Research shows that posttraumatic stress disorder (PTSD) and mild traumatic brain injury (mTBI) independently increase suicide risk; however, scant research has investigated whether mTBI increases suicide risk above and beyond the risk associated with PTSD alone. Design: The current research compared suicide risk factors among a matched sample of Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) military personnel and veterans with PTSD alone or PTSD and a history of mTBI. Results: Differences in the assessed risk factors were small and suggest that if PTSD and mTBI are associated with elevations in suicide risk relative to PTSD alone, the added risk is likely mediated or confounded by PTSD symptom severity. Conclusion: This finding highlights the importance of screening and treating military personnel and veterans for PTSD. Future explication of the impact of TBI-related impairments on suicide risk will be critical as we strive to ensure safety and optimize care for our military personnel and veterans.

Keywords: traumatic brain injury, posttraumatic stress disorder, PTSD, suicide, veteran

Introduction

Suicide has become an increasing concern for the U.S. military as suicide rates have climbed since the start of Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF; Kang & Bullman, 2008). Suicide rates among United States active duty military personnel reached record highs in 2009 and 2010, making suicide the third leading cause of death among those fighting the War on Terror. Since 2003, suicide rates have ranged between 11 and 18 deaths per 100,000 U.S. active duty military personnel (U.S. Department of Defense, 2011). Furthermore, research suggests that suicide continues to be a concern for military personnel even after they separate from the military. Veterans have been found to be twice as likely as non-veteran civilians to die by suicide (Kaplan, Huguet, McFarland, & Newsom, 2007). The increasing rates of suicide among military personnel highlight the critical importance of gaining a better understanding of the factors that influence the likelihood that a veteran 1 or active duty service member will die by suicide. With this knowledge, rehabilitation psychologists working with veterans would be able to assist in the identification of primary psychological factors associated with suicide risk and facilitate comprehensive rehabilitation treatment in order to optimize the patients’ quality of life.

Researchers have identified over 75 biopsychosocial suicide risk factors (Wingate, Joiner, Walker, Rudd, & Jobes, 2004), including posttraumatic stress disorder (PTSD) and traumatic brain injury (TBI). Given that PTSD and TBIs both involve traumatic experiences that often occur in combat deployments, it is not surprising

Impact and Implications

- Research shows that posttraumatic stress disorder (PTSD) and mild traumatic brain injury (mTBI) independently increase suicide risk, and frequently co-occur; however, scant research has investigated whether suicide risk is increased for veterans with PTSD and a history of an mTBI relative to veterans with PTSD alone.
- This research provides an initial examination of suicide risk associated with history of mTBI among military personnel and veterans with PTSD.
- The results tentatively suggest that it is unnecessary for clinicians to assume that patients with PTSD and history of mTBI are at an elevated risk for suicide relative to other patients with PTSD alone. These findings may not generalize to military personnel and veterans with histories of moderate to severe TBIs, which are associated with more lasting deficits that may be more likely to disrupt functioning and increase the risk of suicide.
- The results also indicate that if there is a slightly heightened risk of suicide associated with mTBI among patients with PTSD, it may be mediated by, or confounded with, PTSD symptom severity rather than deficits specifically related to mTBI impairments. This highlights the importance of United States Department of Veterans Affairs (VA) initiatives to screen and treat military personnel and veterans for PTSD.
that these conditions frequently co-occur among OEF/OIF veterans and have been dubbed the “signature injuries” of the War on Terror (Department of Defense Task Force on Mental Health, 2007, p. ES-1). Research estimates that 5–25% of OEF/OIF veterans have reported symptoms consistent with PTSD (Hoge et al., 2004; Hoge, Auchterlonie, & Miliken, 2006; Schell & Marshall, 2008; Seal, Bertenthal, Miner, Sen, & Marmar, 2007) and 15–23% have sustained a TBI (Hoge et al., 2008; Tanielian & Jaycox, 2008; Terrio et al., 2009). Hoge and colleagues (2008) found that among individuals with a history of a probable TBI, 32.6% also had PTSD. Similarly, Lew and colleagues (2007) found that 42% of OEF/OIF veterans with a TBI also had PTSD. The prevalence of PTSD and TBI emphasize the need to understand the impact of these co-occurring conditions on suicide risk.

