, each of which is characterized by sleep problems. Sleep disturbance increases difficulty regulating mood in individuals diagnosed with a mood disorder, and is, in and of itself, a significant predictor of suicidal ideation (SI) and suicide attempts (Singareddy, & Balon, 2001; Cukrowicz, et al., 2006). In a broad review of the literature Taylor, Lichstein, and Durrence (2003) demonstrated that insomnia related to psychological disorders, such as

depression and anxiety, predicted suicidal ideation, intent, and suicide attempts at follow-up across studies. Similarly, in a sample of veterans who died by suicide, a chart review revealed that individuals with sleep disturbances were more likely to complete suicide sooner following their last VA appointment than those without sleep disturbances (Pigeon, Britton, Ilgen, Chapman, & Conner, 2012).

Objectives and Hypothesis

In sum, prior research suggests that (1) TBI is associated with poor sleep, as well as increased risk for suicidal attempts; and that (2) sleep quality (regardless of origin) also increases risk for suicidal attempts. To date, however, no study has examined if sleep quality mediates the effect of TBI history on suicidal ideation among veterans. The aim of the current study was to address this gap in the literature by testing the hypothesis that sleep quality mediates the association between TBI history and current suicidal ideation in Iraq/Afghanistan veterans.

Methods

Participants

One hundred and forty-five Iraq/Afghanistan veterans within the Central Texas Veterans Health Care System (CTVHCS) were recruited to participate in a larger study that assessed warzone experiences and post-deployment functioning. CTVHCS Institutional Review Board approved all study procedures. Recruitment was conducted through (a) advertisements at veteran's service organizations and other recruitment sites; (b) in-service presentations to VA staff in areas such as OEF/OIF programs, mental health and primary care; and (c) recruitment letters mailed to veterans enrolled in the CTVHCS. Based on eligibility criteria listed below, 15 participants were deemed ineligible (7 unable to complete the assessment, 6 bipolar disorder, 2 psychosis). Thus, only the data from the 130 eligible participants were analyzed.

Participants were eligible if they (a) had served in Iraq or Afghanistan after September 11, 2001; (b) were able to provide informed consent; (c) were on psychiatric medication or receiving psychotherapy, deemed stable on medication or in psychotherapy; and (d) able to complete all assessment procedures. Participants were excluded if: (a) they had a diagnosis of bipolar or psychotic disorder; (b) they could not complete the assessment; (c) were moving out of state within the next four months; or (d) were experiencing suicidal/homicidal intent or plan at a level of warranting immediate crisis intervention.

Measures

Inclusion/exclusion criteria—The Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) is a clinician-administered diagnostic assessment for Axis I disorders that was used to screen participants for bipolar and psychotic disorders (exclusion criteria).

Demographic Information—Demographic information collected included age, gender, race, ethnicity, relationship status, education, employment, income, and military service.

Traumatic Brain Injury and Postconcussive Symptoms—The Defense and Veterans Brain Injury Center Brief Traumatic Brain Injury Screening Tool (BTBIS) was designed to identify service members who may need evaluation for mild traumatic brain injuries. The BTBIS is a 3-item measure that was administered by a clinical assessor to assess whether the veteran experienced any head injuries during his/her deployment, if those injuries resulted in any immediate symptoms, and if those injuries resulted in any post-concussive symptoms (Schwab, et al., 2007). The TBI screen was considered positive if the Veteran indicated that they had experienced a head injury which resulted in altered consciousness (dazed, confused, seeing stars, or disoriented), loss of consciousness, or posttraumatic amnesia). This measure has good construct and concurrent validity (Schwab et al., 2006; Schwab et al., 2007; Ivins, Kane, & Schwab, 2009). A history of TBI during deployment (yes or no) was the variable used in the analyses.

Sleep Quality—Sleep quality was assessed with the Pittsburgh Sleep Quality Index (PSQI), which is an 19-item self-report instrument designed to measure sleep quality and disturbances over a one-month period in clinical populations (Buysee, Reynolds, Monk, Berman, Kupfer, 1988). Respondents are asked to rate sleep duration, latency, and efficiency by answering questions about their average sleep habits for the past month. Sleep medication use, daytime dysfunction due to fatigue and sleep quality are rated on a 4-point scale ranging from 0 (have not had trouble in the past month) to 3 (have had trouble 3 or more times a week). The sum of the seven subscores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction, yield the participant's total score, with higher scores indicating greater sleep dysfunction. The total score was used in all subsequent analyses. Norms for the PSQI are as follows: healthy controls: $M = 2.67$ ($SD = 1.70$), Major Depressive Disorder: $M = 11.09$ ($SD = 4.31$), Disorders of Initiating and Maintaining Sleep: $M = 10.38$ ($SD = 4.57$), Disorders of Excessive Somnolence: $M = 6.53$ ($SD = 2.98$; Buysee, et al., 1988). The instrument demonstrates both good test-retest reliability and validity (Buysee, et al., 1988). Internal consistency using Cronbach's alpha was .81 in the current study.

