

A Predictive Screening Index for Posttraumatic Stress Disorder and Depression Following Traumatic Injury

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Posttraumatic stress disorder (PTSD) and major depressive episode (MDE) are frequent and disabling consequences of surviving severe injury. The majority of those who develop these problems are not identified or treated. The aim of this study was to develop and validate a screening instrument that identifies, during hospitalization, adults at high risk for developing PTSD and/or MDE. Hospitalized injury patients ($n = 527$) completed a pool of questions that represented 13 constructs of vulnerability. They were followed up at 12 months and assessed for PTSD and MDE. The resulting database was split into 2 subsamples. A principal-axis factor analysis and then a confirmatory factor analysis were conducted on the 1st subsample, resulting in a 5-factor solution. Two questions were selected from each factor, resulting in a 10-item scale. The final model was cross-validated with the 2nd subsample. Receiver-operating characteristic curves were then created. The resulting Posttraumatic Adjustment Scale had a sensitivity of .82 and a specificity of .84 when predicting PTSD and a sensitivity of .72 and a specificity of .75 in predicting posttraumatic MDE. This 10-item screening index represents a clinically useful instrument to identify trauma survivors at risk for the later development of PTSD and/or MDE.

Keywords: predictive screen, posttraumatic stress disorder, depression, injury

In 2005, over 2 million people in the United States were hospitalized following nonfatal injuries (National Center for Injury Prevention and Control, 2006). Within the 12 months following their injury, 10%–30% of these injury survivors would have de-

veloped posttraumatic stress disorder (PTSD; O'Donnell, Creamer, Pattison, & Atkin, 2004; Zatzick, Jurkovich, Gentilello, Wisner, & Rivara, 2002) and 10%–15% would have developed major depressive episode (MDE; O'Donnell, Creamer, Pattison, &

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A preliminary version of this manuscript was presented at the 22nd annual meeting of the International Society of Traumatic Stress Studies in Los Angeles, November 4–7, 2006. This study was supported by Victorian Trauma Foundation General Grant V49, National Health and Medical Research Council Australian Clinical Research Fellowship 359284, and National Health and Medical Research Council Program Grant 300304. The authors gratefully acknowledge all the participants involved in this study. The authors wish to thank Anke Ehlers, Jonathon Bisson, Arie Shalev, Dan and Linda King, Douglas Zatzick, Nancy Kassam-Adams, and Ulrich Schnyder for comments on the original pool of question items.

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Atkin, 2004; Shalev et al., 1998). The frequency with which traumatic injury occurs makes it a leading cause of trauma-related psychiatric disorder (Creamer, Burgess, & McFarlane, 2001; Kessler, Sonnega, Hughes, & Nelson, 1995).

Although chronic posttrauma psychopathology is disabling (Kessler, 2000), the majority of injury survivors are not identified or treated for their posttraumatic psychological problems (Zatzick, 2003). There is growing evidence that mental health problems after injury have detrimental impacts on physical recovery, quality of life, and functional outcomes such as return to work (O'Donnell, Creamer, Elliott, Atkin, & Kossmann, 2005). That is, poor mental health outcomes following traumatic injury represent a significant public health issue.

The acute hospital environment provides a window of opportunity for identifying trauma patients at risk for subsequent development of posttrauma psychopathology. The challenge is one of differentiating between transient distress and the risk of subsequent serious psychiatric disorder. Specifically, although a majority of individuals experience anxiety and depression symptoms in the aftermath of trauma, most recover without persistent emotional problems (Shalev, 2002). This point is emphasized by recent British PTSD treatment guidelines that encourage a period of "watchful waiting" or monitoring following a traumatic event before deciding whether trauma-focused intervention is required (National Collaborating Centre for Mental Health, 2005).

The development of service delivery models that identify individuals in the acute hospital setting for a period of monitoring followed by targeted intervention (e.g., O'Donnell, Bryant, Creamer, & Carty, 2008) is dependent on reliable and valid screening instruments to identify individuals at risk for poor subsequent adjustment. The majority of available screens, however, have been developed to identify current disorder rather than risk for future disorder (for a review of screens for current PTSD, see Brewin, 2005). A few studies have examined the degree to which these current disorder screens can identify risk for future disorder (see O'Donnell et al., 2008). Although these studies show that various screens have moderate to high capacity to identify vulnerability to PTSD, there are a number of important points to consider. First, these screens rely exclusively on acute stress symptom severity as indicators of risk. There is a large body of literature examining vulnerability to PTSD that identifies the disorder as being multiply determined (for review, see Brewin, Andrews, & Valentine, 2000; Ozer & Weiss, 2004). That is, there is clear evidence that a range of pretrauma, peritrauma, and posttrauma variables significantly contribute to the development of PTSD. Importantly, these pre-, peri-, and posttrauma variables, in addition to acute stress symptoms, generally improve predictive models (e.g., O'Donnell, Creamer, & Pattison, 2004). For this reason it may be important to include other vulnerability factors, in addition to acute stress symptoms, in the identification of later risk. While the child trauma literature has already developed tools that recognize the complexity of PTSD vulnerability (e.g., Winston, Kassam-Adams, Garcia-Espana, Ittenbach, & Cnaan, 2003), the adult trauma literature lags behind. Second, it is reasonable to assume that utilizing factors drawn from several different domains (in addition to acute stress symptoms) will increase the robustness of the screen across different trauma populations (e.g., trauma type, gender, age, culture). Third, with the exception of the Trauma Screening Questionnaire (TSQ, Brewin et al., 2002), the few current disorder

screens that have been tested for their ability to predict future disorder range in length from 15 to 35 questions and are therefore (relatively) time consuming to administer. Finally, the few available predictive screening instruments are designed to predict later PTSD, and their ability to identify later depression is unknown. In our review of the literature we could find no depression screen that had been used to predict a later diagnosis of MDE.

