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Investigating Relations between Traumatic Brain Injury and Relationship Functioning among OIF/OEF Veterans

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Abstract

Traumatic brain injury (TBI) is one of the most common injuries among Veterans of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). TBI can negatively affect Veterans' close relationships, undermining an important source of support to aid recovery and rehabilitation. Given the complex symptom profile of TBI, the present research aimed to pinpoint key mediators of the link between TBI and marital functioning to help identify targets for intervention. Data from married OIF/OEF Veterans (N=188) were drawn from a larger sample. Mediation analyses simultaneously examined the potential roles of depressive, posttraumatic stress disorder (PTSD), and post-concussive symptoms in the association between TBI and Veterans' marital satisfaction. Results revealed associations between TBI and all three types of symptoms; however, only depressive symptoms independently mediated the association between TBI and marital satisfaction. These findings suggest depression as a mechanism by which TBI may interfere with healthy relationship functioning and highlight targets for intervention.

Keywords

traumatic brain injury; marital satisfaction; depressive symptoms; post-concussive symptoms; posttraumatic stress disorder; veterans

Advances in protective equipment and medical care have increased survival rates among Veterans of the recent conflicts in Iraq and Afghanistan. As a result, post-9/11 Veterans are living with more than double the rate of service-connected injury than previous generations of Veterans (*Profile of Post-9/11 Veterans: 2014, 2016*). Due to the prevalence of improvised explosive devices in these combat theaters (Owens et al., 2008), traumatic brain injury (TBI) is one of the most common injuries among Veterans of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). TBI occurs when a blow or jolt to the head damages the brain. Whereas Kevlar helmets and body armor can protect against bullets and shrapnel, they cannot completely protect against blast-related, closed brain injuries (Okie, 2005; Warden, 2006). Accordingly, it is estimated that up to 25 percent of OIF/OEF Veterans have suffered at least one TBI (Bosco, Murphy, & Clark, 2013; Hoge et al., 2008). Given that

more than 2.77 million Service Members have deployed as part of OIF/OEF (Wenger, O'Connell, & Cottrell, 2018), understanding and addressing the various consequences of TBI represent critical tasks for professionals working with this population.

TBI often leads to a range of cognitive (Arciniegas, Held, & Wagner, 2002; Lippert-Gruner, Kuchta, Hellmich, & Klug, 2006), emotional (Fleminger, 2008; Saunders, McDonald, & Richardson, 2006), and psychosocial (Franulic, Carbonell, Pinto, & Sepulveda, 2004; Morton & Wehman, 1995) problems. Although most TBI that occurs in the military is classified as mild, and most individuals recover within 3 to 12 months (Carroll et al., 2004), for some people, problems related to the injury can persist for longer periods of time, negatively impacting their health and overall functioning (Vanderploeg, Curtiss, Luis, & Salazar, 2007). In particular, psychosocial problems tend to persist longer following TBI, often creating a considerable barrier to rehabilitation (Morton & Wehman, 1995).

The importance of relationship functioning

The interpersonal consequences of TBI have received far less attention in research examining military populations than have neuropsychological sequelae and other aspects of polytrauma. Thus, much of what is known largely comes from the literature on civilian populations. This research shows that TBI can negatively impact various aspects of individuals' social functioning, including close relationships. Indeed, TBI of any severity is associated with poorer relational communication, intimacy, quality, and satisfaction (Burridge, Huw Williams, Yates, Harris, & Ward, 2007; Gill, Sander, Robins, Mazzei, & Struchen, 2011; Gosling & Oddy, 1999), with evidence of greater injury severity predicting increasingly poor relationship satisfaction and adjustment (Peters, Stambrook, Moore, & Esses, 1990). Individuals with TBI and their romantic partners also report decreased sexual functioning and sexual satisfaction following the injury (Ponsford, 2003; Sander et al., 2016; Sander et al., 2012). Further, there is evidence that divorce rates may be higher post-injury (Blais & Boisvert, 2005; Wood & Yurdakul, 2009). The consequences of TBI can also take a toll on those closest to the injured individual: prior research has found evidence of psychological distress (i.e., depression, anxiety) among 23–73% of relatives and caregivers of TBI patients (Blais & Boisvert, 2005; Ponsford, Olver, Ponsford, & Nelms, 2003).