Suicidal Ideation—The Beck Scale for Suicide Ideation (BSS) is a 19-item self-report measure of thoughts, behaviors and plans to commit suicide during the past week (Beck, Steer & Ranieri 1988; Beck & Steer, 1991; Steer, Kumar & Beck, 1993). Participants rate items on a 3-point, Likert-type scale ranging from 0 (least severe or low suicidal intensity) to 2 (most severe or high suicidal intensity). The internal consistency, test-retest reliability, and concurrent validity have all been established (Beck & Steer, 1991; Steer, Kumar & Beck, 1993; Beck, Steer & Ranieri 1988). The internal consistency in this study was 0.91.

Procedures

This study is a secondary analysis of a larger longitudinal study of Iraq/Afghanistan veterans. Participants were screened by telephone to determine initial eligibility prior to scheduling their first visit. After completing the informed consent process, veterans completed a baseline assessment during which final eligibility was confirmed. The assessment was completed by trained Master's level assessors under the supervision of licensed clinical psychologists.

Data Analytic Plan

To test the main hypothesis, that overall sleep quality on the PSQI would mediate the association between a history of TBI during deployment, as measured by the BTBIS, and current suicidal ideation measured on the BSS, data was analyzed with Preacher and Hayes' (2008) method of mediation with bootstrapping. This analysis employs non-parametric bootstrapping, which yields an approximate sampling distribution. This procedure gives both point estimates and 95% confidence intervals for the indirect effects. In bootstrapping mediational analyses, the model is significant if zero does not fall in the 95% bias corrected and accelerated confidence intervals for the indirect effect (Hayes, 2013; Preacher & Hayes, 2004; Preacher et al., 2007). The analysis was based on 1000 bootstrapped samples. Age, gender, and education were chosen as covariates in the model due to differences in these factors in terms of suicide outcomes (Curtin, Warner, & Hedegaard, 2016; Pompili et al., 2013).

Results

Sample characteristics

The mean age of the 130 eligible participants was 38.0 years ($SD = 10.76$ years). Participants were primarily Caucasian (63.4%) and male (84.6%). In terms of race, 17.9% identified as African-American, 3.9% as Asian-American, 0.8% as Hawaiian/Pacific Islander, and 8.9% as "Other" (categories were not mutually exclusive). Twenty-six percent of the sample identified as Hispanic. The mean education level in the sample was 14.1 years ($SD = 2.5$ years). The majority of the participants served in the Army (82.3%), while 8.6% served in the Marine Corps, 6.3% served in the Navy, and 4.7% served in the Air Force (categories were not mutually exclusive).

Traumatic Brain Injury

Nearly half ($n = 59$; 46.1%) of the 130 veterans reported experiencing at least one TBI during their deployment. Of these, 42 (71.2%) were due to a blast exposure, 28 (47.5%) were due to a vehicular accident, 24 (40.7%) were due to a fall, 8 (13.6%) were due to a fragment, 7 (11.9%) were due to an incident not listed, and 4 (6.8%) were due to a bullet (categories not mutually exclusive).

Sleep

Over the entire sample, the mean of the PSQI total score was 10.38 ($SD = 5.20$). Among veterans with a positive TBI history, the mean PSQI total score mean was 12.12 ($SD = 4.91$) and in those without a history of TBI the PSQI total score was $M = 9.29$ ($SD = 4.96$).

Suicidal Ideation

A significant minority of all veterans ($n = 24$, 18.5%) endorsed experiencing suicidal ideation in the past two weeks. Almost half ($n = 59$, 46.1%) sustained a TBI during deployment. Of those who sustained a TBI, 11 (18.6%) reported suicidal ideation in the past two weeks. The mean score of the BSS in the total sample was 1.16 ($SD = 3.57$) and total scores ranged from 0 to 21. Among the TBI group the average BSS score was $M = 1.23$ (SD

= 3.47), and in those without a history of TBI it was $M = 1.17$ ($SD = 3.84$). Within individuals with a history of TBI who experienced suicidal ideation in the past two weeks the mean was 5.75 ($SD = 5.66$). The BSS data were skewed and kurtotic; therefore, log transformation was used to reduce both skew and kurtosis. A small amount of data on the BSS was missing (2.9%), which was resolved by substituting the individual's mean item score for the missing data.

Mediation Analyses

Nonparametric bootstrapping was used to test the proposed mediational model of poor sleep quality as a mediator between a history of TBI and current suicidal ideation. Demographic variables of gender, age, and education were put in the model as covariates. Results revealed the total direct effect of TBI on suicidal ideation was not significant (direct effect = -.0056, $SE = .0126$, $p = .67$; see figure 1). Demographic factors were not significant in the model, gender: point estimate (PE) = .0017, $SE = .0170$, $p = .92$, age: $PE = -.0009$, $SE = .0006$, $p = .14$, and education: $PE = .0006$, $SE = .0026$, $p = .83$. The direct effect of TBI on sleep was $PE = .46$, $SE = .14$, $p = .0014$, and the direct effect of sleep on suicidal ideation was $PE = .0232$, $SE = .0098$, $p = .0201$. Sleep quality mediated the association between a history of TBI and current suicidal ideation (indirect effect = .0082, $SE = .0055$, 95% CI: .0019, .0196), such that those with a history of TBI were more likely to experience poor sleep quality, which was, in turn, associated with increased suicidal ideation during the past two weeks. Since the 95% confidence interval did not contain zero, the indirect effect can be interpreted as significantly different from zero at $p < .05$.

