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The Influence of Musculoskeletal Conditions, Behavioral Health Diagnoses, and Demographic Factors on Injury-Related Outcome in a High-Demand Population

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Background: The extent to which musculoskeletal injuries and sociodemographic factors impact long-term outcome remains unknown. The purpose of this study was to provide a prognostic analysis of the influence of musculoskeletal conditions, behavioral health diagnoses, and patient-based characteristics on outcomes among a longitudinal cohort.

Methods: This is a longitudinal observational study of the population of an Army brigade deployed to Iraq from 2006 to 2007. The 4087 soldiers who survived the deployment were followed for forty-eight months and were observed for the development of chronic musculoskeletal conditions, behavioral health disorders, and inability to remain in active service as indicated by the findings of the Physical Evaluation Board. The influence of demographic factors, behavioral health conditions, and deployment-related musculoskeletal injuries on the capacity to remain in the military was assessed using Poisson multivariate analysis and receiver operating characteristic curves.

Results: The mean age of the cohort was twenty-seven years (range, eighteen to fifty-two years). One hundred and sixty-three soldiers sustained combat-related musculoskeletal trauma, and 587 soldiers had musculoskeletal injuries not related to battle. Three hundred and seventy-four soldiers (9%) were found to be unfit by the Physical Evaluation Board, with 236 soldiers (63%) referred for at least one musculoskeletal condition. Of these 236 soldiers, 116 (49%) also had a behavioral health diagnosis. Multivariate regression analysis revealed that junior enlisted rank (incidence rate ratio, 9.7 [95% confidence interval, 3.1 to 30.3]), senior enlisted rank (incidence rate ratio, 5.6 [95% confidence interval, 1.8 to 17.7]), behavioral health diagnosis (incidence rate ratio, 7.4 [95% confidence interval, 5.6 to 9.6]), age of eighteen to twenty-three years (incidence rate ratio, 1.6 [95% confidence interval, 1.2 to 2.3]), and male sex (incidence rate ratio, 2.5 [95% confidence interval, 1.2 to 5.0]) were significant predictors of referral to the Physical Evaluation Board for a
continued

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musculoskeletal condition. A prognostic model developed using receiver operating characteristic curves and the risk factors of musculoskeletal injury, presence of a psychiatric condition, and lower rank explained 78% (95% confidence interval, 77% to 80%) of the risk of being found unfit by the Physical Evaluation Board.

Conclusions: Musculoskeletal conditions, psychological diagnoses, and lower rank (socioeconomic status) were identified as potent predictors of inferior outcome in this study. Targeting at-risk patients within populations may improve results.

Level of Evidence: Prognostic Level IV. See Instructions for Authors for a complete description of levels of evidence.

Injuries to the musculoskeletal system have long been recognized to have a negative impact on patient functionality and the ability to return to work[1-7]. Several prospective analyses have pointed toward inferior health status, as well as a reduced capacity to work, among individuals who have sustained musculoskeletal trauma for up to seven years following injury[2,3]. Although some studies contend that access to health care, quality of treatment, and the nature of injury are factors predictive of outcomes[1,4,8], others have indicated that socioeconomic status, social support systems, and educational level of the injured are disproportionately responsible for the capacity to return to work[2-4,8]. Behavioral health conditions, in particular, have been increasingly recognized as comorbid factors that not only elevate the risk of traumatic injury, but also have a depreciative effect on post-injury results[2,3,7-14].

Challenges to the effective evaluation of variables influencing inadequate outcomes following musculoskeletal injury include the fact that previous work conducted in this area has been performed among individuals following the onset of trauma, and appropriate control groups are difficult to devise. When psychiatric conditions or posttraumatic stress disorder are considered as covariates, it is especially difficult to discern whether behavioral health concerns were present prior to the trauma, or if they were potentially involved in precipitating the injury[2,9,10,14].

This investigation attempted to preclude these issues by studying a longitudinal cohort of American military service members deployed to Iraq as part of the Iraq War troop surge. Soldiers deployed with this unit were followed after their return from Iraq, with the military's electronic medical records database, combat casualty rosters, and U.S. Army Physical Evaluation Board proceedings used to construct a comprehensive data set. All service members in the unit were included in this analysis irrespective of the presence of deployment injury, facilitating the derivation of a control group that was exposed to similar combat conditions while avoiding injury.

