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RELATIONSHIP STABILITY AFTER TRAUMATIC BRAIN INJURY AMONG VETERANS AND SERVICE MEMBERS: A VA TBI MODEL SYSTEMS STUDY

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Abstract

Objective—To explore stability of relationships and predictors of change in relationship status two years following TBI/Polytrauma.

Setting—Five Department of Veterans Affairs Polytrauma Rehabilitation Centers (VA PRCs).

Participants—357 active duty service members and Veterans enrolled in the VA PRCs Traumatic Brain Injury Model Systems (TBIMS) database with complete marital status information at two-year post-injury.

Design—Prospective, longitudinal, multi-site.

Main Measures—Relationship status change was defined as change in marital status (single/never married; married; divorced/separated) at 2-year follow-up, compared to status at injury.

Results—At the time of injury, 134 participants (38%) were single/never married; 151 (42%) were married, and 72 (20%) were divorced/separated. Of those married at enrollment, 78% remained married at Year 2 while 22% underwent negative change. Multivariable analyses revealed that age and education at the time of injury, and mental health utilization prior to injury, were significant predictors of relationship change. Among those who were single/divorced/separated at the time of injury, 87% remained so at Year 2 while 13% underwent positive change. Injury during deployment significantly predicted positive relationship change.

Conclusions—The unmalleable, pre-injury characteristics identified may be used as potential triggers for education, prevention, surveillance and couples therapy, if needed.

Keywords

Relationship Stability; Marital Status; Brain Injuries; Polytrauma; Veterans; Couples

Traumatic brain injury (TBI)/Polytrauma can result in a range of cognitive, emotional, behavioral, and physical impairments that impact the family,^{1,2,3,4} resulting in familial distress,⁵ marital strain,⁶ and relationship dissatisfaction.⁷ Existing research regarding the impact of TBI on relationships has focused on marital stability and/or marital satisfaction. Using the Karney & Crown (2007) categorization,⁸ *marital stability* refers to whether a marriage ends or remains intact, whereas *marital satisfaction* assesses the extent to which a spouse perceives their marriage to be worth maintaining, and can include aspects such as marital adjustment and quality. While marital stability and satisfaction are often significantly associated, they are not overlapping constructs and should be examined separately.⁸

Studies on marital satisfaction following TBI have documented marital dissatisfaction^{9,10,11} and reduced relationship quality.^{12,13,14} A decrease in overall intimacy between partners has been documented,¹⁵ as well as impaired sexual functioning and satisfaction for both persons with TBI and their spouses/partners.^{16,17,18} Spouses of individuals with TBI have also reported greater emotional distress compared to parents^{19,20,21} and compared to healthy controls.^{9,22,23} Studies investigating marital stability have yielded inconsistent results, with rates of divorce or separation ranging from 9-78% at periods ranging from 2-15 years post-injury.^{6,12,14,24-28} Sample sizes have ranged from 48 to 977 and most have included persons with severe injury. Notably, recent findings suggest that marital stability following brain injury might be high despite the presence of marital distress.²⁹ Several factors have been found to be related to marital stability, including older age at time of injury,²⁴ non-violent injury etiology,¹² and female gender of the person with TBI,²⁴ though the latter finding was not replicated in two additional studies.^{12,14}

Despite the robust literature exploring the impact of TBI on marital relationships, several gaps still exist. First, much of the work in this areas focuses on stability for people who were married at the time of injury, with little known about changes in relationship status over time. Second, research in this area is largely based on civilian samples, with only one study to date observing marital change following TBI/Polytrauma in a Veteran sample. In this study, Vanderploeg and colleagues³⁰ found that 33.8% - 48.9% of Vietnam-era Army Veterans were divorced or separated 8 years post TBI. Mild head injury moderated the influence of preinjury characteristics on marital status; in those who had a mild injury, older age, majority race, absence of preexisting externalizing psychiatric difficulties, and current full-time employment status were associated with being married.