The aim of this study was to develop a brief and simple screening instrument—the Posttraumatic Adjustment Scale (PAS)—that could be routinely administered during an acute hospital admission to identify patients at risk for subsequent development of PTSD (PAS-P) or MDE (PAS-D) at 12 months posttrauma. With a strong empirical base in the traumatic stress vulnerability literature on which to draw (Brewin et al., 2000; Ozer & Weiss, 2004), we hypothesized that we could utilize pretrauma, peritrauma, and acute symptom factors that could be measured in the acute setting to predict later PTSD and/or depression.

Method

Participants

Patients randomly selected during weekday admissions to four Level 1 trauma centers in three states of Australia were recruited into the study between April 2004 and April 2005 (see Figure 1 for the flow chart representing the progress of participants through the study). The study was approved by the research and ethics committee at each hospital. Patients met entry criteria if they were between 18 and 70 years of age, could understand and speak English proficiently, and were hospitalized for a period greater than 24 hr. Individuals were excluded from the study if they were currently psychotic or suicidal. Individuals with traumatic brain injury (TBI) were included in the study if they had a *mild traumatic brain injury* (mTBI), defined as a loss of consciousness for approximately 30 min or less; a Glasgow Coma Scale score of 13–15 after 30 min; or posttraumatic amnesia not greater than 24 hr (American Congress of Rehabilitation Medicine, 1993). Those with moderate or severe TBI were excluded. Individuals who met entry criteria were randomly selected with an automated, random assignment procedure, stratified by length of stay. Those selected

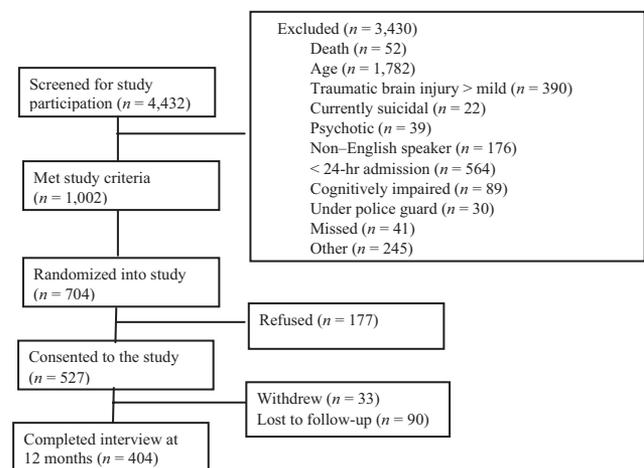


Figure 1. Flow chart of the progression of participants through the study.

for the study were approached, and after being given a complete description of the study, they provided written informed consent. The item pool of questions was then administered to 527 patients.

Individuals who refused to participate in the current study ($n = 177$; 25%) did not differ from participants in terms of gender, $\chi^2(1, N = 696) = 0.11, p = .74$; age, $t(697) = 0.51, p = .61$; length of stay, $t(691) = 0.66, p = .51$; injury severity score (Baker, O'Neil, Haddon, & Long, 1974), $t(294) = 0.67, p = .51$; or presence of an intensive care unit (ICU) admission, $\chi^2(1, N = 672) = 3.02, p = .08$.

At follow-up, 404 (77%) participants completed the assessment at 12 months. Individuals lost to follow-up did not differ from participants in terms of gender, $\chi^2(1, N = 523) = 0.03, p = .86$; length of stay, $t(515) = 1.35, p = .18$; or injury severity score, $t(431) = 0.02, p = .98$. Those who failed to complete the study were less likely to have an ICU admission, $\chi^2(1, N = 499) = 4.10, p < .05$, and more likely to be younger, $t(519) = 2.80, p = .005$.

The majority of participants were men (72%; $n = 374$) with an average age of 37.85 years ($SD = 14.34$). Forty-four percent of participants experienced an mTBI ($n = 227$), and the mean injury severity score was 11.42 ($SD = 8.20$), which is of moderate severity. Participants spent an average of 12.24 days ($SD = 12.62$) in the hospital, and 14% of participants had an ICU admission ($n = 70$). The principal mechanism of injury was transport accidents (62%, $n = 325$); 17% experienced falls ($n = 87$), 5% were assaults ($n = 28$), 7% experienced work-related accidents not specified in the above categories ($n = 35$), and 9% were other forms of traumatic injury ($n = 47$). The majority of participants were discharged home (75%; $n = 379$), and the remainder were discharged to a rehabilitation facility.

