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Psychological Correlates of Battle and Nonbattle Injury Among Operation Iraqi Freedom Veterans

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ABSTRACT Limited research exists on the relationship between physical injury and PTSD within military populations. The present study assessed postinjury rates of PTSD and other psychological correlates among battle and nonbattle injuries. A total of 1,968 men (831 battle injuries and 1,137 nonbattle injuries) injured between September 2004 and February 2005 during Operation Iraqi Freedom (OIF) composed the study sample. Patients were followed through November 2006 for mental health diagnosis (ICD-9 290-319). Compared with nonbattle injuries, those with battle injuries had a greater risk of PTSD and other mental health diagnosis, and there was a positive association with injury severity. Self-reported mental health symptoms were significantly higher for both minor and moderate-severe battle injury in comparison to nonbattle injury and previous population estimates from an earlier OIF period. More research is needed to further define this relationship by examining potential mechanisms and addressing the possible contributing effect of combat exposure.

INTRODUCTION

Traumatic events can lead to a variety of psychological outcomes, including generalized anxiety disorder, substance abuse, phobia, posttraumatic stress disorder (PTSD), and major depressive disorder.[1] PTSD, first formalized as a diagnosis in 1980, is an anxiety disorder initiated by exposure to a traumatic event and characterized by symptoms of avoidance, reexperiencing, and hyperarousal.[2,3]

Posttraumatic stress disorder is a significant source of morbidity among military personnel; research within military populations after Vietnam, the Persian Gulf War, and Operation Iraqi Freedom (OIF) has found higher rates of PTSD and other psychological morbidity among deployed than nondeployed personnel.[4–7] Among deployed military personnel, physical injury appears to be an important predictor of PTSD. Studies of PTSD among Vietnam veterans have identified a 2- to 3-fold greater lifetime prevalence of PTSD symptoms in injured combat veterans compared with uninjured.[8,9] A recent study by Koren et al. found a more than 8-fold increased risk of PTSD among those with combat injury than those uninjured.[10] Hoge et al. found a similar association between physical injury and PTSD among OIF veterans.[11] These findings are consistent with those among civilian populations surviving terrorist attacks and natural disasters and among police officers involved in critical shooting incidents.[12–18] Some studies among military populations, however, have failed to replicate this result.[19–22] Previous research within military populations has not compared battle and nonbattle injury with respect to the relationship between injury and mental health.

The purpose of the current study was to describe the prevalence of PTSD, other mental health correlates, and self-reported mental health symptoms among injured OIF combatants. Rates of mental health outcome for battle and nonbattle injury were compared; self-reported mental health symptoms were additionally compared with previous population estimates by Hoge et al.[7]

METHODS

Study Sample

A total of 1,968 male, injured personnel (831 battle injuries, 1,137 nonbattle injuries) composed the study sample. The study sample was identified from the U.S. Navy-Marine Corps Combat Trauma Registry Expeditionary Medical Encounter Database (Navy-MC CTR EMED). The Navy-MC CTR EMED, a deployment health database maintained by the Naval Health Research Center (NHRC), consists of documented clinical encounters of deployed military personnel. Records are obtained for battle injury, nonbattle injury, disease, psychiatric, and routine sick-call encounters.[23,24] Eligible personnel were OIF combatants who presented to forward deployed medical treatment facilities for battle or nonbattle injury during the 6-month period from September 2004 to February 2005. Precise date of injury

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was not indicated for all personnel, therefore date of arrival for medical care was used as a proxy for injury date. After excluding females because of low representation among battle injuries (less than 1%) and 41 individuals who died as a result of their wounds, 2,088 participants (881 battle injuries, 1,207 nonbattle injuries) were matched against the Career History Archival Medical and Personnel System (CHAMPS). A database maintained by NHRC, CHAMPS contains demographic, career, and medical information on all military members on active duty in the U.S. Armed Services since 1973 (see Gunderson et al. 2004, for a detailed description of CHAMPS).[25] A total of 1,983 eligible injured personnel (95.0%) had a matching record in CHAMPS. Fifteen individuals were excluded because of evidence of military discharge less than 90 days into the follow-up period. This study was approved through the Institutional Review Board at NHRC, San Diego State University, and University of California, San Diego.