There are several ways in which adjustment to TBI/Polytrauma may be different for civilians versus Veterans or service members and their spouses.³¹ Given the polytraumatic nature of injuries, military families cope with a much more uncontrollable and unpredictable medical treatment course. Families of polytrauma patients also tend to be more distressed than families of patients who sustain a TBI with no other injuries.⁴ Injured service members typically spend long periods of time with their loved one at rehabilitation settings far from home, resulting in prolonged limited accessibility to familiar support networks. The family may have undergone strain and role changes due to the service member's deployment or multiple deployments. Additionally, many injured active duty individuals are young with relatively recent marriages and young children, which may increase vulnerability to strain.³¹

Even before a potential TBI, military families experience unique challenges, including long work hours, extended and involuntary separation, and the physical and mental effects of war.³² Studies of non-TBI samples of military service members and Veterans have reported low relationship satisfaction, increased stress levels, and decreased emotional and physical intimacy, which has been associated with deployment-related stress.^{33,34} With regard to marital stability, both male and female service members are less likely to get divorced compared to civilians; however, male and female Veterans have demonstrated higher divorce rates compared to civilians.^{35,36} Among Vietnam Veterans, marital stability has been reported to be higher for those who married after, as compared to before, their military service.^{37,38} Involvement in combat has been found to be related to marital stability in one

study of WWII/Korean/Vietnam Veterans,³⁹ but not in a different study of Vietnam Veterans.⁴⁰

Given the unique challenges experienced by military persons with TBI and their families, it is important to examine relationship stability among active duty service members and Veterans. The current study addresses this gap in the literature and also improves upon prior civilian research by investigating relationship changes for service members and Veterans with TBI/Polytrauma, regardless of pre-injury relationship status.

Method

Participants

Participants were enrolled prospectively in the Department of Veterans Affairs Polytrauma Rehabilitation Centers TBI Model Systems (VA PRC TBIMS) national database (a multicenter, longitudinal study of TBI outcomes). Follow-up interview was attempted for all participants. Currently, there are 5 sites across the country enrolling service members and Veterans with a TBI into the VA PRC TBIMS database, which has been in existence since 2010. All VA PRC TBIMS enrollees are age 18 or older and were transferred to a comprehensive rehabilitation program at one of the participating Polytrauma Rehabilitation Centers.⁴¹ All participants provided informed consent directly or by legal proxy. This analysis was conducted with a subset of participants meeting study-based inclusion and exclusion criteria as detailed below.

VA TBIMS database enrollees who enrolled and were discharged between August 2009 and June 2015 were considered for analysis. Further inclusion criteria were 1) completion of inpatient rehabilitation, 2) enrollment within two years of index TBI, and 3) eligibility for and completion of a two-year post-injury follow-up. Individuals were excluded if deceased, refused interview, or withdrawn from the study at the time of follow-up. Individuals who were widowed at time of injury or were missing marital status at follow-up were also excluded from analyses. Veterans or service members are enrolled in the database if they are admitted to inpatient rehabilitation and have a diagnosis of TBI, even if TBI is not the primary reason for admission.

Measures

Relationship Status—The relationship status data came from marital questions obtained during interview with the person with injury or a close other at the time of enrollment and subsequent follow-up. Relationship status was coded as “married,” “single,” “divorced,” or “separated.” Participants were categorized into the following relationship change groups: Unchanged, Positive, and Negative. Unchanged included participants who had the same marital status at enrollment and at Year 2. Those who were divorced at enrollment and single at Year 2, and those who were separated at enrollment and divorced or single at Year 2 were also considered “unchanged” (as they were ‘not in a relationship’ at both time points). The Positive Change group included participants who were not in a relationship at enrollment (i.e., single, divorced or separated) and who were married at Year 2. The Negative Change

group included participants who were married at enrollment and then not in a relationship at Year 2 (single, separated or divorced).

Baseline demographic and injury characteristics—Data on demographic, and injury characteristics were obtained during inpatient rehabilitation at the time of study enrollment. Since not all commonly used TBI severity indices (e.g., initial Glasgow Coma Scale score; time to follow commands; duration of altered consciousness/post-traumatic amnesia) were available for all participants, injury severity was classified as mild, moderate, or severe according to the most severe metric available for each index. Injuries obtained while a participant was deployed during active military service were coded as deployment-related injuries.

