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Predicting the Future Development of Depression or PTSD after Injury

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Abstract

Objective—To develop a predictive screener that when given soon after injury will accurately differentiate those who will later develop depression or PTSD from those who will not.

Method—Prospective, longitudinal cohort design. Subjects were randomly selected from all injured patients in the emergency department; the majority was assessed within one week post-injury with a short predictive screener, followed with in-person interviews after 3 and 6 months to determine the emergence of depression or PTSD within 6 months after injury.

Results—192 completed a risk factor survey at baseline; 165 were assessed over 6 months. Twenty-six subjects (15.8%, 95%CI 10.2–21.3) were diagnosed with depression, 4 (2.4%, 95% CI 0.7–5.9) with PTSD, and 1 with both. The final 8 item predictive screener was derived; optimal cut-off scores were ≥2 (of 4) depression risk items and ≥3 (of 5) PTSD risk items. The final screener demonstrated excellent sensitivity and moderate specificity for both clinically significant symptoms and for the diagnoses of depression and PTSD.

Conclusions—A simple screener that can help identify those patients at highest risk for future development of PTSD and depression post-injury allows the judicious allocation of costly mental health resources.

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Keywords

Injury; Depression; PTSD; Prediction; Screening

Introduction

Thirty-seven to 56% of injured patients admitted to a trauma service experience depression [1,2,3]. Up to 38% of injured patients are depressed by six months, with similar rates of depression observed one year after injury [4,5]. Post traumatic stress disorder (PTSD) is also common after injury with10% to 22% of injured patients meeting diagnostic criteria for PTSD [6,7]. Injured patients are more likely to commit suicide than the general population, an extreme indicator of the impact of depression and psychiatric co-morbidity [8].

Injury events can generate feelings of helplessness, horror, and a belief that the world is no longer safe. Mental health consequences of injury pose serious health care problems, and depression and PTSD interfere in daily activities [9,10,11]. Thus, it should not be surprising that injured patients who develop depression or PTSD have higher levels of functional impairment. Depression and PTSD exert a significant, independent, and persistent effect on general health, work status, somatic symptoms, adjustment to illness, and function after injury [12,13]. Even sub-diagnostic depression or PTSD is associated with lost wages, use of temporary workers, sick time, an inability to fully function, and increased cost [14].

Physical injury is experienced as life-threatening and engenders a response of fear, helplessness, or horror, such that the event may cause a traumatic stress response (DSM IV-TR) [15]. Therefore, PTSD is a potential psychiatric consequence of injury. Cognitive processing in the posttraumatic setting contributes to development of PTSD and may also influence an individual's negative core schemas (e.g. I'm worthless, I'm unlovable). This can contribute to depression, a second potential consequence of injury [16]. A consistent finding, however, is that the objective severity of physical injury is not related to the occurrence or severity of post-injury psychological consequences; even minor injuries can lead to traumatic stress responses [17].

Early intervention models are designed to mediate the damaging effects of potentially traumatic events. These models require reliable predictors of risk for the development of psychological consequences in order to allow interventions to be targeted to those most in need [18]. The challenge is to identify those injured patients at highest risk for the future development of depression or PTSD. Studies over the past decade suggest that there are identifiable risk factors for the development of post-injury psychological disorders. Factors associated with an increased likelihood of depression or PTSD include acute stress symptoms [11], previous treatment for depression [11], previous trauma exposures [19,20], limited financial and social resources [21], history of maladaptive coping responses (e.g. substance abuse) [18], concerns related to injury [22], and appraisal of acute stress reactions [23].

Several predictive screeners have been developed and tested in the UK and Australia, one focused on the prediction of the future development of PTSD (UK) [24], one with the intent to predict the future development of depression after motor vehicle crash (Australia) [25], and one to predict depression and PTSD post-injury (Australia) [26]. To our knowledge, no predictive screeners for the future development of depression or PTSD post-injury in adults have been developed in the U.S.