It is vital to understand the effects of TBI on relationship functioning in military samples, because anything that may undermine relationship satisfaction may also undermine individuals' chances of successful recovery and rehabilitation. Spouses and family members are a primary source of support for individuals with TBI – civilian and military – and the quality of these relationships can play a key role in recovery (Dausch & Saliman, 2009; Griffin, Friedemann-Sanchez, Hall, Phelan, & van Ryn, 2009; Kreutzer, Marwitz, & Kepler, 1992). Spouses, in particular, are a critical aspect of Veterans' environment. Indeed, prior research has demonstrated the specific importance of spousal support in the prevention and course of service-connected conditions (e.g., posttraumatic stress disorder; Guay, Billette, & Marchand, 2006). However, if injury-related symptoms interfere with healthy relationship functioning (e.g., impair communication, exacerbate conflict), this can erode social support and impair recovery.

Mechanisms linking TBI and relationship functioning

In order to protect this vital aspect of Veterans' support system, there is need for a greater understanding of the specific mechanisms linking TBI and relationship functioning. This information is essential for designing effective prevention and intervention. However, given the complex symptom profile of TBI and related polytrauma, it can be difficult to determine which aspects may be most influential for the marital relationship. For example, there is meta-analytic evidence that TBI puts individuals at double the risk of subsequently developing a range of psychiatric illnesses (Perry et al., 2016), which, in turn, may also take a toll on the marital relationship. Disentangling the potential effects of these various factors is a critical next step for research in this domain.

In particular, it may be worthwhile to examine the explanatory roles of depressive, PTSD, and post-concussive symptoms in the associations between TBI and poorer marital functioning. Depression has been repeatedly identified as one of the most common psychiatric diagnoses following TBI (Hibbard, Uysal, Kepler, Bogdany, & Silver, 1998; Koponen et al., 2002; Perry et al., 2016; Whelan-Goodinson, Ponsford, Johnston, & Grant, 2009), and rates of subsequent posttraumatic stress disorder (PTSD) are also high (Hoge et al., 2008; Institute of Medicine, 2009; Schneiderman, Braver, & Kang, 2008; Tanielian & Jaycox, 2008). Indeed, roughly one third of Veterans with TBI also have comorbid depression or PTSD (Hoge et al., 2008; Tanielian & Jaycox, 2008). Additionally, neuropsychiatric symptoms related to TBI, known as post-concussive symptoms, can also persist following the injury (Cicerone & Kalmar, 1995; Schneiderman et al., 2008; Vanderploeg et al., 2007). Whereas these issues are most likely to occur in the first year following injury (Alway, Gould, Johnston, McKenzie, & Ponsford, 2016; Deb, Lyons, Koutzoukis, Ali, & McCarthy, 1999), there is evidence of vulnerability lasting years and even decades later (Koponen et al., 2002; Whelan-Goodinson et al., 2009).

These problems may, in turn, take a toll on Veterans' romantic relationship functioning. Links between both depression and PTSD symptoms and poorer relationship functioning in Service Members and their spouses are well established (Lambert, Engh, Hasbun, & Holzer, 2012; Sayers, Farrow, Ross, & Oslin, 2009; Taft, Watkins, Stafford, Street, & Monson, 2011; Whisman, 2001). Whereas research on post-concussive symptoms and relationship functioning is lacking, there is considerable overlap among post-concussive symptoms, PTSD symptoms, and depressive symptoms (Brenner et al., 2010; Carlson et al., 2010; King et al., 2012). Thus, they may similarly impair relationship functioning. Taken together, this suggests that these symptoms may play an important role in how TBI ultimately affects injured service members' marital relationships. However, in order to pinpoint the most fruitful targets for intervention, research is needed to disentangle their unique effects on relationship functioning. This is the primary focus of the present research.

Present Research

Close relationships are an important source of support that can aid recovery and rehabilitation among Veterans; however, history of TBI can also take a toll on these relationships. Given the prevalence of TBI among recent Veterans, and the fact that more

than half of current Service Members are married (*Profile of Post-9/11 Veterans: 2014, 2016*), it is important to develop a better understanding of the extent to which TBI-related symptoms may impact Service Members' marital relationships, as well as the mechanisms through which this may occur. Such an approach would help identify fruitful targets for intervention to help protect this important source of support for injured Veterans.