Measures

Injuries were classified as either battle or nonbattle on the basis of thorough review of the Navy-MC CTR EMED clinical record by clinical research staff. A battle injury was defined as any injury that resulted from hostile action. Injury severity was calculated for battle injuries using the Injury Severity Score (ISS).[26] Although not measured for nonbattle injuries, most of the nonbattle injuries were minor orthopedic injuries corresponding to an ISS of 1-3. To take injury severity into account, injury status was categorized into nonbattle and minor (ISS 1-3), moderate (ISS 4-8), serious (ISS 9-15), and severe (ISS $\geq$ 16) battle injury. Categorization was preferred because ISS was not normally distributed.

Four primary correlates were considered: (1) diagnosis of any mental health outcome, (2) diagnosis of PTSD, (3) diagnosis of mood/anxiety disorder, and (4) self-reported mental health symptoms.

Diagnoses in the form of International Classification of Diseases, Ninth Revision (ICD-9) codes were abstracted from the CHAMPS system. The CHAMPS database was updated through November 2006, therefore, there were approximately 22–27 months of follow-up time, although some participants were discharged from the military over the course of the follow-up period. Upon military discharge, CHAMPS no longer monitors personnel. Those discharged without a mental health diagnosis were assumed to not have developed the outcome.

A diagnosis of PTSD was indicated by ICD-9 code 309.81, and any mental health outcome was indicated by an ICD-9 code in the range of 290–319, excluding 305.10 (tobacco addiction). The date of PTSD diagnosis must have been at least 1 month postinjury because the definition of PTSD requires symptoms to persist for at least 1 month; any diagnosis of PTSD less than 1 month postinjury was treated as a previous mental health diagnosis. Other mental health diagnoses of interest included mood disorders (ICD-9 296, 300.4, 301.13, and 311) and anxiety disorders (ICD-9 300.00–300.02, 300.21–300.29, 300.3, 308.3, 308.9, and 309.81). Because of a typically high rate of comorbidity, mood and anxiety disorders were combined for analysis. Though not of primary interest, rates of adjustment disorders (ICD-9 309.0–309.9, excluding 309.81), substance abuse disorders (ICD-9 291, 292.0–292.1, 292.3–292.9, 303, 304, 305.0, 305.2–305.7, and 305.9), and other mental health disorders (other ICD-9 code between 290 and 319 not previously listed) were also examined.

Self-reported mental health symptoms were abstracted from Post-Deployment Health Assessments (PDHA). The Department of Defense (DoD) requires that all military personnel complete a PDHA (revised DoD form 2796) within 1 to 2 weeks of return from an overseas deployment.[27] A list of all pertinent mental health questions is shown in Table I. Posttraumatic stress symptoms were ascertained using a previously validated 4-item screening tool.[28] Answering "yes" to 3 of the 4 questions was considered a screen positive and a risk factor for PTSD. For purposes of comparing with previous population estimates by Hoge et al., an alternate screen-positive definition of answering "yes" to 2 of 4 questions was used.[7]

TABLE I. Mental Health Questions, Post-Deployment Health Assessments

Posttraumatic Stress	Depression	Other Mental Health
Have you ever had any experience that was so frightening, horrible, or upsetting that, in the past month, you…	Over the last 2 weeks, how often have you been bothered by any of the following problems?	Are you currently interested in receiving help for a stress, emotional, alcohol, or family problem? (yes/no)
Have had any nightmares about it or thought about it when you did not want to? (yes/no)	Little interest or pleasure in doing things (none/some/a lot)	Are you having thoughts or concerns that …
Tried hard not to think about it or went out of your way to avoid situations that remind you of it? (yes/no)	Feeling down, depressed, or hopeless (none/some/a lot)	You might have serious conflicts with your spouse, family members, or close friends? (yes/no/unsure)
Were constantly on guard, watchful, or easily startled? (yes/no)		You might hurt or lose control with someone? (yes/no/unsure)
Felt number or detached from others, activities, or your surroundings? (yes/mo)		Over the last 2 weeks, how often have you been bothered by any of the following problems?
		Thoughts that you would be better off dead or hurting yourself in some way (none/some/a lot)
		During this deployment have you sought, or do you now intend to seek, counseling or care for your mental health? (yes/no)