Discussion

TBI frequently occurred during the conflicts in Iraq and Afghanistan. Results of the current study indicated that a history of TBI was associated with poor sleep quality, which was, in turn, associated with increased risk for current suicidal ideation. This study adds to the literature by examining a modifiable predictor of suicidal ideation (i.e., sleep quality) that may help to explain the previously reported association between TBI and suicidal ideation.

TBI indirectly influenced suicidal ideation through its impact on sleep quality. This finding is in contrast to the existing literature supporting a direct association between TBI and current suicidal ideation. Possible reasons for this discrepancy could be the way in which TBI, sleep, and suicidal ideation were measured across studies, as there can be variation in the operationalization and assessment of TBI (e.g., McCrea et al., 2008; Tate et al., 2013), sleep (e.g., Rosipal et al., 2013; Troxel et al., 2010), and suicidal ideation (e.g., Batterham et al., 2015). For example, the current study only assessed deployment-related TBI and not lifetime TBI. It is possible that cumulative head trauma, not just head trauma experienced during deployment, contributes to overall suicidal ideation. Further, suicidal ideation was only assessed during the past two weeks. Therefore, given the episodic nature of suicidal ideation, we could have missed relatively recent ideation. However, given the often proximal relationship between suicidal ideation and attempts, the impact of sleep disturbances on past-two-week ideation is important. Thus, clinicians should assess for both TBI history and ongoing sleep quality problems during suicide risk assessments. As is typical in VA systems,

if veterans indicate they are experiencing suicidal ideation or a recent attempt, suicide safety planning should be initiated immediately (Brenner et al., 2009). However, our data suggest that attention should also be paid to mitigating post-concussive sleep problems. Recently, VA rolled out the implementation of cognitive-behavioral therapy for insomnia, which may be a good treatment option to address sleep quality issues associated with TBI, and which could, in turn, reduce suicidal ideation (Karlin, Trockel, Taylor, Gimeno, & Manber, 2013; Trockel, Karlin, Taylor, Brown & Manber, 2015; Weber, Webb & Killgore, 2013). Further research is needed to determine if this therapy could be a successful suicide prevention tool.

In addition to psychotherapeutic interventions, it is common for physicians to prescribe sleeping medication to individuals who are experiencing sleep disturbances. In a six-year period there were nearly 100 million outpatient visits in the United States for sleep disturbance related reasons. Sixty three percent of those patient visits resulted in a prescription for sleep medication (Balkrishnan, Rafia, & Rajagopalan, 2005). However, prescription sleep medication use has also been found to be positively associated with SI and suicide attempts (Brower, McCammon, Wojnar, & Valenstein, 2011). Thus, it is imperative for psychologists, psychiatrists, and other care providers to work in close contact to ensure that these individuals who suffer from TBI and sleep problems are prescribed medications that alleviate these issues, while also balancing safety issues inherent in medications that may be used in a suicide attempt. This is particularly relevant in the context of the current data in which sleep problems were associated with current suicidal ideation.

Another area that should be considered in the design of a treatment plan is the presence of any comorbid psychiatric conditions. TBI is strongly associated with subsequent mood and anxiety disorders that persist over time (Scholten, Haagsma, Cnossen, Olff, van Beeck, & Polinder, 2016; van Reekum, Cohen, & Wong, 2000). Long-term disability associated with TBI is largely attributed to psychiatric conditions, such as depression (Rapoport, 2010). This in turn may increase risk for suicide. A challenge in the treatment of comorbid psychiatric conditions is the fact that individuals with TBI may not be aware of changes in their behavior (Mathias & Wheaton, 2007). Additionally, they may lack motivation to change (Starkstein & Pahissa, 2014).

While this study had several strengths, including an adequate sample size and the use of validated measures to assess suicidal ideation, traumatic brain injury, and sleep quality, several limitations should be noted. First, the data collected in this study were cross-sectional. Future research should use longitudinal methods to determine if these findings hold over time as well as explore the possible bidirectional relationship of sleep quality and suicidal ideation. Second, the present findings relied on self-report to assess key constructs (e.g., sleep quality, suicidal ideation). Third, the sample was comprised of a convenience sample of Iraq/Afghanistan-era veterans. Thus, the extent to which these findings might generalize to civilians and veterans from other war eras is unclear. Despite these limitations, the findings from the present research suggest that TBI may indirectly influence suicidal ideation through its impact on sleep quality; however, additional research aimed at replicating and extending these findings in other populations is still needed.

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Figure 1.
Mediational Model of Sleep Quality as a Mediator of the Association between Traumatic Brain Injury and Suicidal Ideation

$*p < .05$, $**p < .01$