The present research will address a number of key limitations of prior research. It is clear that the consequences of TBI can strain close relationships. However, much of the extant research has examined these relations in civilian samples and has frequently used blended samples of spouses, parents, and even children (Blais & Boisvert, 2005). Therefore, it is difficult to disentangle potential effects of the TBI on marital vs. parental relationships, as well as the extent to which these findings are generalizable to military and Veteran populations. Given that TBI is by definition only one aspect of polytrauma for Service Members and Veterans, coping and adjustment may be different for these families compared to civilians (R. C. Collins & Kennedy, 2008). The complex and unpredictable nature of combat-related injuries and associated recovery places these families under considerably greater stress (Griffin et al., 2012). Further, research examining the influence of TBI specifically on marital functioning has tended to focus on the marital satisfaction of the non-injured spouse (Blais & Boisvert, 2005), implicitly assuming that TBI-related relationship problems only arise through the burden placed upon them. However, the perspective of the person who sustained the TBI also plays an important role in the functioning of the relationship. For example, the injured Veteran's perception of the relationship is likely to influence the extent to which they are willing to turn to their spouse as a source of support during recovery.

The present research aims to fill these critical gaps in the literature. Specifically, using a sample of OIF/OEF Veterans, the present research will simultaneously examine three potential mediators of the association between TBI and Veteran-reported relationship functioning: post-concussive symptoms, PTSD symptoms, and depressive symptoms. Consistent with the extant literature, we expect that a positive TBI diagnosis will be associated with all three types of symptoms. Further, we hypothesize that these variables will mediate the association between TBI and veteran-reported relationship functioning. However, we make no specific predictions regarding the relative size of the indirect effects associated with each mediator. The present research aims to determine which of these symptoms may have the strongest relation to relationship functioning, and thus be a fruitful target for focusing treatment.

Method

Participants

Data were drawn from a larger longitudinal study enrolling OIF/OEF veterans (N = 500). Participants were recruited from five VA medical centers and one VA outpatient clinic in New York State. The sample was drawn from a registry of OEF/OIF Veterans across the New York State Veterans Integrated Services Network (VA VISN 2) and from clinical referrals to polytrauma or neuropsychology clinics at each site. Veterans were compensated \$75 for participation in each of four assessments in the larger study. The analytic sample for

the present research was drawn from a single time point of the parent study and was comprised of 168 married male (89.4%) Veterans and 20 married female (10.6%) Veterans. Sample characteristics are reported in Table 1. Participants were predominantly Caucasian (90.4%, $n = 170$) with at least some college education or a 4-year degree and ranged in age from 20 to 60 years old ($M = 35.3$, $SD = 9.7$). At the time of participation, on average, Veterans had served 12.4 years ($SD = 8.2$) in the military, and 3.5 years ($SD = 2.0$) had passed since their most recent head injury. On par with the national average for post-9/11 deployments (Institute of Medicine, 2013), Veterans had been deployed an average of 1.7 times ($SD = 1.5$) at the time of participation.

Procedure

Each of the five participating study sites received approval from its institutional review board (IRB) and Research and Development Committee. Participants' responses are protected by a Certificate of Confidentiality granted by the National Institute of Mental Health. The study consisted of four assessment time points, each conducted at 6-month intervals. The first assessment included the TBI diagnostic interview, conducted by one of six licensed psychologists. This was followed by a comprehensive neuropsychological assessment battery, which included the measures assessing depressive symptoms, PTSD, and post-concussive symptoms. Marital satisfaction data were collected at the second assessment time point. Assessment batteries were administered by trained research assistants. All research assistants were initially trained by the principal investigator (a board-certified clinical neuropsychologist) in study protocol and test administration and scoring, during a meeting of investigators and staff from all five study sites. The project coordinator trained the research assistants in data coding and entry and facilitated weekly telephone conferences to discuss study-related issues and to monitor progress. Each site-specific principal investigator was responsible for ongoing direct and indirect clinical supervision of the local research assistants.