Symptoms of depression were ascertained using a modified version of a previously validated 2-item screening instrument; the subject must have answered "a lot" to at least one of the depression questions to be considered a screen positive for depression.[29] Subjects who screened positive for PTSD or depression, or endorsed any of the other mental health questions, were considered to have "any mental health concern." In this analysis, participants were restricted to those who completed a PDHA 1 to 6 months postinjury to increase the likelihood that injury was the predicating factor for the PDHA screening results. A total of 918 individuals (46.6%) met this criterion and made up the study sample for this subgroup analysis.

To more precisely assess the relationship between injury type and mental health outcome, factors reportedly related to the development of PTSD, or covariates, were assessed for adjustment purposes. Age, military rank, and military service were abstracted from the clinical record for all persons in the study sample. Intelligence, reportedly related to development of PTSD,[30] was measured with the Armed Forces Qualification Test (AFQT) score abstracted from CHAMPS.[31] Marital status was abstracted from CHAMPS as well. Previous mental health diagnoses have also been identified as a risk factor for PTSD development, and were identified from CHAMPS.[32] Patients with an ICD-9 code between 290 and 319 (excluding 305.10) at any time while in the military since January 1, 2000, and before the date of injury, were considered to have a previous mental health diagnosis. Reported history of combat experiences was ascertained from the PDHA for the subgroup analysis. Reporting "yes" to seeing dead bodies, discharging a weapon, or perceiving a threat to one's life indicated exposure to any combat experience.

Data Analysis

All statistical analyses were performed in SAS version 9.1 software (Cary, North Carolina). Demographic information was assessed by injury status (nonbattle, minor battle, moderate battle, serious battle, and severe battle). Differences across groups by injury status were tested using χ^2 and Fisher's exact tests for categorical variables and analysis of variance for continuous variables. Prevalence rates for mental health diagnoses were reported by injury status, and differences in rates were tested using χ^2 and Fisher's exact tests. Multiple comparisons were taken into account using Bonferroni for categorical variables and Tukey-Kramer for continuous variables. Logistic regression modeling was used to relate injury status to subsequent mental health diagnosis; covariates were assessed for potential confounding using criterion of a 20% change in odds ratio. Multiple sensitivity analyses were conducted to assess the impact of loss to follow-up via military discharge; in 1 case it was assumed all discharges developed the outcome and in another it was assumed a 50% random sample of the discharges developed the outcome. Sensitivity analyses were conducted separately for first-year discharges and total discharges. Self-reported mental health symptoms were reported by injury status, and differences were compared using χ^2 tests; a separate analysis was restricted to those reporting any combat experience. Additionally, self-reported mental health symptoms were compared with previous estimates in the OIF population by Hoge et al. from May 1, 2003 through April 30, 2004.[7]

RESULTS

Table II shows both the overall and battle injury-specific characteristics of the study sample. The mean age of the

TABLE II. Descriptive Statistics by Injury Status, Male Injured Combatants, Operation Iraqi Freedom, September 2004–February 2005