Problematic Substance Use—Alcohol use was assessed by asking whether the person with TBI had at least one drink in the month prior, the number of days per week or month these beverages were consumed, the average number of drinks per occasion, and the number of binge occasions—defined as five or more drinks on one occasion.^{42,43} Illicit substance use was assessed by asking if the person with TBI used any illicit or non-prescription drugs during the last 12 months. Problematic substance use was defined as heavy alcohol consumption (i.e., >14 drinks/month for males and >7 drinks per month for females), or use of illicit drugs, or binge drinking in the past month.^{44,45}

Mental Health History—Mental health history was assessed at the time of enrollment by asking if the person with TBI had sought treatment for depression, post-traumatic stress disorder (PTSD), or other mental health issues during the year prior to injury. Participants endorsing “yes” to any of these questions were coded as positive for mental health utilization.

FIM™—The FIM™ is comprised of 18 items designed to operationally measure functional independence in self-care, mobility, and cognition.⁴⁶ Higher scores represent a greater level of independence. Items are summed into a Cognitive subscale (5-35), Motor subscale (13-91), and overall FIM Total Score (18-126). FIM scores at rehabilitation discharge were utilized in this study.

Procedure

After enrollment, trained research assistants obtained demographic information, including pre-injury relationship status, and premorbid status via interview with the participant or from a proxy for those unable to provide reliable data for themselves.⁴¹ Research staff collected data on injury characteristics, military history, and FIM™ scores via review of medical charts from the acute and rehabilitation hospital stays, consistent with the protocol for the TBIMS database.⁴⁷ Relationship status at 2 years post-injury was collected as part of the 2 year follow-up interview conducted by telephone with the person with injury or a proxy. The window for follow-up data collection was within three months of the injury anniversary date.

Statistical Analyses

Data were analyzed using statistical software R v3.2.2 (R Foundation for Statistical Computing, Vienna, Austria). Descriptive statistics were expressed as 1st quartile; median; 3rd quartile for continuous variables and percentage (count) for categorical variables. Subgroup analysis was performed among those married at enrollment and among those who were single, divorced, or separated at enrollment respectively.

For the subgroup analysis of those married at enrollment, due to a relatively small sample size (i.e. N=33 negative changes at two-year follow-up), a logistic regression model with Firth's penalized likelihood approach was fitted for predicting negative change (Yes vs. No) at two-year follow-up as a function of each risk factor to evaluate the univariate association between negative change and each risk factor. Redundancy analysis was performed to check the collinearity among all the risk factors to be included in the multivariable model. None of the variables were found to be redundant. A multivariable model with Firth's penalized likelihood approach was fitted for predicting negative change at two-year follow-up as a function of age at injury, education, injury severity, cause of injury, injury during deployment, FIM cognitive score at discharge, FIM motor score at discharge, mental health utilization prior, and problematic substance use.

For the subgroup analysis of those who were single, divorced, or separated at enrollment, a similar approach was used for predicting positive change (Yes vs. No) at two-year follow-up among the combined subset. When performing redundancy checks among all the risk factors to be included in the multivariable model, cause of injury was found to be redundant, with 77.7% of its variation explained by other covariates. Therefore, cause of injury was dropped from the multivariable model.

The odds ratio (OR) estimate, its' corresponding 95% confidence interval (CI) and p-value were computed for each risk factor based on the above models. P-values ≤ 0.05 were considered to indicate statistical significance.

Results

Study population

A total of 712 participants were enrolled in the VA PRC TBIMS database. As detailed in Figure 1, 101 participants were excluded from analyses due to not having enrolled within two years of TBI, and 158 were not eligible for two year follow-up. Of the remaining sample of 453 eligible participants, five were expired at time of follow-up. At the two-year follow-up, 70 participants were lost, refused, or withdrew (15% lost to follow-up rate), leaving a sample of 378 participants with completed two year follow-up evaluations. Participants were further excluded if missing marital status at two-year follow-up (N=18) or were coded as widowed, leaving a final sample of N=357.

A total of 357 individuals remained in the final analytic sample. The majority of participants sustained a severe TBI and were injured stateside. The majority of injuries were caused by vehicular accidents, with blast injuries the second most frequent. There were an equivalent number of persons single and married at the time of injury, with fewer divorced or separated.

Among those married at enrollment, 23% reported mental health utilization during the year prior to injury and 16% reported problematic substance use. Among those single/divorced/separated at enrollment, 21% reported mental health utilization during the year prior to injury, and 37% reported problematic substance use.