Measures

Traumatic brain injury.—Prior TBI was assessed using a 22-item structured diagnostic interview developed by Donnelly et al. (2011) in accordance with Cifu et al. (2009) TBI diagnostic criteria. The interview was designed to assess the probability, nature, and severity of TBI among OIF/OEF veterans. It also contained items assessing the circumstances of the injury. The interview produces ratings of the probability and severity of each TBI event. Injuries assessed to be “very likely” or “almost certainly” were considered positive diagnoses. These ratings were aggregated and used to create a binary variable (1/0) indicating whether the Veteran had experienced any prior TBI. This served as the primary predictor variable in the present analyses.

Post-concussive symptoms.—Post-concussive symptoms experienced since the time of participants' TBIs were measured using the 22-item, self-report Neurobehavioral Symptom Inventory (NSI; Cicerone & Kalmar, 1995). The measure includes 11 somatic/sensory items, including: feeling dizzy; vision problems, blurring, trouble seeing, and sensitivity to noise. The measure includes 11 affective items, including: feeling anxious or tense; irritability, easily annoyed; and difficulty making decisions. Degree of severity for each symptom is

rated on a 5-point scale ranging from 0 (*none; symptom is rarely ever present/not a problem at all*) to 4 (*very severe; symptom is almost always present/impairs performance at work, school, or home/individual probably cannot function without help*). Total scores on the NSI range from 0 to 88. Higher scores indicate more severe post-concussive symptoms.

PTSD symptoms.—PTSD symptoms were measured using the PTSD Checklist-Military Version (PCL-M; Weathers, Litz, Herman, Huska, & Keane, 1993). The PCL-M is a 17-item self-report measure of PTSD symptoms experienced over the past month in response to “stressful military experiences,” based on DSM-IV criteria. Example items include: “repeated, disturbing *memories, thoughts, or images* of a stressful military experience from the past”; “having *physical reactions* (e.g., heart pounding, trouble breathing, or sweating) when *something reminded* you of a stressful military experience from the past”; and “feeling *irritable* or having *angry outbursts*” (emphasis original). Participants rate the frequency of experiencing each symptom over the past month on a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely*). Total scores on the PCL-M range from 17 to 85. Higher scores indicate more severe PTSD symptoms.

Depressive symptoms.—Depressive symptoms were measured using the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996). The BDI-II is a 21-item self-report measure of depressive symptoms experienced over the past two weeks. Example symptoms include: sadness, pessimism, guilty feelings, suicidal thoughts or wishes, changes in sleep, and changes in appetite. Participants rate the intensity of each symptom on a 4-point scale ranging from 0 to 3. Total scores on the BDI-II range from 0 to 63. Higher scores indicate more severe depressive symptoms.

Marital satisfaction.—Marital satisfaction was measured using the Multidimensional Satisfaction Scale (MDS; Kearns & Leonard, 2004). The MDS assesses satisfaction with 11 functional aspects of romantic relationships: social pleasure, division of labor, problem solving, sexual intimacy, emotional security, companionship, balance of power, feelings of love and acceptance, emotional closeness, personal growth and autonomy, and expressions of affection. Each aspect is then illustrated through examples. Participants rate the extent to which they are satisfied with each aspect of their current relationship on an 8-point scale ranging from 1 (*not at all satisfied*) to 9 (*completely satisfied*). Responses were averaged across items. Higher scores indicate greater marital satisfaction.

Analytic Plan

Mediation analyses using MPlus 8.0 software (Muthén & Muthén, 2017) were used to examine the explanatory role of post-concussive symptoms (M1), PTSD symptoms (M2), and depressive symptoms (M3) in the association between TBI (X) and marital satisfaction (Y; see Figure 1). Analyses controlled for the effects of participant sex and age on the mediators and focal outcome variable. Covariance paths were included to model the associations among the three mediator variables, as there is conceptual overlap in the symptoms assessed in each measure (King et al., 2012). Parameters were estimated using full information maximum likelihood estimation (Schafer & Graham, 2002). Indirect effects were calculated using the product of coefficients approach (MacKinnon, Lockwood,

Hoffman, West, & Sheets, 2002). Standard errors and confidence intervals for parameter estimates and indirect effects were estimated using bias corrected bootstrapping with 1000 samples, which addresses the non-normality of the product terms used to estimate indirect effects (Hayes, 2009, 2013). Statistical significance of the parameter estimates and indirect effects is determined by the absence of zero from the confidence interval.