Measures

Item pool of questions. An item pool of questions was created from which the screening instrument was developed. Creating the item pool involved reviewing the PTSD vulnerability literature, including meta-analyses (e.g., Brewin et al., 2000; Ozer, Best, Lipsey, & Weiss, 2003). Where possible, we also referred to studies that aimed to predict posttrauma depression (e.g., O'Donnell, Creamer, & Pattison, 2004), although it must be stated that there were few of these studies. We aimed to select predictor variables with moderate to high effect sizes across studies. Questions were constructed to ensure that all items had the same 5-point Likert response scale. The final item pool was derived following feedback and consensus from eight international experts (see author note). It comprised 41 items consisting of three general categories of questions (pretrauma, peritrauma, and posttrauma factors) that tapped 13 constructs of vulnerability (see Table 1). The pretrauma constructs included psychiatric history, trauma history, negative childhood experiences, neuroticism, and premorbid social support; the peritraumatic constructs included emotional response during the traumatic event, perceived threat during the traumatic event, and severity of the event; and the posttrauma constructs included acute symptom levels, acute pain levels, cognitive response, coping self-efficacy, and negative social support. We did not include peritraumatic dissociation in our original list of items for both methodological and empirical reasons. Firstly, injury survivors invariably receive opioids at the scene and/or experience traumatic brain injuries, both of which create symptoms that are similar to dissociative symptoms. As such, it is difficult to

interpret peritraumatic dissociative responses on self-report measures (O'Donnell, Creamer, Bryant, Schnyder, & Shalev, 2003). Secondly, our research has shown that dissociative symptoms in this population are particularly poor in predicting later psychopathology (O'Donnell, Creamer, & Pattison, 2004).

Comparison measure. The Acute Stress Disorder Interview (ASDI; Bryant, Harvey, Dang, & Sackville, 1998) was chosen as a comparison against which to test the developed screen's ability to predict PTSD. The ASDI is a 19-item, structured clinical interview that possesses good internal consistency (.90) and has been shown to be useful in predicting a later PTSD diagnosis (Bryant, Harvey, Dang, & Sackville, 1998). In that study of 65 motor vehicle accident survivors, the ASDI had a sensitivity of .91, a specificity of .93, a positive predictive value (PPV) of .67, and a negative predictive value (NPV) of .98. We chose the ASDI as a comparison measure because it is one of the few instruments specifically developed to identify individuals who are likely to develop later PTSD, and as a structured clinical interview, it offered a high standard against which to compare our brief self-report screen (e.g., Bryant, Harvey, Dang, Sackville, & Basten, 1998). The ASDI comprises 19 symptom questions that are scored dichotomously (0, 1). The ASDI total severity score is computed by adding positive scores on each symptom question.

The depression subscale of the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was used as a comparison against which to test the prediction of depression by the developed screen. In our review of the depression literature we could find no depression screen that had been used to predict a future diagnosis of MDE. We utilized the HADS for several reasons. First, it is a useful predictor of current MDE. For example, in a recent study of cancer survivors, a cutoff of ≥ 7 on the HADS depression subscale had a sensitivity of .90, a specificity of .88, and a PPV of .40 (Walker et al., 2007). Second, the HADS is a particularly useful tool for identifying depression among injured populations, as it excludes somatic symptoms that may be attributable to the injury and its treatment. The HADS comprises 14 questions that are scored on a 4-point scale from 0 (*Not at all*) to 4 (*Most of the time*). Scores range from 0 to 21 on the depression subscale.

Outcome measures. The Clinician-Administered PTSD Scale (CAPS; Blake et al., 1998) was used to assess PTSD diagnosis at 12 months postinjury. The CAPS was specifically anchored to the event in which the individual was injured, so the PTSD diagnosed was specific to the injury event. The CAPS is one of the most widely used tools for diagnosing PTSD and measuring PTSD severity and has excellent reliability and validity (Weathers, Keane, & Davidson, 2001). In line with common practice (O'Donnell et al., 2003; Schnyder, Moergeli, Klaghofer, & Buddeberg, 2001), Item 8 of the CAPS ("Inability to recall an important aspect of the trauma") was excluded from the scoring process of PTSD due to high levels of mTBI in the sample and the difficulty of differentiating organic from psychogenic amnesia (O'Donnell et al., 2003). Thus, to meet PTSD criteria, participants needed to score 3 out of 6 avoidance criteria rather than 3 out of 7, so our approach was conservative. We used a "1, 2" scoring method on the CAPS (at least 1 on frequency and at least 2 on intensity) to identify PTSD caseness threshold on each symptom.

The Mini International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) was used to assess MDE. The MINI is a short structured diagnostic interview based on the *Diagnostic*

Table 1
List of Screening Items Used in the Development of the Posttraumatic Adjustment Scale