Marital status at enrollment and 2-year follow-up

Marital status at enrollment and Year 2 follow-up is summarized in Table 1. Among 357 individuals, 151 (42%) of them were married at enrollment, 134 (38%) were single at enrollment, 56 (16%) were divorced at enrollment, and 16 (4%) were separated at enrollment. Among 151 married at enrollment, 118 (78%) of them remained married at Year 2, and 33 (22%) underwent negative change at Year 2 (i.e. single/divorced/separated). In the combined subset of 206 single/divorced/separated at enrollment, 179 (87%) remained unchanged at Year 2, and 27 (13%) underwent positive change at Year 2 (i.e. married).

Subgroup analysis of those married at enrollment

Table 2 summarizes study variables for those participants who were married at enrollment, those who remained married at Year 2, and those who underwent negative change at Year 2. Persons who remained unchanged were older than those who underwent negative change (median age: 34.5 years vs. 26 years). There was a higher percentage of persons with more than a high school education in the unchanged relationship status group compared to the negative change group (59% vs. 39%). There were also more people with severe TBIs in the negative change compared to the unchanged group (84% vs. 60%).

The results from univariate and multivariable models representing negative change (i.e., going from married at enrollment to single, divorced, or separated) are shown in Table 3. Based on univariate analysis, age at injury was found to be significantly associated with negative change at Year 2. When we evaluated the impact of all risk factors simultaneously by running the multivariable model, age at injury, education, and prior mental health utilization were found to be significantly associated with negative change. Assuming all other predictors constant, as age at injury increased by 1 year, the odds of negative relationship change decreased by 9% (95% CI: 4% to 15%, $p < 0.001$). The odds of negative relationship change were 65% greater (95% CI: 5% to 88%, $p = 0.040$) for persons with less than a high school education compared to those with greater than high school education. The odds of negative relationship change among persons with prior mental health utilization was 4.80 times greater than those without prior mental health utilization (95% CI: 1.21 to 22.35, $p = 0.025$).

Subgroup analysis of those single/divorced/separated at enrollment

The same analysis was replicated among the subset of persons who were single, divorced or separated at enrollment. Table 4 summarizes study variables for all persons who were single, divorced or separated at enrollment, persons who remained unchanged at Year 2, and those who underwent positive change at Year 2. Compared to those who were married at enrollment, this subgroup had less mental health utilization and more problematic substance use. More persons in the positive change group had been injured during deployment compared to unchanged persons (67% vs. 30%).

The results from univariate and multivariable models representing positive change (i.e., going from single, divorced, or separated at enrollment to married) are shown in Table 5. Based on univariate analysis, age at injury and injury during deployment were found to be significantly associated with positive change at Year 2. When we evaluated the impact of all risk factors simultaneously by running the multivariable model, injury during deployment was found to be positively associated with positive change at Year 2. Assuming all other predictors constant, the odds of positive change among persons injured during deployment was 5.36 times the odds among those injured stateside (95% CI: 1.68 to 20.08, $p=0.004$).

Discussion

The purposes of this study were to explore change in relationship status over the two years following TBI/Polytrauma among 357 active duty service members and Veterans enrolled in the VA PRC TBIMS study and to identify predictors of relationship change within this period of time. Among those married at enrollment, the majority (78%) remained married at Year 2, and (22%) underwent negative change (i.e. single/divorced/separated). Younger age at injury, lower education level, and history of 1-year pre-injury mental health utilization were significant predictors of marital instability. Among those not in a relationship at enrollment (single/divorced/separated), the majority (87%) remained unchanged at Year 2, and 13% underwent positive change. Being injured during deployment was predictive of positive change (i.e., marriage) at Year 2. It should be noted that the labels of “positive” vs. “negative” change relate to whether a relationship was added or removed over time, and available data do not allow for the determination of whether participants considered such changes as beneficial or harmful.

The present investigation is unique in a number of ways. First, the investigation focused primarily on relationship stability and factors related to stability. Prior studies have focused only on those who were married at time of injury, precluding investigation of positive changes in relationship status. Second, data were collected from five centers, whereas most prior studies have collected data at a single center. Finally, the investigation was focused on Veterans and service members whereas most other studies have focused on civilian samples.

