

# Post-traumatic stress disorder can be predicted in hospitalized blunt trauma patients using a simple screening tool

Saad Rahmat <sup>1</sup>, Jessica Velez,<sup>2</sup> Muhammad Farooqi,<sup>3</sup> Abbas Smiley,<sup>4</sup> Kartik Prabhakaran <sup>2,4</sup>, Peter Rhee,<sup>2,4</sup> Maria Khan,<sup>5</sup> Rhea Dornbush,<sup>3</sup> Stephen Ferrando,<sup>3</sup> Yvette Smolin<sup>3</sup>

► Additional material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/tsaco-2020-000623>).

<sup>1</sup>Department of Psychiatry and Behavioral Sciences, Westchester Medical Center, Valhalla, NY, USA

<sup>2</sup>Department of Surgery, Westchester Medical Center Health Network, Valhalla, New York, USA

<sup>3</sup>Department of Psychiatry and Behavioral Sciences, New York Medical College, Valhalla, New York, USA

<sup>4</sup>Department of Surgery, New York Medical College, Valhalla, New York, USA

<sup>5</sup>New York Medical College, St. Vincent's Medical Center, Yonkers, New York, USA

## Correspondence to

Dr Yvette Smolin; Yvette.Smolin@wmchealth.org

Received 9 October 2020  
Revised 25 January 2021  
Accepted 26 January 2021

© Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

**To cite:** Rahmat S, Velez J, Farooqi M, et al. *Trauma Surgery Acute Care Open* 2021;**6**:e000623.

## ABSTRACT

**Background** Post-traumatic stress disorder (PTSD) has debilitating psychiatric and medical consequences. The purpose of this study was to identify whether PTSD diagnosis and PTSD symptom scale score (PTSD severity) could be predicted by assessing peritraumatic experiences using a single question or screening tools at different time points in patients hospitalized after admission to the hospital after significant physical trauma, but with stable vitals (level II trauma).

**Methods** Patients completed the 'initial question' and the National Stressful Events Survey Acute Stress Disorder Scale (NSESSS) at 3 days to 5 days after trauma (NSESSS-1). The same scale was administered 2 weeks to 4 weeks after trauma (NSESSS-2). The Posttraumatic Stress Disorder Symptoms Scale Interview for DSM-5 (PSSI-5) was administered 2 months after trauma. PTSD diagnosis and PTSD severity were extracted from the PSSI-5. Linear multivariate regression analyses were used to establish whether scores for NSESSS-1 or NSESSS-2 predicted PTSD diagnosis/PTSD severity. Non-linear multivariate regression analyses were performed to better understand the relationship between NSESSS-1/NSESSS-2 and PTSD diagnosis/PTSD severity.

**Results** A single question assessing the experience of fear, helplessness, or horror was not an effective tool for determining the diagnosis of PTSD ( $p=0.114$ ) but can be a predictor of PTSD severity ( $p=0.039$ ). We demonstrate that administering the NSESSS after either 3 days to 5 days ( $p=0.008$ ,  $p<0.001$ ) or 2 weeks to 4 weeks ( $p=0.039$ ;  $p<0.001$ ) can predict the diagnosis of PTSD and PTSD severity. Scoring an NSESSS above 14/28 (50%) increases the chance of experiencing a higher PTSD severity substantially and linearly.

**Discussion** Our initial question was not an effective predictor of PTSD diagnosis. However, using the NSESSS at both 3 days to 5 days and 2 weeks to 4 weeks after trauma is an effective method for predicting PTSD diagnosis and PTSD severity. Additionally, we show that patients who score higher than 14 on the NSESSS for acute stress symptoms may need closer follow-up.