Therefore, we report on our initial work to develop a predictive screener that when given soon after injury will accurately predict who, in the future, will develop a diagnosis of depression or PTSD. In this study, we build on the seminal work of Winston and colleagues in predicting PTSD in pediatric injury patients after motor vehicle crashes [27]. This predictive screener has been integrated into clinical care in a number of pediatric settings to help guide decisions about psychological support during and after acute care for pediatric injury. We model their approach to develop a theoretically-derived and empirically-validated predictive screener in the adult injury population and extend the predictive screener to also include depression. This study is an important first step in identifying those individuals at highest risk for developing these disorders in order to target appropriate resources to this vulnerable group.

Materials & Methods

The current study was part of a prospective, longitudinal cohort study whose primary aim was to determine the emergence of depression and PTSD in the year after injury and to examine the contribution of these psychiatric disorders to the return to pre-injury function; these findings have been reported elsewhere. The earlier report showed that those who developed post-injury depression did not return to their pre-injury level of function [28]. This study was approved by the appropriate human subjects' board.

Setting

Subjects were drawn from an urban emergency department (ED) in a tertiary academic medical center with a regional resource trauma center. Over 60,000 patients are treated annually in this ED and the sample demographics represent the demographics of the surrounding neighborhoods. All patients presenting to the ED are triaged immediately and given a preliminary diagnosis. Study consent and a short intake interview took place in a private treatment cubicle in the ED. Follow-up visits were conducted in private offices on the university campus or at the subject's home.

Sample Criteria

English speaking adults (≥18 years) with relatively minor injuries were considered for study entry. Minor injury was operationally defined by the combination of three criteria: 1) presentation to the ED for medical care within 24 hours of a physical injury; 2) an injury severity score (ISS) between 2–8; and 3) normal post-injury physiology - defined by a triage-Revised Trauma Score (t-RTS) of 12. Patients were excluded for: 1) CNS injuries (head or spinal cord injury); 2) traumatic injury requiring medical care in the past 2 years; 3) injury directly resulting from a concurrent medical illness (e.g. pathological fracture) or from domestic violence; 4) current treatment for major depression by a health care provider or whose symptoms met criteria for a major depressive episode at the 72 hour baseline interview; and, 5) a diagnosis of DSM IV Axis I psychotic disorders.

Sample Description

The predictive screener study began several months after the larger study, and thus we report here on a subset of our original sample of 275 who were included in prior reports. One hundred and ninety-two participants completed the risk factor survey at the baseline interview and 165 were available for the 6 month follow-up, representing 85% retention. The 27 who dropped out were younger (mean age 33years vs. 42 years, p=0.006) and had fewer years of education (12.3years vs. 13.8years, p=0.004) than the 165 who completed the follow-up assessment are presented in Table 1.

Instruments

Injury Measures—Standard demographic data were obtained. The AIS ’90, a widely used anatomical rating scale, was used to categorize type of injury. It is a consensus-derived, anatomically-based injury categorization system that ranks and compares injuries by severity according to body system involved. The 6 body systems are head/neck, face, thorax, abdomen, extremities, and external. Injury severity was measured by the ISS, derived from the severity of injury within each of the AIS body systems with a range of scores of 1 (least severe) to 75 (most severe) [29]. The ISS provides a single numerical score that compares multiple injuries across body systems. Physiologic severity was measured by the triage-Revised Trauma Score is based on systolic blood pressure, respiratory rate, and Glasgow Coma Scale [30].

Outcome Measures—The Structured Clinical Interview for DSM-IV Axis I Disorders, Non-Patient Version (SCID I-NP) served as the primary instrument for the diagnosis of depression or PTSD based on the DSM-IV TR diagnostic criteria. The SCID I-NP is a semi-structured psychiatric interview designed to produce judgments with respect to all 5 Axes of the DSM-IV [31]. The SCID I-NP was obtained at the baseline interview and was re-administered at the 6 month follow-up visit.

Symptom Severity Measures—The Hamilton Depression Rating Scale (HAM-D) is a well validated, clinician-rated instrument for ascertaining the severity of depressive symptoms resulting from any psychiatric (or non-psychiatric) cause [32]. It performs consistently across racial/ethnic groups, albeit with variations in symptoms. The Hamilton Anxiety Rating Scale (HAM-A) is a well validated, clinician-rated instrument for ascertaining the presence and severity of anxiety symptoms resulting from any psychiatric or non-psychiatric cause [33].