Pretrauma items
1. Feeling low or sad has impacted on my life in the past.
2. Feeling anxious or nervous has impacted on my life in the past.
3. I have needed professional help to deal with emotional problems in the past.
4. Previously traumatic events have impacted negatively on my life in the past (e.g., assault, sexual abuse, previous combat duty, natural disasters, witnessing traumatic events).
5. Experiences in my childhood have impacted negatively on my life.
6. In the past there was someone in my life I could really trust.
7. In the past others have been there for me when I have needed them.
8. In the past I felt I was listened to and understood by my family members or friends.
9. In the past I was able to talk about my thoughts and feelings with my family members or friends.
10. In the past I was satisfied with the support that I had from my friends and family.
11. I was often angry at people or situations in the past.
12. I saw myself as anxious and easily upset in the past.
13. I saw myself as calm and emotionally stable in the past.
Peritrauma items
1. At the time of the event, I felt terrified, helpless, or horrified.
2. During the event, I thought I was about to die.
3. At the time of the event, I thought I had been seriously injured.
4. I harmed another person during the event.
5. I witnessed other people being killed or injured.
6. The event involved someone deliberately harming me.
Posttrauma items
1. I have felt emotionally numb or have had trouble experiencing feelings such as love or happiness, or have been unable to cry, since the event.
2. Since the event, I have felt emotionally upset when something reminds me of the event.
3. Since the event I have sweated, trembled or noticed my heart beating faster when I am reminded about the event.
4. I have felt so down that nothing could cheer me up since the event.
5. Since the event I have tried to avoid thoughts or feelings about the event.
6. I have had difficulty falling or staying asleep since the event.
7. I have felt irritable or angry since the event.
8. I have found it difficult to concentrate on what I was doing or things going on around me since the event.
9. I have been especially alert or watchful when there was no real need to be since the event.
10. I have experienced severe pain since the event.
11. My reactions since the event mean that I must be losing my mind.
12. My reactions since the event mean that I will not get over it.
13. I think that something terrible will happen if I do not try to control my thoughts about the event.
14. I am afraid that other bad things are going to happen to me since the event.
15. I am confident that I can deal with any feelings I am experiencing as a result of the event (e.g., anger, fear, anxiety, depression, helplessness).
16. I am confident that I am able to deal with the impact my injuries may have on my life.
17. I am confident I can deal with the pain associated with my injuries.
18. I am confident that I can deal with the financial stressors that may arise as a consequence of being injured.
19. I can accept what happened to me.
20. I am confident that I will fully recover from my injuries.
21. People I expected to be supportive have made me feel worse at times since the event.
22. I think about why the event has happened to me.

and *Statistical Manual of Mental Disorders—Fourth Edition (DSM-IV; American Psychiatric Association, 1994)*. It has good reliability for MDE ($\kappa = .73$) when compared with the Composite International Diagnostic Interview (CIDI; World Health Organization Collaborating Centre for Mental Health and Substance Abuse, 1997). Individuals are screened with two MDE screening questions, and the MDE module is administered if a participant responds positively to either question. In the current study, the anxiety, depression, and substance use disorders screen (and modules if relevant) of the MINI were administered, but only the MDE data were used.

Procedure

Randomized participants were assessed prior to discharge from each trauma center, an average of 8.27 days ($SD = 10.61$) after injury. Participants were assessed toward the end of their hospital admission when they were medically stable and had ceased opioid analgesia (wherever possible). They completed the item pool of questions, the ASDI, and the HADS. At 12 months after injury, participants completed structured clinical interviews via the telephone. Study interviewers were trained in the study protocol by a clinical psychologist, and all assessments were digitally recorded

to ensure ongoing adherence to the protocol. To test interrater reliability, an independent assessor who reviewed recordings of the original diagnostic interview and who was blind to the original scoring evaluated 5% of all CAPS, MINI, and ASDI interviews. Overall, the diagnostic consistency on the CAPS was .99, the MINI MDE module 1.00, and the ASDI 1.00.

Data Analyses

The data set was divided randomly into two subsamples using a stratification method to ensure that comparable numbers of PTSD and MDE diagnoses were allocated to each subset. Subsample 1 ($n = 145$) was used for the development of the PAS, and Subsample 2 ($n = 169$) was used to validate the PAS. On Subsample 1 we conducted factor analysis using principal-axis factoring with direct oblimin rotation. Outcomes of this analysis were then refined using confirmatory factor analysis (CFA). Since the primary focus of the CFAs was to identify a good screening instrument to assess likelihood of developing PTSD, the CFA took the following structure: Items were loaded onto the five factors identified through the exploratory factor analysis, and these five factors were then loaded onto a single factor. Finally, this higher order factor, which represented an individual's overall vulnerability to PTSD, was correlated with the observed measure: having a PTSD diagnosis at 12 months. Such an analysis allowed us to assess and compare models in which the derived fit statistics took into account the strength of the association between the screening instrument as a whole and the diagnosis of interest. This CFA was initially conducted on Subsample 1, and items with poor predictive power were removed to improve the model fit. The final model—10 items of the Posttraumatic Adjustment Scale–PTSD (PAS-P)—derived from this analysis was cross-validated using Subsample 2.

Having developed a well-fitting screening instrument for PTSD, we then examined its ability to operate as a screening instrument for MDE. We took the final 10-item PTSD model and tested it in an initial CFA using Subsample 1 with MDE as the outcome variable of interest. A number of items were removed to obtain the best fitting model. The final model consisted of 5 items and was cross-validated in Subsample 2. The 5-itemed scale for depression is referred to as the Posttraumatic Adjustment Scale–Depression (PAS-D).

In the next part of the analysis, we assessed the screening efficacy of the derived screening tools by developing receiver-operating characteristic (ROC) curves for 12-month PTSD and 12-month MDE. The approach taken with the ROC analyses was to determine the optimal cutoff points for predicting PTSD and MDE using Subsample 1. Subsample 2 was used to cross-validate the diagnostic efficiency at this cutoff. We determined the sensitivity (e.g., the proportion of those who developed PTSD at 12 months who screened positively on the PAS-D), specificity (e.g., the proportion of those who did not develop PTSD at 12 months who screened negatively on the PAS-D), positive predictive value (PPV; e.g., the proportion of those who screened positively on the PAS-P and did develop PTSD at 12 months), and negative predictive value (NPV; e.g., the proportion of those who screened negatively on the PAS-P and did not develop PTSD at 12 months).