Results

Preliminary Analyses

Descriptive statistics and correlations for focal study variables are presented in Table 2. Approximately 40% of the analytic sample had experienced a prior TBI. Findings from the full parent study sample indicate that the vast majority of such injuries in the sample (96.8%) are classified as mild (Donnelly et al., 2011). The average score on the PCL-M fell below the recommended cut-score (50) for probable diagnosis of PTSD in military populations (Forbes, Creamer, & Biddle, 2001; Weathers et al., 1993), and the average score on the BDI-II fell in the range (14–19) indicative of mild depression (Beck et al., 1996). The average total score on the NSI suggests that participants average rating for each item fell between “mild” and “moderate.” The average score on the MDS is approximately one standard deviation lower than the mean for non-distressed couples found in prior research (Beach, Fincham, Amir, & Leonard, 2005). As was expected, there were strong correlations among post-concussive symptoms, PTSD symptoms, and depressive symptoms. Further, all three mediator variables were significantly correlated with TBI and marital satisfaction.

Focal Analyses

The aim of the present research was to examine, in parallel, three potential mediators of the association between traumatic brain injury and relationship functioning. Specifically, analyses examined the indirect effect of TBI on veteran-reported marital satisfaction simultaneously via post-concussive symptoms, PTSD symptoms, and depressive symptoms. Results of mediation analyses are presented in Table 3 and Figure 1.

As predicted, TBI was significantly associated with post-concussive symptoms ($a_1 = 11.765$, 95% CI [7.112, 16.993]), PTSD symptoms ($a_2 = 11.031$, 95% CI [6.354, 16.012]), and depressive symptoms ($a_3 = 9.187$, 95% CI [5.189, 13.170]). Individuals with prior TBI reported higher levels of post-concussive symptoms, PTSD symptoms and depressive symptoms. However, only depressive symptoms were significantly associated with veteran-reported marital satisfaction ($b_3 = -0.075$, 95% CI [-0.114, -0.036]). Greater depressive symptoms were related to lower levels of marital satisfaction. Post-concussive symptoms ($b_1 = 0.008$, 95% CI [-0.027, 0.039]) and PTSD symptoms ($b_2 = 0.000$, 95% CI [-0.032, 0.035]) were not significantly related to marital satisfaction.

As predicted, there was a significant total indirect effect of TBI on veteran-reported marital satisfaction through all three mediators ($ab = -0.594$, 95% CI [-0.950, -0.297]). However, only the specific indirect effect of TBI via depressive symptoms was significant ($a_3b_3 = -0.690$, 95% CI [-1.253, -0.316]). With post-concussive symptoms, PTSD symptoms, and depressive symptoms in the model, the direct effect of TBI on veteran-reported marital

satisfaction was not significant ($c' = 0.092$, 95% CI [-0.431, 0.594]). As expected, there were significant covariances among the three mediator variables. However, participant sex and age were not significantly associated with post-concussive symptoms, PTSD symptoms, depressive symptoms, or marital satisfaction, and were therefore removed from Figure 1 for clarity.

Discussion

The present research aimed to advance the literature on the interpersonal consequences of military service by investigating the pathways through which TBI may harm Service Members' close relationships. In a sample of OIF/OEF Veterans, this study found that TBI was associated with greater post-concussive symptoms, PTSD symptoms, and depressive symptoms. These symptoms explained relations between TBI and Veteran-reported marital satisfaction. Further, results suggested that depressive symptoms may play a particularly important role in linking TBI and poorer romantic relationship functioning. Taken together, these findings add to a growing literature on the negative consequences of common service-connected conditions for Veterans and their families.