Research demonstrates that PTSD is the only anxiety disorder which independently predicts suicidal ideation and suicide attempts after controlling for the effects of comorbid psychiatric diagnoses (Bernal et al., 2007; Sareen, Cox, Goodwin, & Asmundson, 2005). Additionally, the results of several studies of veterans have similarly found a significant, direct relationship between PTSD and completed suicides (HR2 = 3.97, 95% CI: 2.2, 7.03; Bullman & Kang, 1994; HR = 1.93, 95% CI: 1.79, 2.08; Ilen et al., 2010). Furthermore, the severity of PTSD symptoms, particularly Criterion B, reexperiencing symptoms, has been found to be significantly related to suicide risk (Bell & Nye, 2007; Jurišić & Marusic, 2009).

Similarly, TBIs have been directly related to suicide risk among civilians, and researchers have suggested that they may play an important role in the increased suicide rates among OEF/OIF veterans (Brenner, Vanderploeg, & Terrio, 2009). Civilians with a history of TBI are approximately 3 to 4 times more likely to commit suicide than the general population, depending on severity of the injury sustained (Teasdale & Engberg, 2001). Relative to the general population, individuals who have experienced a TBI have higher rates of suicidal ideation (Anstey et al., 2004; Simpson & Tate, 2002), suicide attempts (Oquendo et al., 2004; Simpson & Tate, 2002), and death by suicide (Teasdale & Engberg, 2001). Although approximately 80% of all classifiable military TBIs are of “mild” severity (Defense and Veterans Brain Injury Center, DVBC, 2010), civilians sustaining even mild TBIs (mTBI) commit suicide at rates 3 times greater than that of individuals without a history of a TBI (Teasdale & Engberg, 2001).

Although the signature injury of the War on Terror has been individually associated with increased suicide risk, it remains unknown whether veterans with both PTSD and a history of mTBI are at a higher risk of committing suicide than veterans with PTSD alone. Researchers (e.g., Ferraro & Kelly-Moore, 2003; Morgan et al., 2008; Séguin et al., 2007) have found that adversities often have a cumulative impact, whereby deficits and disadvantages are compounded over time. Based on this concept of cumulative disadvantage, Brenner, Vanderploeg, and Terrio (2009) have noted that mTBI and PTSD may be mutually exacerbating and ultimately precipitate detrimental behaviors (e.g., substance abuse), health problems, and negative psychiatric outcomes such as suicide. If this is indeed the case, then interventions to ameliorate PTSD and mTBI-related symptoms early within the rehabilitation process would be critical in order to alter negative trajectories that might eventually lead to suicide.

However, the vast majority of individuals experiencing mTBI-related impairments return to baseline functioning within one week to three months following an mTBI (Belanger & Vanderploeg, 2005; Iverson, 2005; Polusny et al., 2011), suggesting that there may typically be limited opportunity for mTBI-related deficits to compound with PTSD symptoms. Many researchers have found that after adjusting for PTSD symptoms, mTBI is not associated with postdeployment symptoms or outcomes, and these researchers have therefore concluded that PTSD likely mediates or confounds the relation between mTBI and long-term outcomes (Hoge et al., 2008; Marx et al., 2009; Pietrzak, Johnson, Goldstein, Malley, & Southwick, 2009; Polusny et al., 2011; Schneiderman, Braver, & Kang, 2008). This mediational or confounding relation may also describe the way mTBI and PTSD relate to suicide risk.

**Risk Factors Associated With Suicide**

**Psychological Suicide Risk Factors**

Directly comparing the number of suicides among veterans with PTSD to the number of suicides among veterans with PTSD and a history of mTBI would most parsimoniously answer the question “Does a history of mild traumatic brain injury increase suicide risk in veterans with PTSD?” However, suicide remains a fairly low base rate event even among high risk populations. Therefore a very large sample size would be required to directly address this question. Alternatively, the rates of other known suicide risk factors can serve as a proxy for the act of suicide itself. If veterans with PTSD and a history of mTBI display higher rates of suicide risk factors than veterans with PTSD alone, this would suggest that mTBI is associated with higher suicide risk above and beyond that already associated with PTSD. Furthermore, examining suicide risk factors could begin to clarify what about having an mTBI elevates suicide risk, thus informing early assessment and intervention.