Comparisons of the screening utility of the PAS-P with the ASDI and of the PAS-D with the HADS depression subscale were also calculated using ROC curves. When ROC curves are compared, the measure of interest is the percentage area under the

curve at each cutoff point. If the percentage area under the curve is significantly greater for one instrument relative to another, it can be said to be a superior screening instrument. CFAs were conducted using AMOS 6 (Arbuckle, 1999). ROC curve analyses and comparisons of significant differences between ROC curves were undertaken using STATA 10 (StataCorp, 2004).

Results

At 12 months, 8% ($n = 32$) of participants had developed PTSD and 16% ($n = 65$) had MDE. Twenty-two participants had comorbid PTSD and MDE, 10 had PTSD without MDE, and 43 had MDE without PTSD. Of the 65 participants who had MDE at 12 months, only 5 (11%) had MDE at the time they were injured, indicating that the majority of those with MDE at 12 months had posttraumatic depression. Those who met criteria for MDE at the time they were injured and at 12 months were removed from subsequent MDE analyses ($n = 5$).

Development of the PAS as a Screening Instrument for PTSD (PAS-P)

Principal-axis factoring analysis was used to examine the factor structure of the screening items. Outcomes of these analyses, including screen plots and initial eigenvalues, indicated the items could be separated into five factors. The factor loadings are presented in Table 2. Factor 1 described the acute stress response after the injury-causing event (Acute Stress Response); Factor 2 reflected social support prior to the injury-causing event (Prior Social Support); Factor 3 related to preinjury emotional history and trauma history (Prior Psychiatric/Trauma History); Factor 4 contained items related to confidence that one could cope with the consequences of the traumatic event (Self-Efficacy); and Factor 5 related to exposure severity, peritrauma appraisals, and posttrauma pain (Perceived Threat/Pain). At this stage, five items (Pretrauma 13, Posttrauma 21, and Peritraumas 4, 5, and 6) were dropped from the model because of their strong cross-loadings on multiple factors. The variance accounted for by the five-factor model was 52.05%.

This five-factor, 36-item model was then used as the initial model in a CFA. In this part of the analyses, we examined modification indexes and standardized residual coefficients to identify items that could be removed to provide a more parsimonious model with improved goodness of fit. As previously explained, the CFA models included the diagnostic variable of interest: PTSD diagnosis at 12 months. Through this process, we identified a good-fitting model that had the potential to be used as a screening instrument for PTSD. This model had five factors, each of which had two items, and gave the following fit statistics: $\chi^2(39, N = 145) = 64.424, p < .01$; goodness of fit index (GFI) .928; Tucker–Lewis index (TLI) .926; comparative fit index (CFI) .947; root-mean-square error of approximation (RMSEA) .067, $p = .161$. The 10 items included in this model were as follows (see Table 1): Posttraumas 7 and 8 loading on the Acute Stress Response factor; Pretraumas 9 and 10 loading on Prior Social Support; Pretraumas 3 and 4 loading on Prior Psychiatric/Trauma History; Posttraumas 18 and 19 loading on Self-Efficacy; and Peritraumas 1 and 2 loading on Perceived Threat/Pain. These 10 items comprise the PAS-P (see Table 3). This model was then validated in Subsample 2 with a CFA. Fit statistics for this second

Table 2
Results of Principal-Axis Factoring on Subsample 1 With Direct Oblimin Rotation

Item	Factor					Communalities	
	1	2	3	4	5	Initial	Extraction
Posttrauma 12	.778			-.435		.736	.631
Posttrauma 4	.774		.306	-.480	.352	.702	.627
Posttrauma 3	.764		.419	-.504	.539	.771	.692
Posttrauma 13	.719			-.429	.337	.671	.544
Posttrauma 11	.700					.620	.538
Posttrauma 1	.652		.363	-.375	.318	.625	.460
Posttrauma 5	.651			-.326	.359	.532	.439
Posttrauma 2	.647		.386	-.600	.520	.762	.616
Posttrauma 8	.643	-.319	.446			.584	.492
Posttrauma 6	.612		.355		.510	.601	.517
Posttrauma 22	.573			-.347	.363	.557	.366
Posttrauma 7	.524		.316	-.384		.508	.338
Posttrauma 14	.523	-.344	.372	-.434		.487	.377
Posttrauma 9	.512		.315	-.339	.433	.551	.348
Pretrauma 10		.916	-.409			.843	.847
Pretrauma 7		.887		.320		.801	.797
Pretrauma 9		.870	-.349			.781	.764
Pretrauma 8		.864	-.431	.305		.789	.766
Pretrauma 6		.663				.556	.454
Pretrauma 2			.864			.805	.759
Pretrauma 1			.812			.762	.686
Pretrauma 4	.357	-.320	.799	-.309		.694	.651
Pretrauma 3			.653			.524	.433
Pretrauma 5		-.515	.621			.688	.482
Pretrauma 12	.355	-.305	.620	-.344		.591	.426
Pretrauma 11			.530			.490	.297
Posttrauma 17	-.329	.305	-.383	.860	-.307	.772	.764
Posttrauma 19	-.400			.846	-.338	.720	.723
Posttrauma 16	-.421			.831	-.373	.706	.706
Posttrauma 20	-.379			.639	-.302	.576	.427
Posttrauma 18	-.307	.375		.614	-.308	.627	.437
Posttrauma 15	-.349			.607		.546	.390
Peritrauma 2	.467			-.347	.689	.587	.537
Peritrauma 1	.355			-.330	.632	.568	.431
Peritrauma 3					.606	.349	.386
Posttrauma 10					.491	.403	.251