**Level of evidence** Level III, prognostic.

## BACKGROUND

Post-traumatic stress disorder (PTSD) is a complex psychiatric disorder. Fortunately, not everyone with exposure to a traumatic experience develops PTSD. Within the general population, there is a 1 year

prevalence between 3% and 4.7%.<sup>1,2</sup> This prevalence increases to 17.5% to 42% in persons who incur physical trauma 1 month to 6 months after injury.<sup>3</sup> PTSD exacerbates underlying medical comorbidities and subsequently increases the risk of death.<sup>4,5</sup> Work impairment translates into an estimated annual productivity loss in excess of \$3 billion.<sup>6</sup> Only 9.8% of individuals diagnosed with PTSD received treatment.<sup>7</sup>

To qualify for the diagnosis of PTSD according to the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (DSM-5), subjects must be exposed to a trauma, and exhibit several symptom criteria (figure 1). If they exhibit these symptoms for less than 1-month duration, then the diagnosis becomes acute stress disorder (ASD).<sup>8</sup> The diagnosis of full criteria of ASD has been shown to be correlated with the diagnosis of PTSD.<sup>9</sup>

The purpose of this study was to identify whether the diagnosis of PTSD and PTSD symptom severity could be predicted by assessing peritraumatic experiences using a single question and/or a short screening tool. Prior studies have shown that peri-traumatic emotional factors such as fear, helplessness, and horror at the time of trauma can be an effective predictor of PTSD.<sup>10–12</sup> The single question asked hospitalized level II trauma patients to rate their experience of fear, helplessness, or horror 3 days to 5 days after the trauma. We also evaluated whether the severity of ASD symptoms 3 days to 5 days after the trauma or the severity of ASD symptoms 2 weeks to 4 weeks after the trauma could be used to predict PTSD diagnosis and PTSD symptom severity.

## PATIENTS AND METHODS

### Design and procedures

The study was approved by the New York Medical College Institutional Review Board and Clinical Research Institute of Westchester Medical Center (WMC). WMC is a quaternary care medical center that serves a large catchment area and is an American College of Surgeons Verified Level I Trauma Center. Within our institution's protocols, patients are classified as level II trauma that consider mechanistic, physiological, and anatomic criteria, as well as clinician judgment as detailed in online supplemental figure 1.<sup>13,14</sup> Level I trauma activations represent the highest level of activation with respect to resources and urgency. Level I trauma activation patients are critically ill, often to the extent of functional

Post-traumatic Stress Disorder Diagnostic Criteria (Adapted from DSM-5)
A. Exposure to actual or threatened death, serious injury, or sexual violence.
B. One (or more) of the following intrusion symptoms associated with the traumatic event(s), and beginning with the traumatic event(s): <ol style="list-style-type: none"> <li>1. Recurrent, involuntary, and intrusive distressing memories of the traumatic event(s).</li> <li>2. Recurrent distressing dreams in which the content and/or affect of the dream are related to the traumatic event(s).</li> <li>3. Dissociative reactions (e.g. flashbacks) in which the individual feels or acts as if the traumatic event(s) are recurring.</li> <li>4. Intense or prolonged psychological distress at exposure to internal or external cues that symbolize or resemble an aspect of the traumatic event(s).</li> <li>5. Marked physiological reactions to internal and external cues that symbolize or resemble an aspect of the traumatic event(s).</li> </ol>
C. One (or both) symptoms of persistent avoidance of stimuli associated with the traumatic event(s), and beginning after the traumatic event(s): <ol style="list-style-type: none"> <li>1. Avoidance of efforts to avoid distressing memories, thoughts, or feelings about the traumatic event(s).</li> <li>2. Avoidance of, or efforts to, avoid external reminders that arouse distressing memories, thoughts or feelings about the traumatic event(s).</li> </ol>
D. Two (or more) symptoms of negative alterations in cognitions and mood associated with traumatic event(s), and beginning or worsening after the traumatic event(s): <ol style="list-style-type: none"> <li>1. Inability to remember an important aspect of the traumatic event(s).</li> <li>2. Persistent and exaggerated negative beliefs or expectations about oneself, others, or the world.</li> <li>3. Persistent, distorted cognitions about the cause or consequences of the traumatic event(s) that lead the individual to blame himself/herself or others.</li> <li>4. Persistent negative emotional state (e.g. fear, horror, anger, guilt, or shame).</li> <li>5. Markedly diminished interest or participation in significant activities.</li> <li>6. Feelings of detachment or estrangement from others.</li> <li>7. Persistent inability to experience positive emotions.</li> </ol>
E. Two (or more) symptoms of marked alterations in arousal and reactivity associated with the traumatic event, and beginning or worsening after the traumatic event(s): <ol style="list-style-type: none"> <li>1. Irritable behavior and angry outbursts</li> <li>2. Reckless or self-destructive behavior.</li> <li>3. Hypervigilance.</li> <li>4. Exaggerated startle response.</li> <li>5. Problems with concentration.</li> <li>6. Sleep disturbance.</li> </ol>
F. Duration of the disturbance (Criterion B, C, D, or E) is more than one month.
G. The disturbance causes clinically significant distress or impairment in social, occupational, or other important areas of functioning.
H. The disturbance is not attributable to the physiological effects of a substance or another medical condition.