The current finding that 22% of Veterans or service men with TBI who were married at the time of injury had changed marital status at 2 years post-injury is consistent with more recent studies conducted in non-military samples that have shown divorce rates between 15% to 25%.^{12,24} Additionally, though literature shows higher marital stability for Veterans without TBI that were married after service compared to before service³⁷⁻³⁸ and equivocal findings related to the impact of combat experience on marital stability,³⁹ the present study did not capture information about timing of marriage in relation to military service or involvement in combat.

The current finding that older age was associated with greater marital stability is consistent with the findings of Arango et al. (2008).²⁴ It is possible that the maturity that comes with age, combined with the possibility that older persons may have been married longer, contributes to increased stability. Higher education was also associated with better marital stability in our sample. This relationship has not been previously investigated in persons

with TBI; however, there is evidence of lower education in men being related to marital instability in a recent large, population-based study of normals.⁴⁸ Lower education has been associated with marital instability among African-American couples;⁴⁹ however, one study found that black women have higher rates of marital instability across all levels of education.⁵⁰ These findings with non-TBI samples indicate that socioeconomic differences in marital stability in the general population may be reflected in the TBI samples. The current sample was not diverse enough to investigate the potential interaction of race/ethnicity with education, but this is a topic for future research.

The occurrence of treatment for mental health issues during the year prior to injury was predictive of marital instability in this sample, which makes sense given that chronic, long-term moderate to severe mental health problems result in marital disruption.⁵¹ The relationship between mental health functioning and marital stability in this sample suggests that future research should explore the comparison of marital stability between service members and Veterans with TBI versus depression and/or PTSD, in order to better determine which factors are contributing to marital difficulties.

Most studies have focused on predictors of marital dissolution following injury and this is the first known study to examine predictors of entering into marriage following TBI. The finding that being injured during deployment, compared to being injured stateside, was predictive of marriage at Year 2 is interesting. It is important to note that, for our sample, sustaining an injury during deployment does not necessarily mean that the injury occurred during combat. It may be possible that attributions made about someone being injured during a military deployment somehow contribute to a potential partner's more favorable outlook regarding the injury, which then leads to higher likelihood of getting married. It is also possible that being injured during deployment results in higher financial VA benefits and care, which may then provide the injured individual with more resources and support to manage the injury and develop relationships. It will be important for future studies to replicate this finding and elucidate potential explanations.

Limitations

This study assessed relationship stability among individuals who received inpatient rehabilitation at a VA Polytrauma Center following primarily moderate-to-severe TBI. Findings may differ among individuals with mild TBI, civilians with TBI, those with moderate-to-severe TBI who receive inpatient rehabilitation in a civilian setting, or those admitted to acute care but who do not receive inpatient rehabilitation. The sample size is modest and the proportion maintaining relationship stability high; therefore, the samples in which relationship change was being examined were small. The self-report nature of the marital status variable also resulted in some inconsistencies in responses (e.g., some participants who went from single to divorced) and the possibility exists that changes occurred within the two year timeframe that were not captured. The predictor variables studied were limited to those variables available in the TBIMS database. This database does not include certain variables that might contribute to marital stability, including age at marriage, years of marriage, whether the participant is married to the same person at each time point, partner demographics, religious beliefs, presence of children from the marriage,

relationship satisfaction at time of injury, and behavioral dysfunction. Lastly, this study looks at the important question of marriage stability in the first couple of years following TBI, but does not consider the equally important question of marital satisfaction or relationship quality. Future research should endeavor to replicate these analyses with larger samples and include additional variables known to impact marital stability. Additionally, future research should further explore predictors of positive relationship change and explore strengths associated with persons showing positive change in an effort to facilitate them.

Clinical Implications

In spite of limitations, the current findings have clinical implications for working with injured military service members and Veterans and their spouses/partners. For example, couples/marital counseling could be included as part of Polytrauma rehabilitation, particularly for those patients who have a premorbid mental health history, are younger, and have less education. Identifying at-risk couples early on and getting them into appropriate treatment may better prepare them for navigating marital problems post-TBI. Such counseling may also help injured individuals who may be more susceptible to mental health problems. Practitioners should also be familiar with the unique stressors related to deployment and/or military training in general,⁵² which may require individualized treatment in addition to marital therapy. Moreover, spouses may require their own separate training for serving as a caregiver in an effort to reduce caregiver burden, which has been shown to compromise caregiver health in caregivers of persons with TBI.⁵³ Given the growing research on divorce and marital strain related to military service in general,^{54,55} a family systems-based approach⁵⁶ following a TBI among military service members and Veterans should be emphasized in routine rehabilitation efforts.