Note. $N = 145$. Bold signifies the highest loading for each item. Loadings within the range of $-.3$ to $+.3$ are not shown. Pretrauma 13, Posttrauma 21, Peritrauma 4, Peritrauma 5, and Peritrauma 6 were cross-loaded on multiple factors and were removed from the model.

analysis were also strong, $\chi^2(39, N = 169) = 62.643, p < .01$; GFI .933; TLI .934; CFI .953; and RMSEA .062, $p = .229$.

Subsample 1 was then used to conduct an ROC analysis, with the total PAS-P score as a predictor of PTSD. Overall, the PAS-P was found to significantly predict PTSD (percentage area under the curve = .91, $SE = .035, p < .001$). The point of highest combined sensitivity and specificity was a PAS-P cutoff score of 16. At this threshold, the sensitivity of the screen was .80 and the specificity was .84. At this cutoff, the screen had a PPV of .28 and an NPV of .96.

We then tested the reliability of this instrument model with ROC curve analyses in Subsample 2 ($n = 169$), with the cutoff score of 16. In this validation subsample, the PAS-P had a sensitivity of .82, a specificity of .84, a PPV of .27, and an NPV of .98. The screen correctly classified the PTSD outcome of 84% of participants at 12 months. We also used ROC curve analyses to examine whether the accuracy of the PAS-P was affected by time between admission for injury and assessment. The total sample was divided into two groups: those who were assessed within 8 days of admis-

sion ($n = 203$) and those who were assessed after 8 days from the time of admission ($n = 71$). For the subgroup assessed within 8 days of admission, the percentage area under the curve was .85 ($SE = .074, p < .001$); for those assessed after 8 days the percentage area under the curve was .84 ($SE = .60, p = .001$). There was no significant difference between these two ROC curves, $\chi^2(1, N = 274) = 0.01, p = .96$, suggesting that the accuracy of the PAS-P was not influenced by the timing of the assessment.

For comparison purposes, we then used Subsample 2 to assess the utility of the 19-item ASDI for predicting PTSD at 12 months. At its best cutoff of 7, the ASDI recorded a sensitivity of .82, a specificity of .74, a PPV of .19, and an NPV of .98. It correctly classified 75% of participants. ROC curves of both the PAS-P and ASDI screening tests are provided in Figure 2. Statistical tests indicated there was no significant difference between the ROC curves for these two measures, $\chi^2(1, N = 169) = 0.32, p = .57$. That is, the PAS-P was as good as the ASDI at identifying risk to PTSD.

Table 3
Posttraumatic Adjustment Screen

This questionnaire asks you questions that relate to factors that occurred before, during or after the event that caused your injuries. Circle the response that best describes how much you **agree** with the following statements.

Q	Not at all	To a small extent	To a moderate extent	To a large extent	Totally
1* I have needed professional help to deal with emotional problems in the past.	0	1	2	3	4
2* Previously traumatic events have impacted negatively on my life in the past (e.g., assault, sexual abuse, previous combat duty, natural disasters, witnessing traumatic events).	0	1	2	3	4
3 In the past I was able to talk about my thoughts and feelings with my family members or friends.	4	3	2	1	0
4* In the past I was satisfied with the support that I had from my friends and family.	4	3	2	1	0
5 At the time of the event, I felt terrified, helpless or horrified.	0	1	2	3	4
6 During the event, I thought I was about to die.	0	1	2	3	4
7* I have felt irritable or angry since the event.	0	1	2	3	4
8* I have found it difficult to concentrate on what I was doing or things going on around me since the event.	0	1	2	3	4
9 I am confident that I can deal with the financial stressors that may arise as a consequence of being injured.	4	3	2	1	0
10 I can accept what happened to me.	4	3	2	1	0

Note. Add all items to calculate the posttraumatic stress disorder score on the Posttraumatic Adjustment Scale (PAS). Add items marked with an * to calculate the depression score on the PAS.