With approximately four years of post-deployment observational data, we sought to determine the impact of musculoskeletal trauma, sociodemographic factors, and the presence of behavioral health conditions on an individual's ability to continue active military service. We also intended to model the risk incurred by the presence of individual factors, as well as cumulative conditions, on work capacity following injury. We hypothesized that soldiers who incurred musculoskeletal injuries during deployment and had behavioral health conditions would have lower rates of retention on active duty, as compared with service members who had not had war trauma or any psychiatric diagnoses.

Materials and Methods

Subjects

This research received approval from the William Beaumont Army Medical Center Investigational Review Board prior to its commencement. All service members assigned to a single U.S. Army Brigade Combat Team that deployed to Iraq for a fifteen-month period (2006 to 2007) were included in the study. At the time of the Brigade Combat Team's deployment, unit rosters, casualty rosters, the Joint Theater Trauma Registry, and electronic medical records were used to construct a comprehensive data set inclusive of all service members assigned. Service member demographic information, including age, rank, and sex, was recorded, as were all injuries sustained in theater. Deployment injuries were classified according to those that occurred as a direct result of combat (battle injury) and those precipitated through other circumstances (disease or non-battle injury).

Following their return from Iraq, soldiers' medical records were reviewed for the development, or persistence, of physical and mental health-related issues. Health records were abstracted on a monthly basis for the first six months following deployment and semi-annually thereafter. The ability to remain on active duty was determined for each individual based on the presence of Physical Evaluation Board proceedings. Military personnel are referred to a Physical Evaluation Board when psychiatric or physical conditions prevent satisfactory performance of duty[15,16]. With referral to a Physical Evaluation Board, board proceedings for each soldier were reviewed and condition(s) requiring separation (e.g., discharge) from the Army were documented. Individual medical records and Physical Evaluation Board proceedings, if available, were abstracted for every soldier who survived the 2006 to 2007 deployment, regardless of whether or not they remained part of the original Brigade Combat Team. Data collection was finalized in December 2011 and was reflective of forty-eight months of military medical evaluation and approximately forty-two months of Physical Evaluation Board proceedings, following the unit's return from Iraq.

Data Analysis

The inability to remain on active duty, as defined by the findings of a Physical Evaluation Board, was considered the dependent variable. Predictor variables included age, sex, military rank, presence of a diagnosed psychiatric condition, and a deployment-related injury. Age was categorized as eighteen to twenty-three years, twenty-four to twenty-nine years, and thirty years and older. Commensurate with previous works showing junior-enlisted ranks to be representative of lower socioeconomic status based on pay scales, soldier background, and the prevalence of certain medical and behavioral conditions[17-19], military rank was defined as junior enlisted (lowest four military ranks), senior enlisted (non-commissioned officers), and officers. Deployment-related injuries were defined as musculoskeletal (battle and non-battle), battle injury without

TABLE I Demographic Factors and Injury Characteristics of the Cohort*

Demographic Factor	Musculoskeletal Battle Injury (N = 163)	Musculoskeletal Non-Battle Injury (N = 587)	Battle Injury Not Involving Musculoskeletal System (N = 168)	No Battle or Musculoskeletal Non-Battle Injury (N = 3169)
Rank				
Junior enlisted	75 (46%)	287 (49%)	87 (52%)	1609 (51%)
Senior enlisted	72 (44%)	260 (44%)	74 (44%)	1248 (39%)
Officers	16 (10%)	40 (7%)	7 (4%)	312 (10%)
Age				
Eighteen to twenty-three years	52 (32%)	183 (31%)	76 (45%)	1142 (36%)
Twenty-four to twenty-nine years	68 (42%)	203 (35%)	65 (39%)	1105 (35%)
Thirty years or older	43 (26%)	201 (34%)	27 (16%)	922 (29%)
Sex				
Male	162 (99%)	543 (93%)	166 (99%)	2891 (91%)
Female	1 (1%)	44 (7%)	2 (1%)	278 (9%)

*The values are given as the number of patients, with the percentage in parentheses.

musculoskeletal trauma, and no battle or musculoskeletal injury. Soldiers who completed the deployment without incurring a battle injury or musculoskeletal trauma of any kind were considered the control group. When individuals were separated for a medical condition unrelated to the injury that they sustained during deployment, the non-deployment-related separation was discounted.