The Beck Depression Inventory (BDI) is a validated, patient-rated instrument for ascertaining the presence and severity of depressive symptoms [34]. The Beck Anxiety Inventory (BAI) is a recently developed, validated self-report measure of the presence and severity of anxiety symptoms designed to minimize overlap with the construct of depression [35]. The Impact of Event Scale (IES) is a validated, self-report measure for assessing the presence and severity of symptoms resulting from post-traumatic psychological distress [36].

Quality of life was measured with the Quality of Life Index (QLI), a self-report measure of a person’s satisfaction with key domains of his/her life and the importance of each of these domains [37,38]. The total score ranges from 0 to 30, with 30 indicating higher QOL.

The Risk Factor Survey—The development of the predictive screener reported here was modeled on the work of Winston et al. who developed a screener to predict which children were most likely to develop persistent symptoms of PTSD after unintentional injury [27]. This initial tool, the Screening Tool for Early Predictors of PTSD (STEPP) was derived from a 50 risk factor survey administered within the first month after injury to a sample of 269 children (ages 8–17 years). The final STEPP consisted of dichotomous questions asked of the child (4 items) and parent (1 item) and 3 items easily obtained from the emergency medical record. Sensitivity for predicting posttraumatic stress was 0.88 for children with negative predictive values of 0.95 for children.

We followed the identical approach, albeit for adults and with the addition of the prediction of depression in addition to PTSD. We developed a risk factor survey consisting of 42 yes/no items, plus heart rate, pain ratings and injury severity. (see table 2) Based on the theoretical, clinical, and research literature regarding risk factors for PTSD and depression

following injury, items were developed to represent domains theoretically likely to be early predictors of depression and/or PTSD post-injury.

Procedure

Patients with a triage diagnosis of injury were identified in the ED and underwent screening when medically stable. If sampling criteria were met, patients were provided a short overview of the study and asked for verbal consent to have their contact information released to the study team. This group served as the eligible pool of potential participants. Because of the volume of injury patients and the intensity of follow-up, participants were randomly selected from the eligible pool using a computer generated random number scheme based on the time of entry to the treatment cubicle. The random sampling scheme took into consideration the flow of patients in this ED and reflected the proportion of patients typically seen over the span of 24 hours and 7 days of the week.

Randomly selected patients were contacted within 1–2 days of injury by the study team whether they were in-hospital or via telephone if at home and were provided information about the study. If the patient consented to participate, a baseline interview was arranged within 2 weeks of the injury. The majority was interviewed within one week after injury. At this interview, all questions about the study were answered and written consent was obtained. A diagnostic psychiatric interview was conducted using the SCID I-NP. At this point, patients diagnosed with an existing major depression were excluded from the study.

The psychiatric interview using the appropriate SCID modules took place at 3 and 6 months. The 3 and 6 month interviews took place at the trauma outcomes research section, the participant's home, or a mutually agreeable public location with private space. Subjects were paid $30 at the completion of the baseline interview, $30 at the 3 month and $30 at the 6 month interview. The primary outcome was the diagnosis of depression and PTSD between baseline and 6 months. All interviews were conducted in-person by one trained rater with 30 years experience in this area. He underwent 40 hours of additional training that included reviewing SCID training tapes with scoring and administering and videotaping practice SCIDs with students and clinical patients. Training was considered complete when all diagnoses (or absence of diagnoses) concurred with the study psychiatrist. Cases were reviewed regularly with the study psychiatrist and any discrepancies were resolved by consensus.

Statistical Analysis

All data were summarized descriptively, using frequencies for categorical variables and means and standard deviations for continuous variables. Analyses were conducted using the most current version of SPSS with a two-sided p-value ≤ 0.05 as the criterion for statistical significance. The most current version of SAS was used to conduct the best subset analyses.