In the current research numerous suicide risk factors will be explored to determine if mTBI is related to increased suicide risk above and beyond that associated with PTSD. Two primary psychological risk factors for suicide are suicidal ideation and intent according to the American Psychiatric Association (APA; 2003). Although suicidal ideation is necessary, it is far from indicative of an impending attempt. Approximately 15% of the US population seriously considers suicide at some point in their lives; however 1.4% will actually die by suicide (Nock et al., 2008). Suicidal intent likely confers a substantially greater risk of a suicide attempt than suicide ideation, but there are many individuals with the desire to commit suicide who nonetheless find themselves incapable of doing so (see Van Orden et al., 2010). Therefore it is not surprising that researchers have found that the best predictor of

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2 Hazard ratios are slightly different than odds ratios. An odds ratio is the proportion of events occurring in the experimental group compared with that in the control group; whereas, a hazard ratio is a ratio of the rate at which patients in the two groups are experiencing events at any given time during observation. A hazard ratio of 3.97 means that at any given point in time, patients with PTSD who have not committed suicide are 3.97 times more likely to have committed suicide at the next time point than patients without PTSD. This does not necessarily indicate that one group progressed 3.97 times as fast as the other group (see Duerden, 2009).
future suicidal behavior is a history of previous suicide attempts (Mann, Waternaux, Haas, & Malone, 1999; Rudd, Joiner, & Rajab, 1996). A past suicide attempt is such a robust predictor of future suicidal behavior that it uniquely predicts future suicidal behavior even after controlling for 13 other key demographic and psychosocial suicide risk factors (Joiner et al., 2005).

Relatedly, pain and/or the ability to tolerate pain have been proposed as an important risk factor for suicide (see Van Orden et al., 2010). Van Orden, Witte, Gordon, Bender, and Joiner (2008) found that experiences with pain and provocation are directly related to self-reported capability for lethal self-injury, which in turn is theorized to differentiate individuals with the desire to commit suicide from those who actually make a lethal attempt. Chronic pain has been associated with increased risk of suicidal ideation (OR 1.2, 95% CI: 1.0, 1.4) and suicide attempts (OR 1.7, 95% CI: 1.1, 2.6: Ilgen, Zivin, McCammon, & Valenstein, 2008). Furthermore, Ilgen and colleagues (2010) found that veterans with severe pain were more likely to die by suicide than patients experiencing none, mild, or moderate pain (HR: 1.33; 95% CI: 1.15, 1.54).

Hopelessness is another psychological factor that predicts an increased risk of suicide and has been a focus of suicidality assessments (e.g., Joiner et al., 2005; APA, 2003; Van Orden et al., 2010). Beck, Brown, Berchick, Steward, and Steer (1990) found that patients scoring above 8 on the Beck Hopelessness Scale were 11 times more likely to die by suicide than those scoring below 8. A meta-analysis indicated a somewhat lower, but still significantly increased risk of suicide associated with hopelessness (McMillan, Gilbody, Beresford, & Neilly, 2007).

In addition to PTSD symptom severity, the presence of one or more comorbid psychiatric conditions is associated with an increased risk of suicide. Specifically, Bullman and Kang (1994) found that veterans with PTSD and a comorbid psychiatric disorder were nearly twice as likely to kill themselves as veterans with PTSD alone. For example, researchers have found that PTSD and affective disorders interact to increase suicidality (Oquendo et al., 2003, 2005; Gradus et al., 2010, but also see Pfeiffer, Ganoczy, Ilgen, Zivin, & Valenstein, 2009; Zivin et al., 2007). This comorbidity is particularly relevant given that approximately 50% of individuals diagnosed with PTSD also have a diagnosis of major depressive disorder (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). Researchers have also clearly documented the direct relation between drug and/or alcohol use disorders and suicidal ideation, attempts, and completions (see Borges & Loera, 2010). Ilgen and colleagues (2010) found that veterans diagnosed with substance abuse or dependence showed an increased hazard ratio for death by suicide of 2.47 (95% CI: 2.30, 2.64), and veterans diagnosed with alcohol abuse or dependence similarly showed an increased hazard ratio of 2.48 (95% CI: 2.32, 2.65).

Social Suicide Risk Factors

In addition to psychological risk factors, there are several social suicide risk factors that will be included in the current study due to their relation with suicide risk. Researchers have hypothesized that a lack of belonging is a primary risk factor for suicide (see Van Orden et al., 2010). Lacking an emotional support system has been related to suicide risk (e.g., Field, Diego, & Sanders, 2001). Several studies have shown that unmarried, divorced, or separated marital status adds to an individual’s risk of suicide (see Norström, 1995). Kposowa (2000) found that divorced men were more than twice as likely as married men to commit suicide (HR = 2.08, 95% CI: 1.77, 2.30). Finally, the unemployed are more likely to take their own lives than employed individuals (OR 2.63, 95% CI: 1.87, 3.70; Blakely, Collings, & Atkinson, 2003).