Statistical Analysis

The raw incidence of being deemed unfit by the Physical Evaluation Board, expressed as the number of individuals per 1000 person-years, was determined for each of the three injury categories, as well as for the study cohort as a whole. Incidence rates were also determined, within injury categories and for the entire cohort, using the predictor variables of age, rank, and sex. Significant risk factors for being deemed unfit by the Physical Evaluation Board were determined using Poisson multivariate analysis that controlled for other variables present in the model. Multivariate analysis was performed using a referent that was identified by convention as the predictor variable with the lowest unadjusted incidence rate of being deemed unfit by the Physical Evaluation Board. Multivariate analysis yielded an incidence rate ratio (IRR) with a 95% confidence interval (95% CI) and a p value. Only those factors with an IRR excluding 1.0 and a p value of <0.05 were considered to be significant predictors of being deemed unfit by the Physical Evaluation Board.

Predictive Model

On the basis of the significant predictor variables identified in multivariate analysis, receiver operating characteristic (ROC) curves were constructed to model the impact of risk factors, alone or in combination, on the chance of being deemed unfit by the Physical Evaluation Board. The area under the curve (AUC) following ROC curve analysis was interpreted to explain the variation in the risk of being deemed unfit by the Physical Evaluation Board attributable to the predictor variable(s).

Source of Funding

No external funding was received in support of this study.

Results

The Brigade Combat Team under study, at the time of deployment (2006 to 2007), consisted of 4122 service members. The mean age at the time of deployment was twenty-seven years (range, eighteen to fifty-two years). Thirty-five service members died over the course of the deployment, resulting in a population at risk of 4087. Three-hundred and thirty-one of these surviving soldiers sustained war trauma, with extremity injuries being the most common (49%), followed by combat-related trauma involving the head and neck (36%), and injuries to the thorax and abdomen (<10%). The most prevalent combat-related diagnosis was soft-tissue extremity wounds, occurring in 158 soldiers, followed by war-related fractures, occurring in fifty-nine soldiers, and traumatic amputations occurring in fourteen soldiers. Musculoskeletal injuries were also the most frequently encountered non-battle injury (50%), followed by psychiatric conditions (24%). Among non-battle casualties, the most common diagnosis was musculoskeletal sprain (139 soldiers), followed by musculoskeletal pain not specified (129 soldiers), and low back pain (eighty-one soldiers). Non-battle-related fractures were documented for sixty-six soldiers.

One hundred and sixty-three soldiers were classified as having sustained musculoskeletal battle injury, and 587 soldiers were classified as having sustained musculoskeletal non-battle injury (Table I). No evidence of combat-related injury, or musculoskeletal trauma, was encountered in 3169 soldiers, who were then designated as the control group. Within four years of the Brigade Combat Team's return from deployment, 374 individuals (9.2%) were found unfit by the Physical Evaluation Board. Among these cases, 236 (63%) were unfit because of one or more musculoskeletal conditions, and 221 (59%) were unfit because of a psychiatric condition. Of the 236 individuals who were referred for musculoskeletal concerns, 116 (49%) also had a psychiatric diagnosis.

Posttraumatic stress disorder, low back pain, and traumatic brain injury were the three most common conditions making individuals unfit for military service for the entire cohort, regardless of the presence of musculoskeletal injury

TABLE II Rank of Unfitting Conditions by Group

Rank	Entire Cohort	Musculoskeletal Injury	No Battle or Musculoskeletal Injury
1	Posttraumatic stress disorder	Posttraumatic stress disorder	Posttraumatic stress disorder
2	Low back pain	Low back pain	Low back pain
3	Traumatic brain injury	Traumatic brain injury	Traumatic brain injury
4	Other medical condition	Knee pain	Other medical condition
5	Knee pain	Knee arthritis	Psychiatric condition
6	Psychiatric condition	Loss of nerve function	Knee pain
7	Neurologic condition	Leg pain	Neurologic condition
8	Knee arthritis	Psychiatric condition	Cervical spine pain
9	Cervical spine pain	Neurologic condition	Shoulder pain
10	Shoulder pain	Other medical condition	Knee arthritis

(Table II). Musculoskeletal diagnoses represented half of the ten most common conditions rendering a soldier unfit for duty for the entire population, as well as among those who sustained no battle or musculoskeletal injuries.