From the theoretically-derived 42 item risk factor survey, we selected candidate items that performed well in univariate analysis of their relationship with significant symptoms of depression or posttraumatic stress and these items were retained for further analyses. We then used all-subsets multiple logistic regression analyses that were performed separately to find the best sets of items to predict significant symptoms of depression (a Ham-D ≥ 9) and post-traumatic stress (IES ≥ 25). We examined coordinates of the ROC curve for each screener to choose a cut point for each that best balanced sensitivity and specificity. In essence, we used a best-subset approach, in which the best models containing 1, 2, 3, or 4 variables that were selected at each step by comparing log-likelihood estimates. No more variables were added to the model when the addition did not produce a significant increase in the log-likelihood.

We then tested the predictive screener against the more rigorous standard of predicting those who were diagnosed with depression or with PTSD using DSM IV-TR criteria and it performed as well or better. Finally, to further check the predictive screener, we used t-tests to compare those who screened positive vs. those who screened negative at baseline on a variety of other important outcomes at 6 months, including psychiatric symptom severity and quality of life.

Results

One hundred and sixty-five of the 192 participants enrolled were available for the 6 month outcome assessment. Of this group, 30 (18.2%; 95%CI 12.3–24.1) participants had significant symptoms of depression and 26 participants (15.8%, 95%CI 10.2–21.3) were diagnosed with depression. Also in this group, 26 (15.8%, 95%CI 10.2 – 21.3) participants had significant symptoms of posttraumatic stress and 4 (2.4%, 95% CI 0.7–5.9) were diagnosed with PTSD. One participant had co-morbid PTSD and depression.

From the results of the all subsets analysis, the best logistic model consisted of a 4 variable model (for significant depressive symptoms) and a 5 variable model (for significant post-traumatic stress symptoms). The regression models containing the final items predicting depressive symptoms or traumatic stress symptoms and the odds ratio for each item alone and in the multivariate predictions are presented in Table 3.

Optimal cut-off scores were determined by examination of coordinates of the ROC curve for each outcome (significant depressive symptoms or significant post-traumatic stress symptoms). Our goal was to optimize sensitivity while retaining adequate specificity. The optimal cut-off score was 2 or more (of 4) depression risk items and 3 or more (of 5) post-traumatic stress risk items. (see Table 4) In this development sample, 37% would have screened positive for depression risk, 36% for PTSD risk, and 25% would have screened positive for both.

Table 5 shows the screener performance for both significant symptoms and for the more rigorous standard of predicting those diagnosed with depression or PTSD at 6 months. To further examine the clinical logic of the screener, we compared the group who screened positive to those who screened negative at baseline on psychiatric symptom severity and quality of life at 6 months post-injury. As seen in Table 6, in all cases those who screened positive had significantly higher psychiatric symptom severity and significantly lower quality of life scores than those who screened negative. The final predictive screener consists of 8 items (one item was common to depression and PTSD risk) and can be seen in Table 7.

Discussion

In the United States, approximately 30 million Americans seek care for injury in the ED annually [39]. The frequency of injury and the prevalence of post-injury psychological sequelae provide the impetus to develop clinically relevant mechanisms to identify those patients at highest risk for depression and PTSD. The final screener is brief and includes only information that is readily available from the medical record, patient or family so that it is easily administered and scored by clinicians in busy clinical settings (less time than acquiring data for the widely used revised trauma score). By doing so, we provide a simple screener that can help identify those patients at highest risk for developing PTSD and depression within 6 months after injury. Clinically, all injured patients can be rapidly assessed for risk in the hospital and those classed as high-risk for the future development of depression or PTSD can be provided anticipatory guidance. For example, at hospital

discharge patients and families can be provided information about symptoms consistent with depression or PTSD and told to contact their primary care provider should they surface. This anticipatory guidance is viewed as essential given the failure of primary care providers to accurately diagnose depression [40]. This will facilitate early diagnosis of these disabling disorders.