Using the PAS as a Screening Instrument for Depression (PAS-D)

This 10-item, five-factor model was then examined to assess its value in predicting a diagnosis of MDE. Using Subsample 1 (*n* = 142), we found that modification indexes obtained from a CFA indicated a further five items could be removed. This resulted in a five-item model of vulnerability to depression composed of Posttrau-

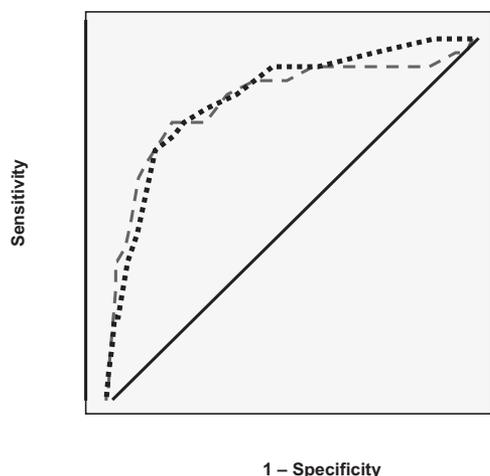


Figure 2. Receiver-operating characteristic (ROC) curves indicating posttraumatic stress disorder according to the Posttraumatic Adjustment Scale (PAS; dotted line) and the Acute Stress Disorder Interview (ASDI; dashed line), as well as a solid diagonal reference line. An ROC curve is drawn by mapping each PAS or ASDI score to a point on the graph with these coordinates: the value of sensitivity for that score on the y-axis and the value of one minus the specificity for that score on the x-axis.

mas 7 and 8 and Pretraumas 3, 4, and 10. Fit statistics for this model in Subsample 1 were highly acceptable, $\chi^2(7, N = 142) = 17.595, p = .32$; GFI .957; TLI .968; CFI .973; and RMSEA .032, *p* = .583.

The PAS-D was then validated with a CFA in Subsample 2, with equally good fit statistics, $\chi^2(7, N = 167) = 12.595, p = .31$; GFI .954; TLI .962; CFI .970; and RMSEA .032, *p* = .585.

An ROC curve analysis was conducted on Subsample 1. Overall, the PAS-D was found to be a useful predictor of MDE (percentage area under the curve = .77, *SE* = .069, *p* < .001). A cutoff score of 4 resulted in a sensitivity of .70, a specificity of .75, a PPV of .34, and an NPV of .92 and correctly classified 74% of participants. The PAS-D was validated in Subsample 2 with the following results: percentage area under the curve = .73, *SE* = .059, *p* < .001; sensitivity .72; specificity .75; PPV .30; and NPV .91. This cutoff for depression diagnosis correctly identified 75% of participants in this subsample.

In Subsample 2 we compared the diagnostic utility statistics of the PAS-D with the predictive ability of the HADS depression subscale. The percentage area under the curve for the HADS depression score was .72 (*SE* = .053, *p* = .001), and with a cutoff score 4, this instrument resulted in a sensitivity of .77, a specificity of .60, a PPV of .24, and an NPV of .91 and correctly identified 62% of MDE cases at 12 months. As shown in Figure 3, the ROC curve for the PAS-D was significantly better than that for HADS depression at all points on the graph. This finding was confirmed by the analysis comparing areas under the ROC curves, $\chi^2(1, N = 167) = 7.50, p = .006$.

Discussion

The screening instrument developed and validated in this multistep study is a 10-item scale: the Posttraumatic Adjustment Scale (PAS), which identifies risk for the development of PTSD and

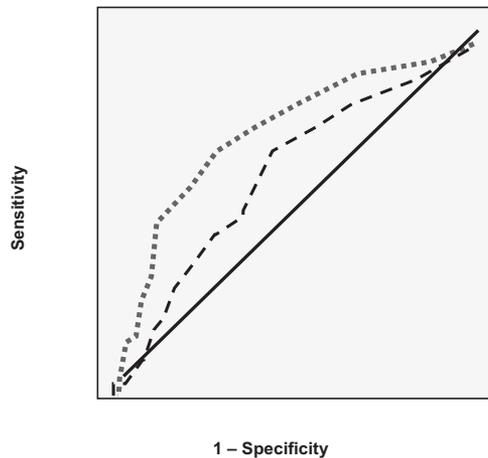


Figure 3. Receiver-operating characteristic (ROC) curves indicating depression according to the Posttraumatic Adjustment Scale (PAS; dotted line) and the Hospital Anxiety and Depression Scale (HADS; dashed line), as well as a solid diagonal reference line. An ROC curve is drawn by mapping each PAS or HADS score to a point on the graph with these coordinates: the value of sensitivity for that score on the y-axis and the value of one minus the specificity for that score on the x-axis.

MDE. The PAS-P identifies the risk for PTSD and is calculated by summing all 10 items. A summary score of 16 or above represents high risk for the later development of PTSD. The PAS-D identifies the risk for MDE and is calculated by summing 5 of the 10 items. A summary score of 4 or above represents high risk for the later development of MDE.

The PAS has been designed to facilitate the early identification of individuals most at risk for developing PTSD and/or depression following a traumatic injury. The PAS is theoretically and empirically derived. The instrument has considerable potential to influence clinical practice and enhance mental health outcomes for individuals following trauma for a number of reasons. First, the PAS is the first adult screen that identifies, with high sensitivity, those at high risk for two of the most common mental health problems to arise after traumatic injury: PTSD and depression. Our screening tool is as good as the ASDI in predicting PTSD even though the ASDI is a structured clinical interview and consists of 19 rather than 10 questions. The sensitivity and specificity of the PAS-P is also comparable to the predictive ability of the Trauma Screening Questionnaire (TSQ) used by Walters, Bisson, and Shepherd (2007). Our study, however, had a number of methodological advantages over the Walters et al. study. Ours utilized a structured clinical interview rather than self-report to assess PTSD; it assessed persistent and chronic PTSD at 12 months rather than at 6 months; it assessed a heterogeneous injury group rather than a homogeneous group of assault survivors; and finally, our screen had the advantage of being able to assess MDE in addition to PTSD. The second reason the PAS is useful for clinical practice is that, while the PAS identified the majority of those who developed PTSD or MDE in our sample, its negative predictive power was also high. This suggests that the PAS is a useful triage instrument for screening out the majority of patients who are unlikely to need attention from mental health practitioners. Third, the instrument is simple and suitable for use by staff not trained in the area of mental

health. It is also brief, so that its administration will not place a high demand on clinical staff resources. Finally, we developed the PAS on the basis of five relatively independent constructs. As such, the PAS recognizes the complexity of vulnerability to PTSD and MDE and that poor psychological adjustment following a traumatic event is determined by multiple factors.