The overall incidence of being deemed unfit by the Physical Evaluation Board for musculoskeletal conditions was 46.2 per 1000 person-years (Table III). The population mean was exceeded by soldiers who were male, eighteen to twenty-three years or twenty-four to twenty-nine years of age, and junior enlisted personnel (Table III). The highest incidence rate was encountered among personnel with a behavioral health diagnosis at 195.8 per 1000 person-years. Among the entire population, multivariate Poisson regression analysis revealed that rank of junior enlisted (IRR, 9.7 [95% CI, 3.1 to 30.3]; $p < 0.001$) or senior enlisted (IRR, 5.6 [95% CI, 1.8 to 17.7]; $p = 0.004$), age of eighteen to twenty-three years (IRR, 1.6 [95% CI, 1.2 to 2.3]; $p = 0.004$), presence of a behavioral health diagnosis (IRR, 7.4 [95% CI, 5.6 to 9.6]; $p < 0.0001$), and male sex (IRR, 2.5 [95%

TABLE III Risk Factors for an Unfitting Musculoskeletal Condition for the Cohort as Determined by Adjusted Incidence Rate Ratio

Demographic Factor	Population at Risk*	Population with Unfitting Musculoskeletal Condition†	Incidence of Unfitting Musculoskeletal Condition‡	Incidence Rate Ratio of Unfitting Musculoskeletal Condition§	P Value
Rank					
Junior enlisted	2058	159 (7.7%)	61.8	9.7 (3.1 to 30.3)	<0.001
Senior enlisted	1654	74 (4.5%)	35.8	5.6 (1.8 to 17.7)	0.004
Officers	375	3 (0.8%)	6.4	Reference#	Reference#
Age					
Eighteen to twenty-three years	1453	100 (6.9%)	55.1	1.6 (1.2 to 2.3)	0.004
Twenty-four to twenty-nine years	1441	86 (6.0%)	47.7	1.4 (1.0 to 2.0)	0.047
Thirty years or older	1193	50 (4.2%)	33.5	Reference#	Reference#
Sex					
Male	3762	228 (6.1%)	48.5	2.5 (1.2 to 5.0)	<0.001
Female	325	8 (2.5%)	19.7	Reference#	Reference#
Behavioral health diagnosis					
Present	474	116 (24.5%)	195.8	7.4 (5.6 to 9.6)	<0.0001
Absent	3613	120 (3.3%)	26.6	Reference#	Reference#
Population total	4087	236 (5.8%)	46.2	N/A**	N/A**

*The values are given as the number of subjects. †The values are given as the number of subjects, with the percentage in parentheses. ‡The values are given as the incidence, expressed as the incidence per 1000 person-years. §The values are given as the incidence rate ratio, with the 95% CI in parentheses. The determinations for rank were controlled for age, sex, and behavioral health diagnosis; the determinations for age were controlled for rank, sex, and behavioral health diagnosis; the determinations for sex were controlled for rank, age, and behavioral health diagnosis; and the determinations for behavioral health diagnosis were controlled for rank, sex, and age. #Reference refers to the condition that was used as the referent in multivariate Poisson regression analysis. **N/A = not applicable.

TABLE IV Risk Factors for an Unfitting Musculoskeletal Condition by Injury Category as Determined by Adjusted Incidence Rate Ratio