The predictive screener is unique in that the purpose is not to screen for current disorders, but to predict the future occurrence of these disorders. To develop it, we chose to use the most rigorous outcome, specifically DSM IV-TR diagnostic criteria for depression and PTSD rather than symptom severity. It is important to state with clarity that our simply worded screener is not diagnostic, but rather is intended to be used to risk-stratify patients soon after injury for the future occurrence of depression or PTSD. The area under the curve (ROC) which was 0.81 for depression and 0.81 for PTSD is very good for a new predictive screener.

The negative predictive value of 0.95 for depression and 1.00 for PTSD supports the role of this predictive screener as a screening tool. Essentially, in this sample, we can indicate with high levels of certainty that only 5% of injured patients who test negative on the screener for depression will develop depression and no patients who test negative for PTSD will develop PTSD. Thus, patients who screen negative can, with confidence, be screened out from further monitoring for these disorders. The majority of injured patients are discharged from the hospital before a PTSD diagnosis could be made (i.e. to diagnose PTSD, symptoms must extend beyond 1 month after injury) and typically before the onset of a major depressive episode (symptoms present for at least 2 weeks), reinforcing the value of a screener that can be applied during hospitalization. Further, the sensitivity (.81 for depression, 1.00 for PTSD) of the screening tool was quite promising, suggesting that a brief set of questions may be able to identify three fourths (or more) of those individuals who will later develop significant psychological sequelae after injury. The screener is an important first step in narrowing down numbers of patients who are likely to develop depression and PTSD and can help focus limited resources on following those patients at highest risk these disorders. Not all who screen positive will develop these disorders, and we do not suggest that all patients who screen positive receive services, but rather that this finding prompt systematic provision of information and additional follow-up. First, patients and families can be provided anticipatory guidance about post-injury psychological symptoms for which they should seek care. Second, this triage information could trigger established systems of follow-up that include psychological assessment as part of post-injury care.

The risk survey from which the final predictive screener was derived included 44 items across 14 domains. The final 8 item screener includes only 7 of the original domains. The loss of some of the domains may be explained by the complexities of injury. For example, the acute physiologic arousal domain was the initial heart rate taken in triage in the ED. While previous studies support elevated heart rate predicting PTSD [41,42], injured adults have many physiologic factors that increase heart rate (e.g., hypovolemia) or decrease heart rate (e.g. beta blockade) that could account for its demise in the screener.

The recognition of the prevalence and impact of post-injury psychological disorders has increased, driving a body of research focused on identifying risk factors for post-injury depression and PTSD. To our knowledge three other predictive screeners for adults have been published. Walters et al. sought to predict PTSD six months after injury in adults in Wales (UK) who presented for emergency treatment of assault-related injuries [24]. They evaluated the utility of the 10-item Trauma Screening Questionnaire as a predictive screener, with PTSD presence based on self-reported PTSD symptoms as the outcome measure. Their study sample was 85% male, focused only on assault victims, and was limited by 45%

attrition. Silove et al. sought to predict depression after motor vehicle crash injury in Australia, but were limited by 52% attrition and a racially homogeneous sample [25]. Concurrent with our work, O'Donnell et al. developed a predictive screener for PTSD and depression after injury using randomly selected patients drawn from 3 level I trauma centers in Australia [26]. Their sample was predominately male (72%), with moderate injury mostly frequently from transport accidents or falls: 77% was available for follow-up. Similar to our study, the outcome measures to be predicted were whether a participant met diagnostic criteria for PTSD and depression. Despite the different analytic approaches, the fact that our sample was less seriously injured (ISS 4.2 vs. 11.4), and that our sample had a more equal gender distribution, our respective predictive screeners function comparably. O'Donnell's screener for diagnostic depression had a sensitivity of 0.72 and specificity of 0.75 (ours was 0.81 and 0.71 respectively). The O'Donnell screener for PTSD had a sensitivity of 0.82 and specificity of 0.84 (ours was 1.00 and 0.66 respectively). Future studies comparing performance of this screener with our predictive screener would be beneficial.