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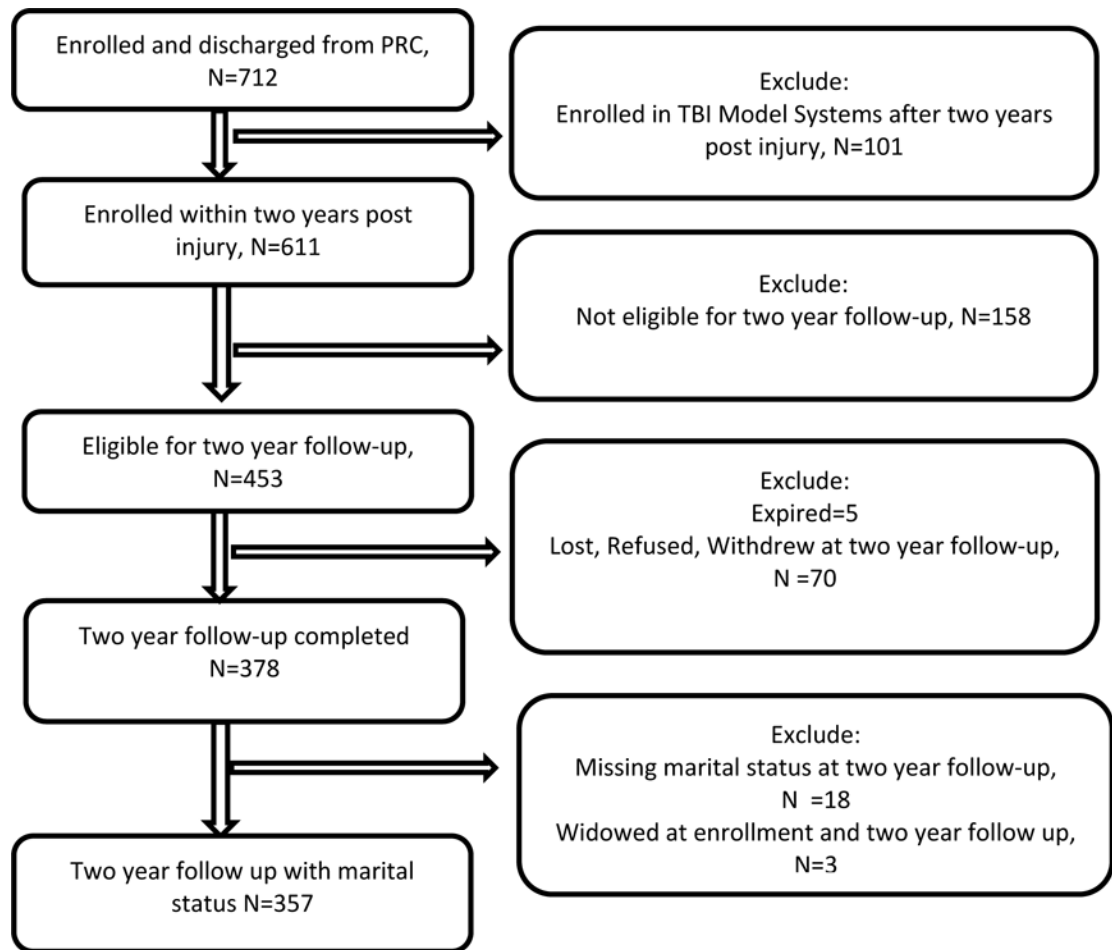


Figure 1.
Flowchart Describing the Study Sample

Table 1

Summary of Marital Status at Enrollment and Two-Year Follow-up

At Enrollment	2-year FU	Count	Type of Change
Married	Married	118	Unchanged
Married	Single	2	Negative
Married	Divorced	18	Negative
Married	Separated	13	Negative
Single	Single	110	Unchanged
Single	Married	16	Positive
Single	Divorced	6	Unchanged
Single	Separated	2	Unchanged
Divorced	Divorced	47	Unchanged
Divorced	Single	2	Unchanged
Divorced	Married	6	Positive
Divorced	Separated	1	Unchanged
Separated	Separated	4	Unchanged
Separated	Single	1	Unchanged
Separated	Married	5	Positive
Separated	Divorced	6	Unchanged
	Total	357	