	No. (%) or Mean (SD)												
			Battle Injury										
Demographics	Total (n = 1,968)		Minor (n = 538)		Moderate (n = 155)		Serious (n = 93)		Severe (n = 45)		Nonbattle Injury (n=1,137)		p value[a]
Age (years)	25.0	(6.3)	24.2	(5.5)[b]	24.1	(5.2)[b]	24.2	(4.9)	22.6	(3.7)[b]	25.6	(6.9)	<0.01
Rank (%)													0.90
E1–E3	813	(41.3)	222	(40.6)	69	(44.5)	42	(45.2)	18	(40.0)	466	(41.0)	
E4–E5	839	(42.6)	242	(44.2)	61	(39.4)	31	(33.3)	22	(48.9)	487	(42.8)	
E6–E9	270	(13.7)	53	(9.7)	19	(12.3)	13	(14.0)	3	(6.7)	119	(10.5)	
WO/Officer	44	(2.2)	30	(5.5)	6	(3.9)	7	(7.5)	2	(4.4)	63	(5.5)	
Missing	2	(0.1)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	2	(0.2)	
Service (%)													0.03
Army	353	(17.9)	97	(18.0)	24	(15.5)	20	(21.5)	17	(37.8)	195	(17.2)	
Marines	1,508	(76.6)	417	(77.5)	123	(79.4)	70	(75.3)	27	(60.0)	871	(76.6)	
Other/unknown	107	(5.4)	24	(4.5)	8	(5.2)	3	(3.2)	1	(2.2)	71	(6.2)	
Married (%)	931	(47.3)	247	(45.9)	63	(40.7)	42	(45.2)	13	(28.9)[b]	566	(49.8)	0.02
AFQT (score)[c]	58.9	(18.5)	58.3	(19.0)	59.2	(18.6)	58.1	(18.6)	65.8	(18.8)	58.9	(18.1)	0.15
Previous MH diagnosis (%)	136	(6.9)	25	(4.7)	14	(9.0)	8	(8.6)	2	(4.4)	87	(7.7)	0.13
Answered PDHA	918	(46.7)	277	(51.5)	32	(20.7)[b]	17	(18.3)[b]	9	(20.0)[b]	583	(51.3)	<0.01

WO, warrant officer; MH, mental health; PDHA, Post-Deployment Health Assessment.

[a] Examining differences across categories.

[b] Significantly different from nonbattle injury after adjusting for multiple comparisons.

[c] Armed Forces Qualification Test: because of missing data, sample sizes were 509, 150, 89, and 43 for minor, moderate, serious, and severe battle injury, respectively, and 1,077 for nonbattle injury.

sample was 25.0 ± 6.3 years, and those with battle injuries were significantly younger than those with nonbattle injuries. A majority of all injuries were among junior enlisted (E1–E5) personnel; this was consistent across injury status. Military rank did not differ by injury status. A majority of all injuries (76.6%) occurred among Marine Corps personnel; military service differed by injury status. Nonbattle injuried were significantly more likely to be married than were severe battle-injured personnel. Moderate-to-severe battle injuried were significantly less likely to answer a PDHA 1 to 6 months postinjury.

Rates of mental health outcome are presented in Table III by injury status. Because of military discharge, follow-up time ranged from 90 to 820 days (median 707 days). Among those with any battle injury, rates of any mental health outcome, mood/anxiety disorders, and PTSD were 31.3%, 22.7%, and 17.0%, respectively, compared with 14.2%, 8.1%, and 5.1% for nonbattle injuries. A majority of mental health diagnoses occurred within the first year postinjury. The median time to diagnosis of any mental health outcome was 125.5 days (range 1–729 days) and 267.0 days (range 6–764 days) for battle and nonbattle injury, respectively. Compared with nonbattle injury, rates of all mental health correlates were significantly higher among battle injury, particularly those with moderate to severe injuries.