**Figure 1** Post-traumatic stress disorder diagnostic criteria.

dependence among survivors. Our selection criteria focused on trauma patients admitted after level II trauma activation, because we chose to study injured but physiologically normal patients that could (1) consent to be included in the study and (2) could have maximized opportunity to participate in both the initial and follow-up screening tools without the confounding element of injury patterns rendering subjects with an inability to participate or complete the study.

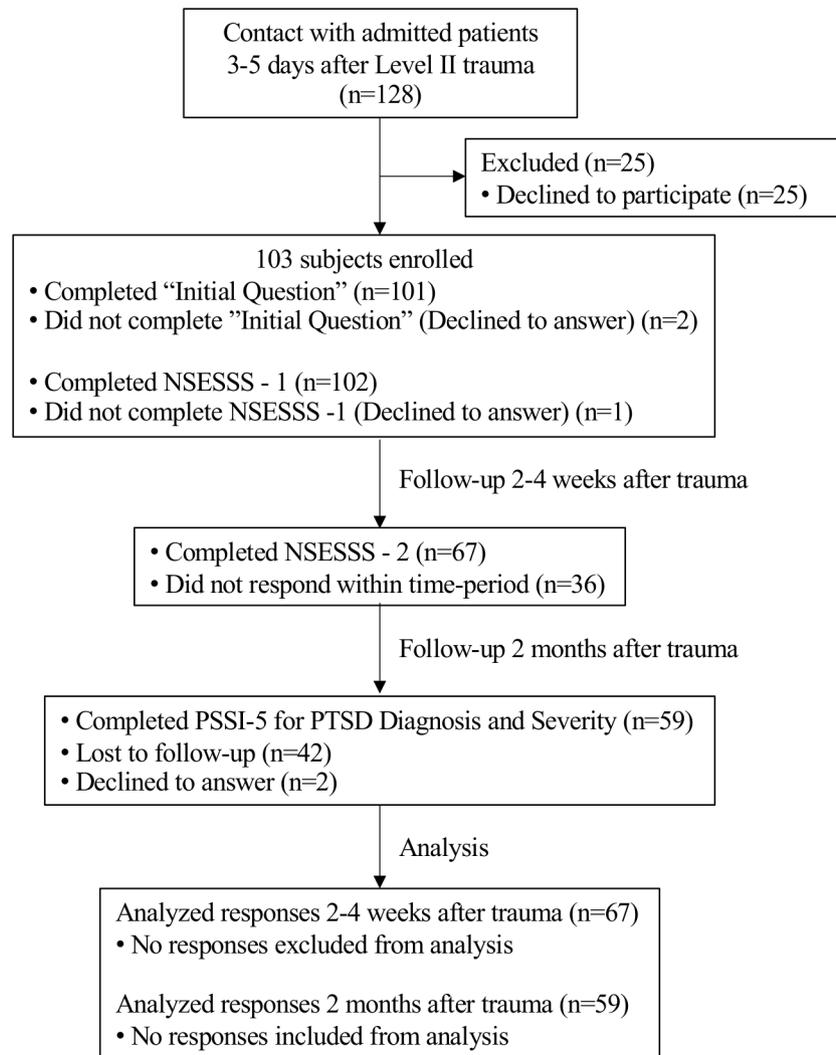
Level II trauma patients were approached for enrollment in the study 3 days to 5 days after trauma by either of two trained clinicians (SR, senior psychiatry resident, and JV, nurse practitioner). The protocol was fully explained to the subjects and their written informed consent was obtained. The subjects completed the initial question and the standardized National Stressful Events Survey Acute Stress Disorder Scale (NSESSS) 3 days to 5 days after trauma in person (NSESSS-1), the NSESSS 2 weeks to 4 weeks after trauma by phone (NSESSS-2), and the Post-Traumatic Stress Disorder Symptom Scale Interview for DSM-5

(PSSI-5) 2 months after trauma by phone (see [figure 2](#)). The outcomes of PTSD diagnosis and PTSD severity were extracted from the PSSI-5.