Risk Factors	Population at Risk*	Population with Unfitting Musculoskeletal Condition†	Incidence of Unfitting Musculoskeletal Condition‡	Incidence Rate Ratio of Unfitting Musculoskeletal Condition§	P Value
Musculoskeletal battle injury	163	33 (20.2%)	162		
Rank					
Junior enlisted	75	19 (25.3%)	202.7	4.1 (0.5 to 30.3)	0.2
Senior enlisted	72	13 (18.1%)	144.4	2.9 (0.4 to 22.1)	0.3
Officers	16	1 (6.3%)	50	Reference#	Reference#
Age					
Eighteen to twenty-three years	52	15 (28.8%)	230.8	2.5 (0.9 to 6.8)	0.08
Twenty-four to twenty-nine years	68	13 (19.1%)	152.9	1.6 (0.6 to 4.6)	0.3
Thirty years or older	43	5 (11.6%)	93	Reference#	Reference#
Sex					
Male	162	33 (20.4%)	163	N/A**	N/A**
Female	1	0 (0%)	0	N/A**	N/A**
Behavioral health diagnosis					
Present	31	23 (74.2%)	593.55	9.8 (4.2 to 22.7)	<0.001
Absent	132	10 (7.6%)	60.6	Reference#	N/A**
Musculoskeletal non-battle injury	587	60 (10.2%)	81.8		
Rank					
Junior enlisted	287	43 (15.0%)	119·9	2.3 (1.3 to 4.0)	0.004
Senior enlisted	260	17 (6.5%)	52.3	Reference#	Reference#
Officers	40	0 (0%)	0	N/A**	N/A
Age					
Eighteen to twenty-three years	183	27 (14.8%)	118	2.7 (1.3 to 5.4)	0.006
Twenty-four to twenty-nine years	203	22 (10.8%)	86.7	2.0 (1.0 to 4.1)	0.06
Thirty years or older	201	11 (5.5%)	43.8	Reference#	Reference#
Sex					
Male	543	58 (10.7%)	85.5	2.4 (0.6 to 9.6)	0.23
Female	44	2 (4.5%)	36.4	Reference#	Reference#
Behavioral health diagnosis					
Present	86	27 (31.4%)	251.2	4.8 (2.7 to 8.3)	<0.001
Absent	501	33 (6.6%)	52.7	Reference#	N/A**
No battle injury and no musculoskeletal non-battle injury	3169	131 (4.1%)	33.1		
Rank					
Junior enlisted	1609	89 (5.5%)	44.3	8.6 (2.1 to 35.0)	0.003
Senior enlisted	1248	40 (3.2%)	25.6	5.0 (1.2 to 20.7)	0.03
Officers	312	2 (0.6%)	5.1	Reference#	Reference#
Age					
Eighteen to twenty-three years	1142	51 (4.5%)	35.7	1.2 (0.8 to 1.8)	0.4
Twenty-four to twenty-nine years	1105	46 (4.2%)	33.3	1.1 (0.7 to 1.8)	0.6
Thirty years or older	922	34 (3.7%)	29.5	Reference#	Reference#
Sex					
Male	2891	125 (4.3%)	34.6	2.0 (0.9 to 1.5)	0.1
Female	278	6 (2.2%)	17.3	Reference#	Reference#
Behavioral health diagnosis					
Present	329	59 (17.9%)	143.5	7.1 (4.9 to 10.2)	<0.001
Absent	2840	72 (2.5%)	20.3	Reference#	N/A**

*The values are given as the number of subjects. †The values are given as the number of subjects, with the percentage in parentheses. ‡The values are given as the incidence of unfitting musculoskeletal condition, expressed as the incidence per 1000 person-years. §The values are given as the incidence rate ratio, with the 95% CI in parentheses. The determinations for rank were controlled for age, sex, and behavioral health diagnosis; the determinations for age were controlled for rank, sex, and behavioral health diagnosis; the determinations for sex were controlled for rank, age, and behavioral health diagnosis; and the determinations for behavioral health diagnosis were controlled for rank, sex, and age. #Reference refers to the condition that was used as the referent in multivariate Poisson regression analysis. **N/A = not applicable.