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Table 2

Summary of Study Variables for all Married at Enrollment, Those Remaining Married and Those Having Negative Change at Year 2

	N	All Married (N=151)	Unchanged (N=118)	Negative Change (N=33)
Age at injury (years)	151	26.0;32.0;42.5	28.0;34.5;45.8	24.0;26.0;30.0
Male	151	148 (98%)	115 (97%)	33 (100%)
Education > high school diploma	149	81 (54%)	68 (59%)	13 (39%)
Marital status at two-year FU	151			
Single		2 (1%)	0 (0%)	2 (6%)
Married		118 (78%)	118 (100%)	0 (0%)
Divorced		18 (12%)	0 (0%)	18 (55%)
Separated		13 (9%)	0 (0%)	13 (39%)
Injury severity	141			
Mild		27 (19%)	24 (22%)	3 (10%)
Moderate		22 (16%)	20 (18%)	2 (6%)
Severe		92 (65%)	66 (60%)	26 (84%)
Cause of injury	151			
Vehicular		64 (42%)	45 (38%)	19 (58%)
Fall		20 (13%)	18 (15%)	2 (6%)
Violence: penetrating		16 (11%)	12 (10%)	4 (12%)
Violence: blast		38 (25%)	31 (26%)	7 (21%)
Other		13 (9%)	12 (10%)	1 (3%)
Injury during deployment	151	65 (43%)	51 (43%)	14 (42%)
FIM cognitive score at rehab discharge	143	24.5;30.0;32.0	25.8;30.0;32.0	21.5;29.0;32.0
FIM motor score at rehab discharge	138	70.2;83.0;89.0	70.5;83.0;89.0	64.0;81.0;88.5
Mental health utilization prior	149	35 (23%)	26 (22%)	9 (27%)
Problematic substance use	139	29 (21%)	20 (19%)	9 (29%)

Note: N means the measured records for each variable.

Table 3
Results from Univariate and Multivariable Models for Predicting Negative Change among Married

Risk factor	Comparison	Univariate Model		Multivariable Model	
		OR (95% CI)	p-value	OR (95% CI)	p-value
Age at injury	1 year increase	0.93 (0.88, 0.97)	<0.001	0.91 (0.85, 0.96)	<0.001
Education	> HS diploma vs. ≤ HS diploma	0.47 (0.21, 1.01)	0.052	0.35 (0.12, 0.95)	0.040
Injury Severity	Moderate vs. Mild	0.85 (0.13, 4.84)	0.857	0.86 (0.11, 6.39)	0.886
	Severe vs. Mild	2.79 (0.93, 11.08)	0.070	2.79 (0.65, 15.44)	0.176
Cause of injury	Fall vs. Vehicular	0.32 (0.06, 1.14)	0.080	0.75 (0.10, 4.04)	0.746
	Penetrating violence vs. Vehicular	0.84 (0.23, 2.66)	0.774	1.06 (0.21, 5.49)	0.945
	Blast violence vs. Vehicular	0.56 (0.20, 1.40)	0.218	0.76 (0.16, 3.50)	0.719
	Other vs. Vehicular	0.28 (0.03, 1.29)	0.111	0.12 (0.001, 1.57)	0.119
Injury during deployment	Yes vs. No	0.97 (0.45, 2.10)	0.948	1.54 (0.36, 6.60)	0.552
FIM cognitive score at rehab discharge	1 score increase	0.98 (0.94, 1.03)	0.375	1.08 (0.97, 1.21)	0.162
FIM motor score at rehab discharge	1 score increase	0.99 (0.98, 1.01)	0.327	0.98 (0.95, 1.01)	0.223
Mental health utilization prior	Yes vs. No	1.32 (0.54, 3.08)	0.529	4.80 (1.21, 22.35)	0.025
Problematic substance use	Yes vs. No	1.82 (0.72, 4.41)	0.198	1.47 (0.40, 5.18)	0.554