The final multivariate model relating battle injury status to subsequent mental health diagnosis is shown in Table IV. Compared with nonbattle injury, those with minor (odds ratio

TABLE III. Mental Health Outcome by Injury Status, Male Injured Combatants, Operation Iraqi Freedom, September 2004–February 2005

	No. (%)												
			Battle Injury										
Diagnoses	Total (n = 1,968)		Minor (n = 538)		Moderate (n = 155)		Serious (n = 93)		Severe (n = 45)		Total (n = 831)		Nonbattle Injury (n = 1, 137)		p value[a]
Posttraumatic stress disorder	199	(10.1)	68	(12.6)[b]	28	(18.1)[b]	30	(32.3)[b]	15	(33.3)[b]	141	(17.0)[b]	58	(5.1)	<0.01
Any mental health diagnosis[c]	421	(21.4)	117	(21.8)[b]	63	(40.7)[b]	52	(55.9)[b]	28	(62.2)[b]	260	(31.3)[b]	161	(14.2)	<0.01
Within first year	324	(16.5)	90	(16.7)[b]	56	(36.1)[b]	46	(49.5)[b]	26	(57.8)[b]	218	(26.2)[b]	106	(9.3)	<0.01
Mood/anxiety disorders	281	(14.3)	86	(16.0)[b]	49	(31.6)[b]	33	(35.5)[b]	21	(46.7)[b]	189	(22.7)[b]	92	(8.1)	<0.01
Mood only	30	(1.5)	7	(1.3)	8	(5.2)[b]	0	(0.0)	1	(2.2)	16	(1.9)	14	(1.2)	0.01
Anxiety only	161	(8.2)	55	(10.2)[b]	24	(15.5)[b]	24	(25.8)[b]	11	(24.4)[b]	114	(13.7)[b]	47	(4.1)	<0.01
Comorbid	90	(4.6)	24	(4.5)	17	(11.0)[b]	9	(9.7)[b]	9	(20.0)[b]	59	(7.1)[b]	31	(2.7)	<0.01
Adjustment disorders	129	(6.6)	26	(4.8)	23	(14.8)[b]	21	(22.6)[b]	10	(22.2)[b]	80	(9.6)[b]	49	(4.3)	<0.01
Substance abuse disorders	102	(5.1)	23	(4.3)	13	(8.4)	11	(11.8)[b]	9	(20.0)[b]	56	(6.7)[b]	46	(4.1)	<0.01
Other disorders	166	(8.4)	46	(8.6)[b]	20	(12.9)[b]	23	(24.7)[b]	17	(37.8)[b]	106	(12.8)[b]	60	(5.3)	<0.01

[a] Examining differences across categories.
[b] Significantly different from nonbattle injury after adjusting for multiple comparisons.
[c] Patients can have more than one diagnosis.

TABLE IV. Final Multivariate Model, Injury Status and Mental Health, Male Injured Combatants, Operation Iraqi Freedom, September 2004–February 2005

Characteristic	Diagnosis ±								
	Any Mental Health Outcome[a]			Mood and Anxiety Disorders[b]			Posttraumatic Stress Disorder[c]		
	OR (95% CI)		p value	OR (95% CI)		p value	OR (95% CI)		p value
Age (years)	0.97	(0.95, 0.99)	<0.01	0.96	(0.94, 0.99)	<0.01	0.98	(0.96, 1.01)	0.23
Injury type			<0.01			<0.01			<0.01
Nonbattle	1.00			1.00			1.00		
Minor battle	1.63	(1.25, 2.12)	<0.01	2.07	(1.51, 2.84)	<0.01	2.63	(1.82, 3.81)	<0.01
Moderate battle	4.02	(2.80, 5.78)	<0.01	5.06	(3.38, 7.56)	<0.01	4.01	(2.46, 6.54)	<0.01
Serious battle	7.49	(4.81, 11.67)	<0.01	6.05	(3.76, 9.75)	<0.01	8.69	(5.22, 14.47)	<0.01
Severe battle	9.28	(4.96, 17.38)	<0.01	9.10	(4.87, 17.03)	<0.01	8.88	(4.51, 17.48)	<0.01

[a] Includes anxiety, mood, adjustment, substance abuse, and other disorders.
[b] Excludes adjustment, substance abuse, and other disorders.
[c] Includes only posttraumatic stress disorder.