The content of the 10 PAS items is consistent with existing research literature on risk factors for PTSD, with acute stress response and past trauma/psychiatric history consistently serving as strong predictors of both PTSD and depression (O'Donnell, Creamer, & Pattison, 2004). It is not surprising that the perception of threat during the peritrauma stage significantly predicts the development of symptoms, since perceived threat is partly what defines a traumatic stressor. High levels of social support prior to the injury were negatively related to later psychopathology. Social support has long been recognized as a protective factor following trauma (Brewin et al., 2000), so it is not surprising that good social support prior to the event would form a strong platform for recovery. High self-efficacy was also negatively associated with later PTSD and depression. The finding that self-efficacy is associated with improved recovery is consistent with much existing research (Benight & Bandura, 2004).

A number of characteristics underpin a viable and effective screening protocol. Primarily, the chosen screening instrument should be brief and easy to administer, acceptable to providers and survivors, reliable with high sensitivity and specificity, useful in directing patients to further assessment and/or evidence-based intervention, and cost effective (UK National Screening Committee, 2003). In developing the PAS, we have been particularly cognizant of these criteria. The PAS facilitates the development and implementation of stepped-care models of service delivery that aim to screen individuals at risk for PTSD and depression following traumatic injury (e.g., O'Donnell et al., 2008). High-risk individuals can be monitored, with early interventions then targeted toward those who do not show normal recovery trajectories in the first few weeks. Such stepped-care models have been utilized for other disorders with public health implications (e.g., Katon et al., 1999), and preliminary findings that these models are effective with posttraumatic psychopathology following traumatic injury (Zatzick et al., 2004) are promising.

We recognize that the PPVs of the PAS-P and PAS-D are relatively low. That is, a proportion of individuals we screen as high risk will not go on to develop PTSD or MDE. We recognize that PPVs are in part determined by the prevalence rates of the disorders being predicted (i.e., the relatively low rates of PTSD and MDE in our sample contributed to our low PPVs). A low PPV would be problematic if it were intended that all those who screened positive to the PAS be offered intervention. This is not, however, the way the screen should be used. We propose that the PAS be used as a triage instrument to identify those who should be monitored and reassessed with a more comprehensive assessment at a later time point (e.g., 1 month postinjury). A comprehensive assessment at that time would identify those who would require intervention.

This study is limited in a number of aspects. First, we acknowledge that we excluded a sizeable proportion of all trauma service admissions, which may impact on the generalizability of our findings. The majority of exclusions, however, were moderate and severe brain injury, and screening in the early aftermath of serious

brain injury with self-report measures would have questionable validity. A second limitation concerns the use of the ASDI as an instrument against which to compare the PAS-P. Given that this is a structured clinical interview, the design may have been improved if we had utilized a validated symptom-based, self-report screening measure such as the TSQ. A third limitation is that while the PAS-P has competitive sensitivity and specificity compared with the ASDI, our ability to identify MDE was not as comprehensive. While the PAS-D had better sensitivity and specificity than did the HADS, the figures were not especially strong. Our main difficulty in identifying predictors of posttraumatic depression was the limited research conducted in this area. While we had large amounts of PTSD vulnerability literature to call on, the literature predicting posttraumatic depression was very limited. We also understand little about the development of depression in the posttrauma environment, especially depression that does not occur comorbidly with PTSD. In our sample, a substantial proportion of posttraumatic depression occurred alone and not in the context of PTSD. Further research is required to increase our understanding of posttraumatic depression. It may be that depression is more influenced by intervening factors related to the traumatic event (such as delays in physical recovery or other subsequent life stressors) rather than the traumatic event itself. Alternatively, unlike PTSD, depression that occurs in the posttraumatic environment does not have to be related to the traumatic event (by definition), and for some cases the depression may be completely unrelated to the traumatic event at all. Thus, attempts to predict depression in the acute phase at 12 months may always have limited success. We recognize that it has been recommended that exploratory and confirmatory factor analytical work be conducted with sample sizes greater than 150–200. Thus, ours may be a limitation of the study. Our final limitation is that we do not know how generalizable our findings are to other trauma groups that may or may not be injured. Further research is required to validate the PAS with other samples of injury survivors, in other settings, and with other trauma populations.

The PAS is one of the first adult screening instruments specifically developed to identify risk for poor psychological adjustment following trauma. It represents a useful, acceptable, and reliable instrument and will facilitate the systematic screening of injury survivors to identify those at greater risk for persistent posttraumatic mental health problems. The development of such tools is a first step in the process of developing public health models of early intervention following traumatic events.

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Received May 8, 2007

Revision received March 31, 2008

Accepted May 9, 2008 ■

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