In order to assess the suicide risk associated with mTBI above and beyond that associated with PTSD, the current research compares elevations in these suicide risk factors among OEF/OIF veterans with PTSD and history of an mTBI to veterans with PTSD alone. If mTBI is associated with unique suicide risk, this should be evident in elevations in the suicide risk factors relative to patients without history of an mTBI. Given evidence suggesting that PTSD symptom severity may mediate the relation between mTBI and suicide (Hoge et al., 2008; Marx et al., 2009; Pietrzak et al., 2009; Schneiderman, Braver, & Kang, 2008), we hypothesize that individuals with a history of mTBI will show more severe PTSD symptoms, but will generally report similar levels of suicide risk as individuals with PTSD alone.

Method

Patient Characteristics

Patients in this study were 92 male veterans identified via medical record review of consecutive referrals for outpatient PTSD treatment between 2006 and 2010 at a Midwestern Veterans Affairs Medical Center. All patients served in OEF and/or OIF and met diagnostic criteria for PTSD due to a combat-related trauma. In addition to a PTSD diagnosis, 46 of these patients had sustained an mTBI, defined as either alteration in consciousness for less than 24 hours, loss of consciousness for less than 30 minutes, or posttraumatic amnesia for less than 24 hours. Patients were excluded from the study if they reported loss of consciousness longer than 30 minutes or posttraumatic amnesia greater than 24 hours following their TBI, which would suggest a greater severity of TBI (Holm, Cassidy, Carroll, & Borg, 2005).

Patients with PTSD and history of an mTBI were matched to patients with PTSD and no history of an mTBI with regard to ethnicity and age (± 1 year). For cases in which there were multiple veterans that matched a PTSD/mTBI participant, a veteran was chosen at random using a random number generator. The mean age for the sample was 30.3 years (SD = 8.2). Seven percent of patients served in OEF, 87.7% of veterans served in OIF, 2.2% served in both OEF and OIF, and 3.3% served in OEF or OIF and a previous military conflict. Racial background of the sample, as determined by self-report, was 93.3% Caucasian, 4.4% African American, and 2.2% Native American. Additional demographic variables related to suicide risk are presented in the Results section.

Measures

Clinician-administered measures. Veterans presenting for treatment were administered a semistructured clinical interview utilized by the mental health care line at the facility. The following psychological, suicide risk factors were based on responses from the psychosocial interview: Suicidal ideation, suicidal intent, past attempts, pain, pain tolerance, and hopelessness. The following
Social suicide risk factors were based on responses from the psychosocial interview: Emotional support, marital status, and employment (see Table 1 for operationalization of these variables). Psychometric properties for the semistructured clinical interview could not be ascertained because the archival data for the current study were generated as part of the clinic’s routine intake process.

The Clinician Administered PTSD Scale (CAPS; Blake et al., 1995) assesses Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.; DSM–IV–TR; American Psychiatric Association, 2000) PTSD diagnostic criteria. The CAPS enables clinicians to evaluate the frequency and severity of each of the 17 PTSD symptoms. Symptom scores are derived by summing the frequency and intensity ratings of each item. Scores can be divided into three subscales corresponding to the DSM–IV–TR: Reexperiencing symptoms (Criterion B), avoidance symptoms (Criterion C), hyper-arousal symptoms (Criterion D), and a total severity score.

The Structured Clinical Interview for DSM–IV Axis I Disorders (SCID-I; First, Spitzer, Gibbon, & Williams, 1996) is a structured interview used to assess Axis I disorders. The SCID-I was utilized to detect current and/or lifetime presence of psychiatric disorders. Research on the reliability and validity of the SCID-I support its use with a variety of samples (e.g., Shear et al., 2000; Zanarini et al., 2000). Researchers have used the SCID-I in numerous studies of PTSD and found that it demonstrates sufficient interrater reliability and test–retest reliability (Maffei et al., 1997).

### Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Interview question</th>
<th>Response options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suicidal ideation</td>
<td>Have you had thoughts about death or about killing yourself?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Suicidal intent</td>
<td>Have you ever intended to commit suicide?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Past Suicide Attempts</td>
<td>Have you ever attempted suicide?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Pain</td>
<td>On a scale of 0 to 10, with 0 as no pain and 10 as the worst pain possible how would you rate your current pain?</td>
<td>0–10</td>
</tr>
<tr>
<td>Pain Tolerance</td>
<td>On the same scale of 0 to 10, what level of pain would be tolerable to you?</td>
<td>0–10</td>
</tr>
<tr>
<td>Hopelessness</td>
<td>Who or what gives you strength and hope?</td>
<td>nothing = no hope</td>
</tr>
<tr>
<td>Emotional Support</td>
<td>Do you have an emotional support system?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Are you married?</td>
<td>Single, divorced, or widowed = unmarried</td>
</tr>
<tr>
<td>Employment</td>
<td>Are you employed?</td>
<td>Having part-time job, full-time job, or being enrolled in school = employed</td>
</tr>
</tbody>
</table>

### Procedure

All participant information was extracted from the PTSD clinic’s diagnostic intake reports and the polytrauma clinic’s TBI assessment reports available through VA computerized medical records. Data were collected as part of routine clinical care; therefore, patients were not compensated for completion of assessment measures. A waiver was obtained from the center’s internal review board to access this archival data. As part of patients’ admission into the PTSD clinic, they were administered a semistructured psychosocial interview and assessment instruments to obtain background information and to determine their pretreatment diagnostic status and symptom severity. The format of the outpatient clinic’s intake assessments became more detailed over the course of the 5-year period of interest, thus resulting in some missing data. In order to ensure the comparability of the PTSD/mTBI and PTSD groups, analyses only include patients for which data were available for both members of a matched pair.

### Statistical Analyses

Significance of between-groups differences in continuous suicide-risk variables meeting parametric assumptions were evaluated via independent-samples t tests. Transformations were used to correct violations of parametric assumptions when possible. When continuous variables still violated parametric assumptions following transformations, Mann–Whitney U tests were used to examine between-groups differences on the original distributions. Between-groups differences in categorical risk factors were assessed using chi-square tests.

### Results

Preliminary analyses assessed parametric assumptions for all continuous variables. With the exception of PCL-S and self-reported pain scores, continuous variables met all parametric assumptions. A reflection and square root transformation were used to correct negative skew in PCL-S scores, and then the distribution was reflected again to restore original directionality. Following transformation, PCL-S scores met all parametric assumptions. However, transformations were unable to correct skew in pain scores, therefore nonparametric statistics were used for analysis of this variable. With a sample size of 92 veterans, power analyses indicated sufficient power (0.8) to detect medium effects ($d = 0.59$).
using independent-samples $t$ tests with continuous suicide risk factors, and adequate power to detect medium effects ($\varphi = .29$) using chi-square tests.

**Psychological Risk Factors**

Eleven people in the mTBI group reported suicidal ideation, whereas five people without a history of an mTBI endorsed suicidal ideation. Despite being adequately powered, results of the chi-square test were not significant and the effect was small (see Table 2). Three veterans with a history of mTBI reported having had the intent to kill themselves, whereas one veteran without a history of mTBI reported having had the intent to kill himself. Two patients with a history of mTBI reported past suicide attempts, whereas three patients without a history of mTBI reported having attempted suicide. The low frequency of veterans reporting suicidal intent and/or a history of past attempts prohibits analysis, interpretation, and generalizability of these data; therefore, no statistical tests of suicidal intent or past suicide attempts were conducted.

Self-reported pain scores violated parametric assumptions so a Mann–Whitney $U$ test was used to examine between-groups differences. Both groups reported a similar level of pain, mTBI $Mdn = 3.5$; no mTBI $Mdn = 2.00$, $U = 698.00$, $p = .18$, $d = .30$. A paired-samples $t$ test also failed to detect a statistically significant difference on reported pain tolerance, although there was a nonsignificant trend toward patients with a history of mTBI reporting lower levels of pain tolerance (see Table 3). In regard to hopelessness, six patients in each group denied having anything that gave them strength and hope, yielding no significant difference between groups.

Of particular note was that veterans with a history of an mTBI generally reported more severe PTSD symptoms relative to veterans without an mTBI (see Table 3). Independent-groups $t$ tests found that patients with a history of an mTBI had significantly higher total scores on the CAPS. However, the type of PTSD symptoms most strongly related to suicide risk, reexperiencing symptoms (i.e., CAPS Criterion B subscale; Bell & Nye, 2007), only displayed a nonsignificant trend toward veterans with an mTBI reporting marginally higher reexperiencing symptom scores. Both tests of CAPS-assessed PTSD-symptom severity detected medium effect sizes. However, no significant differences in PTSD-symptom severity were reported on the PCL-S.