The results of our study should be interpreted in light of its strengths and limitations. Random selection of the sample from the larger injured population enhances the generalizability of the findings. Our sample reflects an equal distribution between Blacks and Whites. Most prior studies seeking to develop a predictive screener have used predominately White samples. Our study included only individuals with minor injuries. The rates of depression and PTSD are lower than found in some reports in the literature, likely for 3 reasons. First, we excluded from the study any participants with a self-reported major depression and also removed those at intake interview who met diagnostic criteria for a major depression disorder. Second, the low rate of PTSD may be due to the focus on minor injury which may not have been perceived as life-threatening. The PPV and NPV are likely affected by the low prevalence of PTSD in this sample. Finally, previous studies of PTSD after civilian injury frequently report rates based on clinically problematic symptoms, but not the diagnosis of PTSD. In our sample, while our diagnostic rate of PTSD (2.4%) was lower than expected, 15.8% of the sample was found to have significant symptoms of posttraumatic stress - consistent with other reports. Generalizability to serious injuries will need to be tested in future samples.

The findings reported here are based on the sample on which the predictive screener was developed. This is the first step of developing new tools for risk assessment, and findings in a variety of medical specialties are typically reported on new screeners at this point in their development [43–45]. It will be important to establish the predictive validity of the screen in additional prospective studies across a variety of injured populations in geographically diverse locations with demographically diverse and larger samples. Although the majority of our subjects completed the screener within 1 week of injury, in some cases this extended to 2 weeks after injury. It will therefore be important in future validation of this screener to apply the screener while patients are still in-hospital, likely several days after injury when medically stable. After further validation, this short, clinically relevant screener could easily be incorporated into practice protocols and the electronic medical record.

Summary

The findings of this study indicate it is possible to identify a subset of injured patients who are likely to develop depression or PTSD in the 6 months after hospital discharge. By differentiating those who will develop depression or PTSD from those who will not, clinicians can focus limited resources to follow, diagnose and treat those most likely to experience problematic psychological sequelae from injury.

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Table 1

Sample Characteristics (n = 192)

Characteristics	N (%) or Mean
Age in years	41.2 (17.3)
Education in years	13.6 (2.7)
Sex	
Male	100 (52%)
Female	92 (48%)
Race	
Black	105 (55%)
White	82 (43%)
Asian	5 (3%)
Ethnicity	
Non-Hispanic	187 (97%)
Hispanic	5 (3%)
Marital Status	
Single, never married	99 (52%)
Married/living as married	53 (27%)
Divorced/Separated	32 (17%)
Widowed	8 (4%)
Employment Status at Injury	
Full-time	101 (53%)
Part-time	36 (19%)
Stay at Home/Student	20 (10%)
Disabled/Retired	19 (10%)
Unemployed	16 (8%)
Mechanism of Injury	
Slip or Fall	93 (48%)
Motor vehicle crash	37 (19%)
Sports	17 (9%)
Assault/GSW	14 (7%)
Bicycle/Pedestrian	13 (6%)
Machinery	9 (4%)
Other	10 (5%)
Injury Severity Score	4.38 (SD 1.0)

Table 2

Domains and Items of the Risk Factor Survey from which the Predictive Screener was derived