[OR] 2.63, 95% confidence interval [CI] 1.82, 3.81), moderate (OR 4.01, 95% CI 2.46, 6.54), serious (OR 8.69, 95% CI 5.22, 14.47), and severe (OR 8.88, 95% CI 4.51, 17.48) battle injury were more likely to receive a diagnosis of PTSD. Similar associations were observed for mood/anxiety disorders and any mental health outcome. None of the covariates assessed met criteria for confounding and thus, were not included in the final model.

Regarding the sensitivity analysis, a total of 11.6% (n = 96) and 10.7% (n = 122) were discharged without a mental health diagnosis within 1 year postinjury among battle and nonbattle injuries, respectively. After the first year, an additional 10.6% (n = 88) of battle injured and 10.6% (n = 120) of nonbattle injured were discharged. Rate of discharge did not differ for battle injury and nonbattle injury. Those lost to follow-up were younger, of more junior rank, less likely to be married, and more likely to serve in the Marines. Results of the sensitivity analyses showed that associations between battle injury status and mental health diagnosis remained consistent.

Frequencies of self-reported mental health symptoms from the PDHA are shown in Table V. As a result of a low PDHA response rate among moderate, serious, and severe battle injuries, these groups were combined into moderate-severe battle injuries for this analysis. A greater percentage of those with nonbattle injuries compared with battle injuries completed a PDHA less than 1 month postinjury, and were not included in the analysis. Additionally among battle-injured personnel, a greater percentage of Marines failed to complete a PDHA 1 to 6 months postinjury and moderate-severe injury was associated with not completing a PDHA or completing a PDHA less than 1 month postinjury. Rates of self-reported mental health symptoms were significantly higher among both the minor and moderate-severe battle injured groups when compared with the nonbattle injured group, with the exception of screening positive for depression. After restricting analysis to those who reported any combat experience, all associations remained significant, with the exception of any mental health concern using the stricter definition of screen-positive PTSD. A PTSD diagnosis was significantly associated with screening positive for PTSD (using both definitions); 18.4% of those answering 2 or more PTSD questions and 27.5% of those answering 3 or more PTSD questions also had a diagnosis of PTSD in the CHAMPS database.

Figure 1 presents the results of comparing rates of self-reported mental health symptoms with previous population estimates among those deployed to OIF from May 1, 2003 to April 30, 2004. Rates of all self-reported mental health symptoms were significantly higher when compared with the previous population estimates, including those for nonbattle injuries. Those with battle injury had higher rates of any combat experience compared with previous estimates,

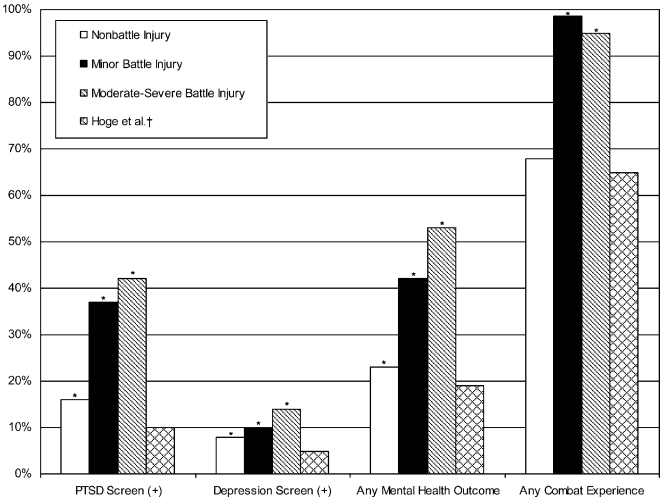

FIGURE 1. Post-Deployment Health Assessments (PDHA) by injury type. †[7]; *significantly different from Hoge et al.