Twenty-five patients with histories of mTBI were also diagnosed with a major depressive disorder, whereas 18 patients without histories of mTBI had major depressive disorder. However, this difference was not statistically significant (see Table 2). Similarly, chi-square tests showed that patients with histories of mTBI did not display different rates of drug or alcohol disorders relative to patients without histories of mTBI (see Table 2). When rates of comorbidity with any Axis I disorder other than substance abuse/dependence were compared between groups, a chi-square test failed to find a significant difference between individuals with or without an mTBI.

**Social Risk Factors**

Nine patients with histories of mTBI denied having people they could turn to for emotional support, whereas six people without histories of mTBI reported a lack of emotional support. A chi-square test showed that this difference was not statistically significant (See Table 2). Similarly, no differences emerged between veterans based on marital status, $\chi^2(1) = 0.13$, $p = .72$, $\varphi = -.04$. There were also no significant differences in regard to employment status (See Table 2). In summary, veterans with PTSD and histories of mTBI were found to have significantly more severe PTSD

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**Table 2**

*Comparison of Categorical Suicide Risk Factors*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$n$</th>
<th>$F$</th>
<th>$\chi^2$</th>
<th>$p$</th>
<th>$\varphi$</th>
<th>$1-\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suicidal Ideation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mTBI</td>
<td>44</td>
<td>11</td>
<td>2.75</td>
<td>.10</td>
<td>.18</td>
<td>.84</td>
</tr>
<tr>
<td>No mTBI</td>
<td>44</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug Problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mTBI</td>
<td>46</td>
<td>4</td>
<td>0.93</td>
<td>.34</td>
<td>-.10</td>
<td>.60</td>
</tr>
<tr>
<td>No mTBI</td>
<td>46</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol Problem</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>mTBI</td>
<td>46</td>
<td>13</td>
<td>0.79</td>
<td>.37</td>
<td>-.09</td>
<td>.46</td>
</tr>
<tr>
<td>No mTBI</td>
<td>46</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major Depressive Disorder</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mTBI</td>
<td>46</td>
<td>25</td>
<td>2.14</td>
<td>.14</td>
<td>.15</td>
<td>.83</td>
</tr>
<tr>
<td>No mTBI</td>
<td>46</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any Co-Morbid Axis I</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mTBI</td>
<td>46</td>
<td>34</td>
<td>1.26</td>
<td>.26</td>
<td>.12</td>
<td>.66</td>
</tr>
<tr>
<td>No mTBI</td>
<td>46</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Emotional Support</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mTBI</td>
<td>35</td>
<td>9</td>
<td>0.76</td>
<td>.38</td>
<td>-.10</td>
<td>.51</td>
</tr>
<tr>
<td>No mTBI</td>
<td>35</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployed, Disabled, or Retired</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mTBI</td>
<td>45</td>
<td>9</td>
<td>1.46</td>
<td>.23</td>
<td>-.13</td>
<td>.62</td>
</tr>
<tr>
<td>No mTBI</td>
<td>45</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* All chi-square tests on one degree of freedom; $\varphi$ = effect size, .1 = small effect, .3 = moderate effect, .5 = large effect; $1-\beta$ = achieved power.
suicide risk with those of veterans with PTSD alone. There were no statistically significant differences in regard to rates of suicidal ideation, depressive symptoms, hopelessness, pain, pain tolerance, lack of emotional support, marital status, employment, drug or alcohol problems, or other comorbid Axis I disorders. These findings suggest that the answer to the question “Does a history of mild traumatic brain injury increase suicide risk in veterans with PTSD?” is “no, with one exception.” Extending past research, the patients with histories of mTBI reported more severe PTSD symptoms than patients with PTSD alone, based on CAPS scores. The increased severity of PTSD symptoms in veterans with mTBI may be indicative of some additional suicide risk based on research showing that PTSD-symptom severity is directly associated with suicide risk (Freeman, Roca, & Moore, 2000; Hendin & Haas, 1991). Although researchers and clinicians generally consider CAPS scores to be the gold-standard indicator of PTSD-symptom severity, it is important to note that veterans did not differ on their self-reported PTSD symptoms as assessed by the CAPS. Analyses indicated that veterans had similar levels of all other suicide risk factors.