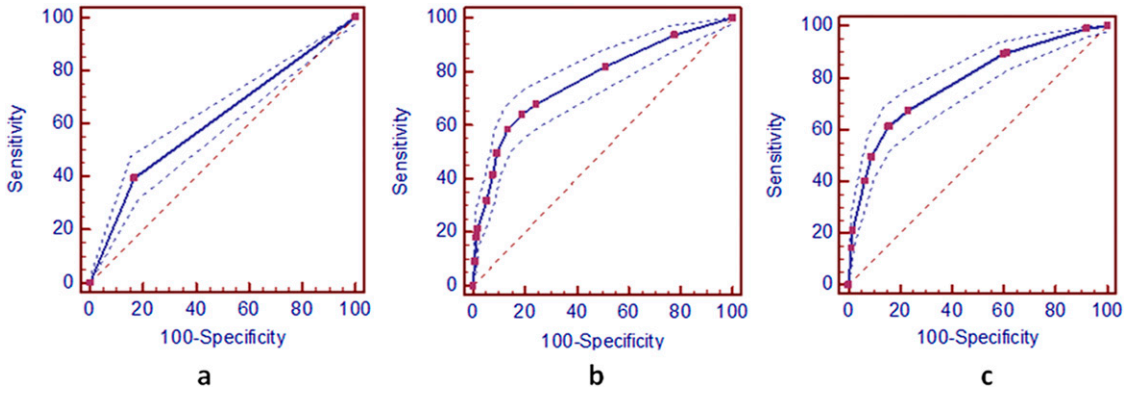

Fig. 1

ROC curve analysis demonstrating the impact of musculoskeletal injury alone (**Fig. 1-A**); musculoskeletal injury, age, and the presence of a psychiatric condition (**Fig. 1-B**); and musculoskeletal injury, presence of a psychiatric condition, and lower military rank (**Fig. 1-C**). The most parsimonious ROC curve was generated by the inclusion of musculoskeletal injury, the presence of a psychiatric condition, and lower rank.

CI, 1.2 to 5.0]; $p < 0.001$) were significant predictors of being deemed unfit by the Physical Evaluation Board for a musculoskeletal condition. A borderline trend was also noted for the age of twenty-four to twenty-nine years (IRR, 1.4 [95% CI, 1.0 to 2.0]; $p = 0.047$) to be influential of the risk for being deemed unfit by the Physical Evaluation Board.

The incidence rate for being deemed unfit by the Physical Evaluation Board was 162 per 1000 person-years for those with musculoskeletal battle casualties, 81.8 per 1000 person-years for those with musculoskeletal non-battle injuries, and 33.1 per 1000 person-years for the control group. Behavioral health diagnosis (IRR, 9.8 [95% CI, 4.2 to 22.7]; $p < 0.001$) was the sole significant predictor for being deemed unfit by the Physical Evaluation Board within the musculoskeletal battle injury group (Table IV). Behavioral health diagnosis (IRR, 4.8 [95% CI, 2.7 to 8.3]; $p < 0.001$), junior enlisted rank (IRR, 2.3 [95% CI, 1.3 to 4.0]; $p = 0.004$), and age of eighteen to twenty-three years (IRR, 2.7 [95% CI, 1.3 to 5.4]; $p = 0.006$) were significant variables for the cohort with non-battle musculoskeletal injuries. Among soldiers with no battle injury and no musculoskeletal injury, behavioral health diagnosis (IRR, 7.1 [95% CI, 4.9 to 10.2]; $p < 0.001$) and ranks of junior enlisted (IRR, 8.6 [95% CI, 2.1 to 35.0]; $p = 0.003$) and senior enlisted (IRR, 5.0 [95% CI, 1.2 to 20.7]; $p = 0.03$) were significant predictors.

ROC curve analysis demonstrated that the presence of musculoskeletal injury explained 61% (95% CI, 60% to 63% [coefficient = 1.2; $p < 0.001$]) of the risk of being deemed unfit by the Physical Evaluation Board (Fig. 1-A). Stepwise addition of age and the presence of a psychiatric condition resulted in age losing significance as a predictive variable (coefficient = −0.2; $p = 0.1$), and a strong association was appreciated for the presence of behavioral health diagnosis and the risk of being deemed unfit by the Physical Evaluation Board (coefficient = 2.2; $p < 0.001$) (Fig. 1-B). The most parsimonious ROC curve was generated by the inclusion of musculoskeletal injury, presence of a psychiatric condition, and lower rank (coefficient = −0.6; $p < 0.001$). The inclusion of these risk factors explained 78% (95% CI, 77% to 80%) of the risk of being deemed unfit by the Physical Evaluation Board (Fig. 1-C).

Discussion

We believe that this investigation provides the first prognostic analysis of the impact of musculoskeletal conditions, behavioral health diagnoses, and patient demographic characteristics on outcomes among a longitudinal cohort of American military adults. Prior studies addressing these issues in civilian populations have been hindered by small sample size, limited duration of follow-up, insufficient controls, and the fact that all investigations were essentially retroactive to the onset of trauma[1-4,7,12]. Our study is unique in that a defined population of more than 4000 individuals was followed from a period antedating the onset of traumatic events and/or exposure to violence.