TABLE V. Post-Deployment Health Screening by Injury Status, Male Injured Combatants, Operation Iraqi Freedom, September 2004–February 2005

	No. (%)								
			Battle Injury						
Demographics	Total (n = 918)		Minor (n = 277)		Moderate-Severe (n = 58)		Nonbattle Injury (n = 538)		p value[a]
PTSD screen (+)									
2 or more PTSD questions	217	(23.6)	102	(36.8)[b]	25	(43.1)[b]	90	(15.4)	<0.01
3 or more PTSD questions	109	(11.9)	53	(19.1)[b]	14	(24.1)[b]	42	(7.2)	<0.01
Depression screen (+)	81	(8.8)	28	(10.1)	8	(13.8)	45	(7.7)	0.20
Any mental health concern[c]									
2 or more PTSD questions	285	(31.1)	116	(41.9)[b]	31	(53.5)[b]	138	(23.7)	<0.01
3 or more PTSD questions	215	(23.4)	85	(30.7)[b]	21	(36.2)[b]	109	(18.7)	<0.01[d]

[a] Examining differences across categories.
[b] Significantly different from nonbattle injury after adjusting for multiple comparisons.
[c] Positive response to any of the 8 criteria: depression screen (+); PTSD screen (+); interest in receiving help for stress, emotional stress, family problem (yes); thoughts of hurting self (some or a lot); thoughts of serious conflicts with others (yes); thoughts of hurting someone or sense of a loss of control with others (yes); and have sought or intend to seek care for mental health (yes).
[d] Does not retain significance after restricting to those reporting any combat experience.

whereas nonbattle injury did not differ significantly from the previous estimates.

DISCUSSION

PTSD is a significant source of morbidity among deployed military personnel. To our knowledge, this is the first population-based study to examine the relationship between physical injury (both battle and nonbattle) and PTSD in a military population. This study found an increased risk of PTSD and other mental health diagnosis when comparing battle injury with nonbattle injury, with more severe battle injuries showing a greater risk. Rates of all categories of mental health outcome were significantly higher among battle injury compared with nonbattle injury. Self-reported symptoms of any mental health concern and PTSD were significantly higher among minor and moderate-severe battle injuries than among nonbattle injuries and were significantly higher than previous population estimates.

The present study identified a 31.3% rate of any mental health outcome and a 17.0% rate of PTSD among those with battle injury. These results are similar to a recent finding among OIF veterans seeking treatment at the Department of Veterans Affairs (VA), where rates of 25.0% and 13.0% were identified for any mental health outcome and PTSD, respectively.[33] The 1-year rate for any mental health outcome found among nonbattle injuries (9.3%) is consistent with a previous estimate Hoge et al. found among the general OIF deployed population.[7]

A previous study among OIF combat veterans also found results similar to the present study. In assessing combat experiences, Hoge et al. found that OIF veterans who indicated "being wounded or injured" had a 3-fold higher risk of PTSD; a similar association was found in the same study among combat veterans deployed to Afghanistan.[11] One other study from the Persian Gulf War examined psychiatric morbidity among those medically evacuated and compared traumatically injured with a group consisting of other medical conditions (e.g., chest pain, gastrointestinal bleeding, and orthopedic injuries).[34] The study found that those with a traumatic injury were more likely than those with other medical conditions to receive a psychiatric diagnosis.

The primary findings of the present study may be explained by the recovery-impeding (RI) model, one of three models proposed by Koren et al. to explain the relationship between physical injury and PTSD.[35] The first two models involve psychoneurobiological mechanisms, one where the injury augments the effect of the trauma itself and the other where the injury creates excess risk of PTSD through an independent psychoneurobiological mechanism; the influence of these models is difficult to establish in the present study because of lack of information. The RI model proposes that the physical injury itself blocks the recovery process by serving as a constant reminder of the trauma; this may explain the association between battle injury and PTSD found in the present study. The positive association found between battle injury severity and PTSD may be a result of increased risk of disability. If it is assumed that disability is associated with increasing injury severity, this may augment the blocking of the recovery process through additional pain and greater impact on daily life. A recent study by Grieger et al. identified early physical problems as a risk factor for PTSD and depression among injured OIF combat veterans.[36] Alternatively, the associations may be a result of a higher rate of combat exposure among those injured in battle. The finding may also be a result of medical utilization bias, since those injured in battle, especially those with higher injury severity, are likely to have more frequent contact with health care providers who may refer them for mental health issues. Overall, these results indicate the need for increased mental health screening among all battle-injured individuals.