Result underscore the need for greater consideration of the injured Veteran's perception of the relationship. Building upon prior work that has largely focused on the perspective of the non-injured spouse (Blais & Boisvert, 2005), the present findings illustrate that TBI may also harm the injured Veteran's satisfaction with the relationship. This finding is important because the Veterans' perception of the relationship is likely to influence the extent to which they will seek support from a spouse and the nature of their responses to that support, when offered. Indeed, higher satisfaction is associated with more supportive interactions in romantic relationships (N. L. Collins & Feeney, 2000). Further, prior work has found that individuals who report higher relationship satisfaction perceive their partners as being more supportive, even after controlling for the partner's self-reported support provision and the ratings of independent observers (N. L. Collins & Feeney, 2000). Thus, Veterans' satisfaction with their marital relationships is likely a key factor in their ability to benefit from spousal support.

In order to effectively intervene to preserve or repair Veterans' marital relationships, it is necessary to understand the specific mechanisms linking TBI and relationship satisfaction. However, an ongoing issue in this area of research is the fact that many post-concussive symptoms are not specific to TBI, and thus often overlap with symptoms of other conditions common among Veterans, such as PTSD and depression (King et al., 2012). The present research was able to disentangle these factors by examining mediator variables in parallel and modeling the associations among them. As would be expected, all covariance paths among post-concussive symptoms, PTSD symptoms, and depressive symptoms were significant. By accounting for this overlap, findings revealed that only depressive symptoms were significantly associated with veterans' marital satisfaction.

Results suggest that depressive symptoms may be especially relevant to the ways in which TBI may interfere with healthy relationship functioning, particularly for the injured individual. The cognitive distortions associated with depression may also negative color

individuals' thoughts about their marital relationships. This finding is consistent with well-established links between depression and poorer relationship functioning in civilian and non-injured military populations (Sayers et al., 2009; Whisman, 2001). Whereas TBI was also associated with greater postconcussive symptoms and PTSD symptoms in the present sample, these factors were not subsequently related to Veteran-reported marital satisfaction. This suggests that the bivariate associations between each of these constructs and marital satisfaction was accounted for by their overlap with depressive symptoms. These findings are consistent with prior research similarly finding more robust associations between depressive symptoms – but not PTSD symptoms – and multiple indicators of family functioning, including marital satisfaction, in National Guard service members (Blow et al., 2013).

The lack of a relationship between PTSD and Veteran marital satisfaction in this sample is somewhat surprising, given prior research linking PTSD and relationship problems (Lambert et al., 2012; Taft et al., 2011). Although speculative, it is possible that Veterans' depressive symptoms may have a greater impact on coloring their own perception of their relationship, but their PTSD symptoms may have a more pronounced effect on their partners' perceptions of the relationship. Due to the nature and primary focus of the parent study, we were not able to assess the perspective of the non-injured spouse. However, future research examining the perspectives of both partners is critical to developing a more complete understanding of the influence of TBI on dyadic relationship functioning.

The present findings suggest key targets for clinical intervention. First, they underscore the importance of looking beyond the individual Veteran to also assess and address the impact that TBI may have on their marital relationships. Whereas there is often an intrapersonal focus in the treatment of service-connected conditions, it is critical to acknowledge the interpersonal context in which related symptoms occur, and the ways in which aspects of Veterans' conditions may differentially impact themselves and their families. Spouses are an important aspect of Veterans' environment, and bolstering the marital relationship is likely to aid recovery and rehabilitation.

Additionally, results shed light on fruitful starting points for intervention with Veterans' and their spouses. Given that TBI has a complex symptom profile, and it often presents as part of polytrauma in Veterans, it can be difficult to know which factors may have the greatest impact on the marital relationship. The present findings suggest that depressive symptoms may be a key factor in the way TBI ultimately interferes with healthy relationship functioning. Thus, counselors working with TBI-affected Veterans should consider utilizing conjoint therapeutic approaches, particularly those that can simultaneously address depression and marital issues, such as behavioral marital therapy for depression (BMT-D). BMT-D has proven effective at bolstering marital functioning and relieving depressive symptoms (Mead, 2002). It also may be beneficial to incorporate psychoeducation to help the Veteran and spouse better understand TBI and related symptoms (Sayers, 2011).