**Discussion**

The study demonstrated that veterans with PTSD and a history of mTBI generally displayed comparable levels of suicide risk with those of veterans with PTSD alone. There were no statistically significant differences in regard to rates of suicidal ideation, depressive symptoms, hopelessness, pain, pain tolerance, lack of emotional support, marital status, employment, drug or alcohol problems, or other comorbid Axis I disorders. These findings suggest that the answer to the question “Does a history of mild traumatic brain injury increase suicide risk in veterans with PTSD?” is “no, with one exception.” Extending past research, the patients with histories of mTBI reported more severe PTSD symptoms than patients with PTSD alone, based on CAPS scores. The increased severity of PTSD symptoms in veterans with mTBI may be indicative of some additional suicide risk based on research showing that PTSD-symptom severity is directly associated with suicide risk (Freeman, Roca, & Moore, 2000; Hendin & Haas, 1991). Although researchers and clinicians generally consider CAPS scores to be the gold-standard indicator of PTSD-symptom severity, it is important to note that veterans did not differ on their self-reported PTSD symptoms as assessed by the PCL. Subtle differences between the measures could explain why there was not a statistically significant discrepancy between PCL scores. The CAPS is better equipped to distinguish between PTSD symptoms and symptoms that might be better accounted for by other factors (e.g., other mental health conditions, environmental, etc.) and considers both frequency and intensity of symptoms, whereas the PCL relies solely upon the patient’s report of how much he is “bothered” by PTSD symptoms. Additionally, a slightly smaller number of veterans completed the PCL, so this null finding could be related to a lack of statistical power.

Several limitations should be considered when interpreting the study findings. First, the reliability and content validity of the items on the semistructured psychosocial interview have not been tested; therefore, the actual suicide risk associated with responses on the specific questions included in the semistructured psychosocial interview is unknown. However, the semistructured psychosocial interview does have good ecological validity. The questions are characteristic of those used in clinical intake interviews typically employed to assess clinical risks and treatment needs. Second, although analyses were adequately powered to detect medium and large effects, the limited sample size prohibited detection of small effects. The results of several analyses (i.e., suicidal ideation, PTSD reexperiencing symptoms, and pain tolerance) approached significance (p < .05) and were in keeping with past research (See Tables 2 & 3). For example, although veterans with mTBI had more severe PTSD symptoms overall, they only trended toward having higher Criterion B reexperiencing symptoms. It is interesting to note that when Bell and Nye (2007) examined the relation between each of the three PTSD symptom clusters (reexperiencing, avoidance, and hyperarousal), they found that only Criterion B reexperiencing symptoms related to increased suicide risk. One possible reason suicidal ideation may have only approached significance in the current research is that the difference in severity of reexperiencing symptoms also only trended toward significance. Because the current data are insufficient to produce reliable conclusions regarding these small effects, future research with larger samples of patients with PTSD and mTBI will be needed to further examine small, but potentially clinically significant differences in suicidality.

Despite the current study’s limited sample size, at this time there is no existing research consisting of larger sample sizes directly

**Table 3**

Comparison of Continuous Suicide Risk Factors

<table>
<thead>
<tr>
<th>Variable</th>
<th>M (SD)</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>LL</th>
<th>UL</th>
<th>Cohen’s d</th>
<th>1-β</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPS Total</td>
<td>74.02 (16.21)</td>
<td>2.19</td>
<td>84</td>
<td>.03</td>
<td>.64</td>
<td>13.00</td>
<td>0.46</td>
<td>.56</td>
</tr>
<tr>
<td>mTBI</td>
<td>67.20 (13.12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No mTBI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPS B-reexperiencing mTBI</td>
<td>20.02 (7.03)</td>
<td>1.80</td>
<td>88</td>
<td>.08</td>
<td>-2.6</td>
<td>5.24</td>
<td>0.38</td>
<td>.43</td>
</tr>
<tr>
<td>No mTBI</td>
<td>17.53 (6.06)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>PCL-S</td>
<td>61.86 (11.04)</td>
<td>1.38</td>
<td>82</td>
<td>.17</td>
<td>-2.14</td>
<td>7.12</td>
<td>0.30</td>
<td>.27</td>
</tr>
<tr>
<td>mTBI</td>
<td>58.19 (12.89)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>No mTBI</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BDI-II</td>
<td>31.56 (11.06)</td>
<td>1.07</td>
<td>84</td>
<td>.29</td>
<td>-2.14</td>
<td>7.12</td>
<td>0.23</td>
<td>.19</td>
</tr>
<tr>
<td>mTBI</td>
<td>29.07 (10.53)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No mTBI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain Tolerance</td>
<td>5.96 (2.09)</td>
<td>-1.79</td>
<td>22</td>
<td>.09</td>
<td>-2.79</td>
<td>0.20</td>
<td>0.73</td>
<td>.40</td>
</tr>
<tr>
<td>mTBI</td>
<td>7.25 (1.36)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>No mTBI</td>
<td></td>
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</tbody>
</table>