Domain	Items
Prior Trauma/Exposure to PTSD	• Before this injury, had you ever seen or experienced anything really frightening or terrible? (such as: a fire, serious accident, natural disaster; being assaulted, mugged, or threatened; being in combat or a war zone; or anything else extremely frightening that happened to you or someone you care about) • Before this injury, did you ever have an experience that caused you serious injury or made you believe you might die? • [If yes to #1 or #2] -When that (OR those things) happened, did you have reactions that were hard to get over (like not being able to get it out of your mind, staying away from things that reminded you of it, feeling really jumpy or anxious)?
History of depression*	• Has there ever been a time in your life that you have been bothered by feeling down or hopeless, or lost all interest in things you usually enjoyed, for more than two weeks? • Have you ever sought treatment for feeling down or depressed (or thought you should have)?
Severity of exposure to trauma (this injury)	• When you were injured, was anyone else hurt or killed? • Did you see anything really frightening or horrible? (for example, bloody or injured parts of your body, other people hurt or dying)? • Did you hear anything really frightening or horrible? (e.g., screaming; crashing sounds) • On a scale of 1–10, what is the worst level of pain you experienced when you were injured? • Injury severity score • Was there an extremity Injury?
Subjective Response to injury*	• Did you feel really afraid? • Did you feel really helpless? • Did it seem really shocking or awful? • Did it seem unreal or like it was happening in a dream or in slow motion? • Did you think you might die? • Did you think someone else might die?
Acute Physiological Arousal	• Emergency department triage heart rate
Acute traumatic stress reactions*	• Did you have thoughts about what happened been popping in your mind, even when you don't want to? • Have you wanted to or tried hard to stay away from things that remind you of what happened? • Have you felt like your were not safe
Acute depression symptoms	• Have you felt down, depressed or helpless more than usual? • Are you depressed, most of the day, nearly every day?
Other acute responses	• Did you feel really angry? • Did you feel all alone?
Appraisal of acute stress reactions*	• Since you were hurt, have you had reactions (feeling faint or shaky, heart beating ast) that scare you? • Since you were hurt, have you been worried because you had trouble keeping your mind on things? • Since you were hurt, have you been bothered by feeling out of control? • Since you were hurt, have you worried that you were going crazy?
Maladaptive coping*	• Have you found yourself drinking more (or more often) than usual?

Domain	Items
	• Have you been staying away from people, even people you are usually close to? • Have you found yourself replaying what happened over and over in your mind?
Negative beliefs about future	• Do you anticipate problems going back to your normal activities? • Do you think this injury is probably going to have a very bad effect on your life?
Resource loss*	• Are you worried that you will miss a lot of time at work or school? • Are you worried about money because of what has happened? • Are you worried that insurance will not cover expenses related to this injury? • Now (today) are there things you cannot do physically because of your injury? • Has this injury disrupted your life?
Lack of perceived social support*	• Do you have family, friends, or other people who you can turn to for help? • Is there someone who has responded badly when you told them about what happened? • Do you have family or friends who really understand what you are going through? • Is there someone you can count on to listen to you?
Current/ongoing pain	• …what is your current pain level? (what you are feeling right now, today)

*Domains retained in the final predictive screener

Table 3

Final predictor items for significant depressive symptoms or significant traumatic stress symptoms: odds ratio [with 95% confidence interval] for each item alone and in multivariable prediction of outcome

Prediction of significant depression symptoms* (N = 164)				
Item	**Single variable**		**Multivariable logistic regression**	
	OR [CI]	**p**	**OR [CI]**	**p**
Has there ever been a time in your life that you have been bothered by feeling down or hopeless, or lost all interest in things you usually enjoyed, for more than two weeks?	4.89 [2.12 – 11.28]	.000	2.66 [1.07 – 6.64]	.04
Have you been staying away from people, even people you are usually close to?	4.59 [1.84 – 11.48]	.001	1.83 [0.61 – 5.54]	.28
Are you worried about money because of what has happened?	6.36 [2.29 – 17.61]	.000	4.12 [1.40 – 12.12]	.01
Since you were hurt, have you been worried because you had trouble keeping your mind on things?	4.14 [1.81 – 9.46]	.001	2.34 [0.87 – 6.32]	.09

Prediction of significant traumatic stress symptoms** (N = 163)				
Item	**Single variable**		**Multivariable logistic regression**	
	OR [CI]	**p**	**OR [CI]**	**p**
Did you feel really helpless?	8.05 [1.83 – 35.44]	.006	3.67 [0.77 – 17.60]	.10
Did it seem unreal or like it was happening in a dream or in slow motion?	4.26 [1.52 – 11.95]	.006	2.79 [0.88 – 8.85]	.08
Have you wanted to (or tried hard to) stay away from things that remind you of what happened?	6.58 [2.57 – 16.88]	.000	2.56 [0.85 – 7.74]	.10
Since you were hurt, have you been worried because you had trouble keeping your mind on things?	5.96 [2.45 – 14.51]	.000	2.58 [0.92 – 7.27]	.07
Is there someone who has responded badly when you told them about what happened?	4.48 [1.85 – 10.83]	.001	2.63 [0.94 – 7.38]	.07

*Multivariable logistic regression for significant depressive symptoms (score of > 9 on Ham-D) - Chi^2 (df=4, N=164) = 30.51, p = .000.