Findings contribute to a greater understanding of the interpersonal consequences of TBI, specifically among military couples. Much of the extant literature on TBI and close relationships has been conducted using civilians; however, these effects may be particularly

pronounced in military samples. Indeed, prior research has found that TBI with more violent causes is associated with greater subsequent relationship instability (Arango-Lasprilla et al., 2008), which is likely to be particularly true of TBI sustained during the course of military service. Further, given the fact that TBI is often only one aspect of polytrauma in Veterans, recovery from TBI in military samples is likely more complicated than among civilian samples, (Brenner, Vanderploeg, & Terrio, 2009; Gironde et al., 2009). It is also important to note that a portion of the sample were treatment-seeking veterans recruited from VA facilities, who may have more severe symptoms or impairment than those who do not seek treatment. Given that less than half of all eligible veterans are enrolled for VA care (Bagalman, 2014), this may limit the generalizability of the findings.

By simultaneously examining the potential moderating roles of post-concussive symptoms, PTSD symptoms, and depressive symptoms, the present research begins to tease apart the unique effects of these factors. Given the cross-sectional nature of the data, we cannot infer causal relations among TBI, depressive symptoms, and marital satisfaction. However, poorer interpersonal functioning post-injury is well documented in both the civilian and military TBI literatures. Further, it is unlikely that relationship quality would put people at higher risk for sustaining TBI. Yet, there may be reciprocal relations among the examined mediators and relationship functioning, and these relations may operate differently for injured and non-injured spouses. Thus, future prospective longitudinal research would help reveal how these processes unfold over time post-injury for Veterans and their spouses.

Conclusion

The present research examines poorer marital satisfaction as an important interpersonal consequence of TBI, which is one of the most common service-connected conditions among OIF/OEF Veterans. The results demonstrate that depressive symptoms can play an important mediating role in the association between TBI and marital relationship functioning in this population. Conjoint counseling approaches targeting Veterans' depressive symptoms may help alleviate depressive symptoms and protect healthy marital relationship functioning, thereby bolstering an important source of support to aid Veteran recovery and rehabilitation.

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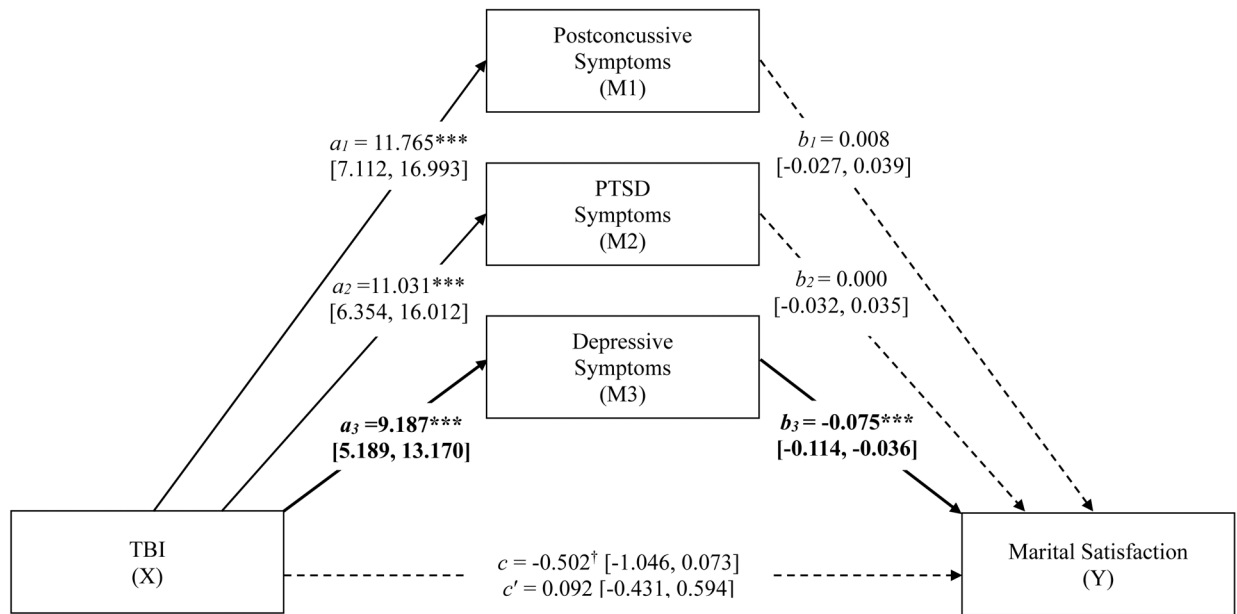


Figure 1. Model of total, direct, and indirect effects of TBI on marital satisfaction.