Irrespective of whether or not combat-related injuries were sustained, the group of soldiers under study was exposed to a substantial amount of violence as evidenced by the fact that 8.7% of soldiers sustained combat-related trauma and approximately 1% died during the deployment. All personnel in the cohort were afforded the same medical, surgical, orthopaedic, behavioral health, and rehabilitative services during deployment and upon return to the United States. These factors render the group that did not sustain combat-related and/or musculoskeletal injuries an effective control to which comparisons can be made.

In total, 12% of soldiers with any musculoskeletal injury during deployment were unable to remain in active military service within forty-eight months after their return from deployment. The prognostic model that was developed, including multivariate analysis and ROC curves, identified musculoskeletal conditions, psychological diagnoses, and lower rank as predictive of inferior outcomes necessitating separation.

In many respects, such findings are unsurprising and comparable with previous reports involving civilians. Prior works have cited a wide range of return to work rates following musculoskeletal injury, highly influenced by the nature of the orthopaedic

trauma, types of injuries sustained, and the duration of follow-up[2,3,5]. The prevalence of behavioral conditions within our population was also anticipated on the basis of previous publications. Several studies have maintained that a high proportion of veterans from Iraq and Afghanistan are discharged from service with mental health conditions, including posttraumatic stress disorder[13,15,16,20,21]. A deleterious effect of mental health conditions on outcomes following trauma has been postulated in studies examining orthopaedic injuries[4,14], the Trauma Recovery Project[1], and survivors of the Oklahoma City bombing[11]. The presence of mental health disorders has been thought to adversely impact outcomes following musculoskeletal injury because of the effect of the acute psychological response on post-injury rehabilitation as well as patient satisfaction[4,9].

Relatively few studies have considered the influence of socioeconomic status on outcomes after musculoskeletal trauma. Some works have maintained that socially disadvantaged patients are at greater risk for inferior results, often citing disparities within the health-care system or hospital segregation[3,22,23]. Works conducted within the military system have found that junior enlisted personnel often derive from, and are representative of, socially disadvantaged civilian populations[17-19]. As the military provides health care in a universal system, socioeconomic discrimination and hospital segregation are not reasonable explanations for the potent influence of rank on outcome appreciated here. More likely, social factors such as attitudes toward the use of health care and the health-care system, educational level, and inadequate social support networks are responsible for the elevated risk of medical separation among soldiers of lower enlisted rank.

The results of this study readily translate to the civilian sector. Although not representative of the American demographic as a whole, the military population has been used as a proxy for athletic and high-demand civilian populations in the past[19,24]. Moreover, the demographic composition of the cohort under study approximates that of many investigations considering civilian trauma patients, including the Trauma Recovery Project[1] and the Lower Extremity Assessment Project (LEAP) study[2,10]. There is no reason to assume that the predictive factors for inferior outcome identified here, including the potent and synergistic effects of mental health conditions and rank (as a proxy for socioeconomic status), are only applicable to military populations. Furthermore, the ROC curve developed using the risk factors of musculoskeletal injury, presence of psychiatric conditions, and rank approximated a good predictive model for outcome that can be meaningfully applied to civilian practice. Aggressive outreach and enhanced access to social and behavioral health services, among military and civilian patients with the risk factors identified, may ultimately be able to enhance outcomes, including overall satisfaction and return to work.

One of the primary limitations in this study was our inability to utilize a standard battery of tests to document outcome. Instead, we had to rely on the recommendation for medical separation as our sole proxy for the end result, a metric that may not be entirely translatable to the civilian sector. Additionally, soldiers who did not seek care for their medical or behavioral health conditions and/or separated through retirement or failure to re-enlist would not be designated in this study as having an inferior result, creating the potential for selection bias. Lastly, this study did not possess a detailed analysis of preexisting alcoholism or mental health conditions that may have already been present in soldiers at the time of their deployment to Iraq.

Although acknowledging these limitations, we emphasize that this investigation is the first to follow a large cohort of American patients with musculoskeletal injuries along with a group of appropriate controls to ascertain important risk factors for inferior outcomes following trauma. The results presented here indicate the substantial burden in deployment-related injuries and disability that result from exposure to the combat environment. Perhaps equally as important, the prognostic model that was developed, including the identification of behavioral health conditions and rank as potent predictors of poor results following musculoskeletal injury, has the potential to improve the care of trauma patients in both the military and civilian settings. ■

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