Note. CAPS = Clinician Administered PTSD Scale; CAPS B-reexperiencing symptoms = DSM-IV Criterion B reexperiencing symptoms; BDI-II = Beck Depression Inventory-II; PCL-S scores were transformed for analysis, but results displayed were converted to original scale; CI = confidence interval for the difference between groups; Cohen’s d = effect size, .2 = small effect, .5 = medium effect, .8 = large effect. 1-β = achieved power.
addressing the risk of suicide associated with mTBI among veterans with PTSD, and therefore detecting or ruling out medium or large effects still makes a valuable contribution to the literature. The study also evinces several strengths, such as the use of gold-standard, structured, clinical interviews (e.g., SCID-I and CAPS) for diagnostic assessment, which is an improvement from previous research examining probable PTSD (e.g., Hoge et al., 2008) and TBI (e.g., Tanielian & Jaycox, 2008) based on self-report. Additionally, inclusion criteria in the current research were rigorous: All patients met diagnostic criteria for PTSD diagnosis related to a combat trauma and had undergone structured neuropsychological assessments to evaluate TBI histories and severity.

The study provides an initial examination of suicide risk associated with histories of mTBI among veterans with PTSD. The results tentatively suggest that the majority of veterans with histories of TBI and current PTSD experience little additional elevation in suicide risk above and beyond that already associated with PTSD. Although there were few differences between the groups, patients with histories of mTBI did present with more severe PTSD symptoms. This raises the possibility that if there is a slightly heightened risk of suicide associated with mTBI among patients with PTSD, it may be mediated by, or confounded with, PTSD symptom severity rather than deficits specifically related to mTBI impairments. This coincides with findings that individuals sustaining mTBIs typically fully recover one week to several months following the event (Belanger & Vanderploeg, 2005; Iverson, 2005; Polusny et al., 2011), and assertions that postconcussive symptoms remit with the treatment of PTSD (e.g., Belanger, Kretzmer, Vanderploeg, & French, 2010). Collectively, this highlights the importance of VA initiatives to screen and treat veterans for PTSD.

Rehabilitation psychologists who provide treatment to patients shortly after a traumatic event have a prime opportunity to assist in the detection of PTSD symptoms, and facilitate early treatment intervention. Although PTSD symptoms may appear of lesser clinical significance than the physical impairments that patients often present with in a rehabilitation setting, research indicates that having PTSD doubles the likelihood that a veteran will die by suicide (Ilgen et al., 2010). Encouraging veterans to seek specialized care for PTSD symptoms could be vital to their rehabilitation and ultimately their survival. In order to prevent PTSD symptoms from interfering with functional treatment goals and potentially increasing suicidality, it is critical to closely monitor acute stress reactions and refer patients for PTSD assessment if symptoms persist and impair functioning. Several researchers and clinicians have suggested that a collaborative model of care be instituted when it appears that veterans have both TBI-related impairments and PTSD, allowing the rehabilitation team and PTSD specialists to determine the best sequence or integration of treatment (see Belanger, Uomoto, & Vanderploeg, 2009; Brenner et al., 2009; Terrio et al., 2009). For clinicians treating patients with PTSD, the current findings suggest that it may be unnecessary to assume that patients with histories of an mTBI are at an elevated risk for suicide relative to other patients with PTSD alone. However, lasting deficits associated with more severe TBIs may be more likely to disrupt functioning, compound with other adversities, and increase the risk of suicide. Given the frequency of these signature injuries of the wars in Afghanistan and Iraq, and the gravity of the increasing rates of OEF/OIF and Operation New Dawn (OND) veterans committing suicide, future explication of the impact of TBI-related impairments will be critical as we strive to ensure safety and optimize care for our OEF/OIF/OND veterans.

References


SUICIDE RISK OF MTBI AND PTSD


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