Note. $^\dagger p < .10$. $*p < .05$. $**p < .01$. $***p < .001$. Significant pathways are depicted as solid lines. Non-significant pathways are depicted as dashed lines. There was a significant total indirect effect of TBI on marital satisfaction through all three mediators ($ab = -0.594$, 95% CI [-0.950, -0.297]). Paths corresponding to the specific indirect effect of TBI on marital satisfaction via depressive symptoms are bolded ($a_3b_3 = -0.690$, 95% CI [-1.253, -0.316]). Model also controlled for the effects of participant sex and age on postconcussive symptoms, PTSD symptoms, depressive symptoms, and marital satisfaction. None of these paths were significant, so they were removed from the figure for clarity.

Table 1

Demographic characteristics of analytic sample (N = 188)

Variable	<i>M (SD) or % (n)</i>
Sex	
Male	89.4% (168)
Female	10.6% (20)
Age	35.3 (9.7)
Education	
Some HS - HS Diploma	21.3% (40)
Some College - 4-Year Degree	70.7% (133)
Some Graduate School - Graduate Degree	8.0% (15)
Race/Ethnicity	
African American	2.7% (5)
Asian American	1.1% (2)
Caucasian	90.4% (170)
Hispanic	2.7% (5)
Native American	0.5% (1)
Other	2.7% (5)
Military History	
Years in Military	12.4 (8.2)
Number of Deployments to War Zone	1.7 (1.5)
Months since Most Recent Head Injury	41.4 (23.7)

Table 2

Descriptive Statistics and Correlations among Focal Variables

Variable	1	2	3	4	M (SD) / % (N)	Range
1. TBI	-				40.4% (76)	0 / 1
2. Postconcussive symptoms	0.396 ^{***}	-			29.33 (16.40)	0 – 88
3. PTSD symptoms	0.339 ^{***}	0.839 ^{***}	-		42.01 (17.28)	17 – 85
4. Depressive symptoms	0.363 ^{***}	0.786 ^{***}	0.837 ^{***}	-	18.00 (13.31)	0 – 63
5. Marital satisfaction	-0.123	-0.319 ^{***}	-0.360 ^{***}	-0.451 ^{***}	5.75 (1.86)	1 – 9

Note.

^{***} $p < .001$.

Table 3 Total, Direct, and Indirect Effects of TBI on Marital Satisfaction, via Postconcussive Symptoms, PTSD Symptoms, and Depressive Symptoms

	estimate	SE	Z	95% CI	
				Lower	Upper
Total effect on marital satisfaction					
<i>c</i> Postconcussive symptoms	-0.502	0.288	-1.741 [†]	-1.046	0.073
Direct effects on marital satisfaction					
<i>c'</i> TBI	0.092	0.264	0.348	-0.431	0.594
<i>b</i> ₁ Postconcussive symptoms	0.008	0.016	0.501	-0.027	0.039
<i>b</i> ₂ PTSD symptoms	0.000	0.017	0.012	-0.032	0.035
<i>b</i> ₃ Depressive symptoms	-0.075	0.020	-3.734 ^{***}	-0.114	-0.036
Indirect effects on marital satisfaction					
<i>ab</i> Total indirect effect	-0.594	0.172	-3.458 ^{***}	-0.950	-0.297
<i>a</i> ₁ <i>b</i> ₁ TBI → Postconcussive symptoms → Marital satisfaction	0.094	0.197	0.476	-0.257	0.516
<i>a</i> ₂ <i>b</i> ₂ TBI → PTSD symptoms → Marital satisfaction	0.002	0.191	0.011	-0.398	0.414
<i>a</i> ₃ <i>b</i> ₃ TBI → Depressive symptoms → Marital satisfaction	-0.690	0.234	-2.942 ^{**}	-1.253	-0.316

Note:

[†] *p* < .10.

** *p* < .01.

*** *p* < .001.

Letters denote corresponding paths in Figure 1.