This study had several limitations. Combat exposure was difficult to quantify. The "any combat experience" measure from the PDHA was utilized, but this equated individuals who had few exposures with those who had many; questions did not ask how much combat experience, just if the individual had any at all. Regarding the study sample, the data were collected from Navy-Marine Corps medical treatment facilities only, therefore, there was a preponderance of injuries from Marine Corps personnel; injuries treated by forward deployed Army facilities were not represented.

The primary outcome measures utilized were ascertained from an electronic database that tracks, among other things, medical encounters. Previous studies in the area of physical injury and mental health have for the most part used survey instruments with participants to ascertain a diagnosis. Using medical encounter data may have led to an underestimate of psychological morbidity because of either an aversion to seek treatment or only the most severe cases presenting, and also may have contributed to the aforementioned medical utilization bias. Toward the end of the follow-up for this study, data from CHAMPS may not have been fully updated because of a lag in entering ICD-9 codes. To account for the lag, the analysis was repeated including only diagnoses through August 2006, and similar results were found. An additional consideration was the high rate of loss to follow-up via military discharge because of the nature of the CHAMPS database and the inability of CHAMPS to track personnel postdischarge. Individuals may have received a mental health diagnosis following discharge, especially given the latency of development for some mental health conditions. There was also possible selection bias with the PDHA analysis among battle injuries; moderate-severe battle-injured personnel often completed a PDHA less than 1 month postinjury, and were thus not included in the PDHA analysis because of the nature of the PDHA questions (the PTSD questions inquired about symptoms experienced specifically in the previous 30 days).

This study also had several strengths. To our knowledge, this was the first population-based study to compare battle

and nonbattle injury with respect to subsequent diagnosis of PTSD and other mental health disorders. Additionally, the injury-specific information available from the Navy-MC CTR EMED allowed for the identification of minor, moderate, serious, and severe battle injuries utilizing the Injury Severity Score. More thorough analysis, however, of the severity and context of nonbattle injuries should be explored in future studies. The use and high matching rate of the CHAMPS database allowed for assessment of demographic variables, as well as previous mental health diagnoses. Using PDHA data as an outcome measure helped correct for the expected underestimation of mental health diagnosis, although it likely overestimated presence of PTSD and other mental health symptoms. The PDHA data also allowed for the comparison of our results to previous population estimates.

In conclusion, those with battle injuries are at greater risk of PTSD and other mental health diagnoses when compared with nonbattle injuries, and injury severity was positively associated with risk. Results remained consistent when examining self-reported mental health symptoms. Future studies might extend the follow-up period by utilizing VA databases, and should better account for combat exposure. As advances in field medicine lead to greater survival from battle injury, defining the impact of postinjury psychological morbidity will become increasingly important.

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14. ABSTRACT (maximum 200 words)

Background: Limited research exists on the relationship between physical injury and posttraumatic stress disorder (PTSD) within military populations. Objective: The present study aimed to examine differences in postinjury rates of PTSD and other psychological outcomes between battle and nonbattle injuries. Methods: A total of 1,968 men (831 battle injuries and 1,137 nonbattle injuries) injured between September 2004 and February 2005 during OIF comprised the study population. Patients were followed through November 2006 for diagnosis of mental health outcome (ICD-9 codes 290-319). Results: Compared with nonbattle injuries, those with battle injuries had a greater risk of PTSD and other mental health diagnosis, with the greatest effect seen as severity of battle injury increased. Self-reported mental health symptoms were significantly higher for both minor and moderate-severe battle injury in comparison with nonbattle injury and previous population estimates from an earlier OIF period. Conclusion: More research is needed to further define the relationship between battle injury and psychological outcomes by examining potential mechanisms and addressing the possible confounding effect of combat exposure.

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