Table 4

Summary of Study Variables at Enrollment for all Single/Divorced/Separated, Those Remaining Single/Divorced/Separated and those Having Positive Change at Year 2

	N	All Single/Divorced/Separated (N=206)	Unchanged (N=179)	Positive Change (N=27)
Age at injury (years)	206	22.0;26.0;33.0	22.0;26.0;34.5	22.5;26.0;28.5
Male	205	196 (96%)	171 (96%)	25 (93%)
Education > high school diploma	206	98 (48%)	86 (48%)	12 (44%)
Marital status at enrollment	206			
Single		134 (65%)	118 (66%)	16 (59%)
Divorced		56 (27%)	50 (28%)	6 (22%)
Separated		16 (8%)	11 (6%)	5 (19%)
Marital status at two-year FU	206			
Single		113 (55%)	113 (63%)	0 (0%)
Married		27 (13%)	0 (0%)	27 (100%)
Divorced		59 (29%)	59 (33%)	0 (0%)
Separated		7 (3%)	7 (4%)	0 (0%)
Injury severity	193			
Mild		29 (15%)	25 (15%)	4 (15%)
Moderate		31 (16%)	28 (17%)	3 (12%)
Severe		133 (69%)	114 (68%)	19 (73%)
Cause of injury	206			
Vehicular		95 (46%)	85 (47%)	10 (37%)
Fall		19 (9%)	18 (10%)	1 (4%)
Violence: penetrating		12 (6%)	10 (6%)	2 (7%)
Violence: blast		59 (29%)	46 (26%)	13 (48%)
Other		21 (10%)	20 (11%)	1 (4%)
Injury during deployment	206	72 (35%)	54 (30%)	18 (67%)
FIM cognitive score at rehab discharge	191	27.0;30.0;33.5	26.0;30.0;34.0	28.0;31.0;33.0
FIM motor score at rehab discharge	191	77;85;90	77;84;89	78;87;91
Mental health utilization prior	204	32 (16%)	30 (17%)	2 (7%)
Problematic substance use	197	72 (37%)	66 (39%)	6 (23%)

Table 5
 Results from Univariate and Multivariable Models for Predicting Positive Change Among Single/Divorced/Separated

Risk factor	Comparison	Univariate Model		Multivariable Model	
		OR (95% CI)	p-value	OR (95% CI)	p-value
Age at injury	1 year increase	0.96 (0.91, 0.998)	0.039	0.98 (0.91, 1.03)	0.409
Education	> HS diploma vs. ≤ HS diploma	0.87 (0.39, 1.94)	0.736	0.81 (0.30, 2.16)	0.681
Marital status at enrollment	Divorced/separated vs. Single	1.34 (0.58, 3.01)	0.481	2.97 (0.92, 9.43)	0.067
Injury Severity	Moderate vs. Mild	0.70 (0.14, 3.14)	0.633	1.28 (0.23, 7.26)	0.773
	Severe vs. Mild	0.97 (0.34, 3.30)	0.950	1.83 (0.51, 8.19)	0.366
Cause of injury [‡]	Fall vs. Vehicular	0.66 (0.07, 3.10)	0.634		
	Penetrating violence vs. Vehicular	1.94 (0.34, 8.01)	0.416		
	Blast violence vs. Vehicular	2.36 (0.98, 5.83)	0.055		
	Other vs. Vehicular	0.60 (0.06, 2.77)	0.547		
Injury during deployment	Yes vs. No	4.48 (1.97, 10.84)	<0.001	5.36 (1.68, 20.08)	0.004
FIM cognitive score at rehab discharge	1 score increase	1.03 (0.97, 1.13)	0.348	0.98 (0.89, 1.08)	0.594
FIM motor score at rehab discharge	1 score increase	1.01 (0.99, 1.05)	0.427	1.02 (0.99, 1.07)	0.223
Mental health utilization prior	Yes vs. No	0.47 (0.09, 1.56)	0.241	1.37 (0.22, 6.97)	0.715
Problematic substance use	Yes vs. No	0.50 (0.18, 1.22)	0.133	0.86 (0.23, 3.07)	0.813

[‡]When performing redundancy check among all the risk factors to be included in the multivariable model, cause of injury was found to be redundant with 77.7% of its variation that can be explained by other covariates. Therefore, cause of injury was dropped from the multivariable model.