**Multivariable logistic regression for traumatic stress symptoms (score of >25 pm IES) - Chi^2 (df=4, N=163) = 35.42, p = .000.

Table 4

Cut Scores for Predictive Screener for Significant Symptoms of the Disorder & Diagnosis of the Disorder

Depression					
Judged positive for Depressive Symptoms if ≥ 2	**Sensitivity**	**Specificity**	**Judged Positive for Diagnosis of Depression if ≥ 2**	**Sensitivity**	**Specificity**
1	0.93	0.38	1	0.92	0.38
2	**0.73**	**0.71**	**2**	**0.81**	**0.71**
3	0.40	0.88	3	0.50	0.89
4	0.30	0.99	4	0.35	0.99

PTSD					
Judged positive for Post-Traumatic Stress Symptoms if ≥3	**Sensitivity**	**Specificity**	**Judged Positive for Diagnosis of PTSD if ≥ 3**	**Sensitivity**	**Specificity**
1	1.00	0.20	1	1.00	0.17
2	0.96	0.44	2	1.00	0.38
3	**0.85**	**0.74**	**3**	**1.00**	**0.66**
4	0.58	0.88	4	0.50	0.81

Table 5

Performance of the Predictive Screener at Set Cut Points for both significant symptoms of each disorder and for diagnosis of each disorder

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	ROC (95% CI)
Significant Depressive Symptoms	0.73	0.71	0.38	0.92	0.78 (0.71–0.84)
Depression Diagnosis	0.81	0.71	0.34	0.95	0.81 (0.75–0.87)
Significant Post traumatic Stress Symptoms	0.85	0.74	0.38	0.96	0.84(0.78–0.89)
PTSD	1.00	0.66	0.07	1.00	0.81(0.74–0.86)

Table 6

Comparison of group who screened positive vs. group who screened negative for depression or PTSD at intake on psychiatric symptom severity measures and quality of life

	Screened Positive Mean (SD)	**Screened Negative Mean (SD)**	**t-test**
Depression Screener			
Hamilton Depression Score	7.4 (5.7)	3.2 (3.5)	$t=-4.19^{***}$
Beck Depression Score	10.4 (11.4)	4.0 (6.3)	$t=-6.39^{***}$
Quality of Life Score	19.8 (6.2)	24.7 (4.4)	$t = 5.37^{***}$
PTSD Screener			
Impact of Event Score	20.7 (18.2)	6.1 (8.4)	$t=-14.62^{***}$
Hamilton Anxiety Score	8.7 (7.7)	4.3 (5.2)	$t=-4.34^{***}$
Beck Anxiety Score	11.0 (14.1)	3.6 (6.0)	$t=-3.79^{***}$
Quality of Life Score	20.9 (6.3)	24.0 (5.1)	$t=-3.19^{**}$

* p<05;

** p<01;

*** p<001

Table 7

Predictive Screening Tool for Depression and PTSD after Injury

BEFORE THIS INJURY:	**Yes**	**No**	**Depression**	**PTSD**
Has there ever been a time in your life you have been bothered by feeling down or hopeless, or lost all interest in things you usually enjoyed for more than 2 weeks?	1	0		
WHEN YOU WERE INJURED OR RIGHT AFTERWARDS:				
Did you feel really helpless?	1	0		
Did is seem unreal or like it was happening in a dream or slow motion?	1	0		
SINCE YOUR INJURY				
Have you wanted to (or tried hard to) stay away from things that remind you of what happened?	1	0		
Have you been staying away from people, even people you are usually close to?	1	0		
Are you worried about money because of what happened?	1	0		
Since you were hurt, have you been worried because you had trouble keeping your mind on things?	1	0		
Is there someone who has responded badly when you told them about what happened?	1	0		
Total (Sum the number in each column)				
Scoring Metric			≥2 is positive for Depression	≥3 is positive for PTSD