Injury Severity Score (ISS) was abstracted from each subject's chart. The ISS is based on severity score from six regions of the body (head or neck, face, chest, abdominal or pelvic contents, extremities or pelvic girdle, and external).<sup>15</sup>

### Screening tools

The 'initial question' asked was 'To what extent did you feel fear, helplessness, or horror?' with three possible choices ('not at all,' 'somewhat', and 'intensely'). This question was a significant criterion for diagnosis of PTSD in DSM-IV TR and has been removed from DSM-5. The NSESSS for acute stress symptoms (online supplemental figure 2) is a seven-item screener that assesses the severity of symptoms of ASD. Each item on the measure is rated on a 5-point scale (0=not at all, 1=a little bit, 2=moderately, 3=quite a



**Figure 2** Modified consort flow diagram. NSESS, National Stressful Events Survey Acute Stress Disorder Scale; PSSI-5, Posttraumatic Stress Disorder Symptoms Scale Interview for DSM-5.

bit, and 4=extremely). The total score ranges from 0 to 28, with higher scores indicating greater severity of ASD. The average score for each subject was used. ASD can be evaluated in terms of none (0), mild (1), moderate (2), severe (3), or extreme (4).<sup>16</sup> The PSSI-5 is a 24-item semistructured interview that assesses PTSD symptoms in the past month.<sup>17 18</sup> A diagnostic determination of PTSD was made by a clinician if the enrolled patient met the DSM-5 criteria of PTSD on completion of the PSSI-5 (figure 1). The PTSD symptom scale from the PSSI-5 was used to assess the severity of PTSD symptoms. The PSSI-5 instructions indicate that a presumptive diagnosis of PTSD may be made if a patient scores  $\geq 23$  on the symptom scale, but there is no available literature confirming this assumption. Symptoms are also rated on a 5-point scale of frequency and severity ranging from 0 (not at all) to 4 (6 or more times a week/severe). The sum of the 20 PTSD symptom items yields a total PTSD symptom scale, which is evaluated as follows: minimal symptoms (0 to 8), mild (9 to 18), moderate (19 to 30), severe (31 to 45), and very severe (46 to 80).

### Subjects

Eligible study subjects were trauma patients meeting level II activation criteria and deemed to be medically stable by an interdisciplinary team of providers. The NSESSS and the PSSI-5 were

administered in English. Patients who did not speak English or had a hospital stay of <72 hours were excluded from the study. In addition, vulnerable populations such as pregnant women, prisoners, and persons with decisional incapacity were excluded. Any patients in the hospital who had symptoms of ASD that were causing distress underwent an inpatient psychiatric consultation as per the standard of care. After discharge from the hospital, subjects who had symptoms of PTSD who self-identified as affecting daily living were provided a referral to a mental health clinician in their locale.

### Statistical analysis

Descriptive statistics were used to describe demographics. Non-parametric tests were used for data analyses. Statistical analyses were conducted in SPSS V.27 using two-tailed tests with a 0.05 significance level. The general population prevalence of 3.5% 1-year prevalence of PTSD in the general population was used for the expected incidence as the range of injury was unknown at the outset of the study.<sup>19</sup> The post hoc power analysis of the study to detect PTSD was 96.3% as the incidence of PTSD in our study group was 16.9% as we ultimately had 59 subjects complete the PSSI-5. Univariable logistic regression was used to assess association of PTSD diagnosis with baseline covariates

**Table 1** Demographics

	Enrolled	Completed PSSI-5	Level II trauma activations (with ISS)
Gender (%)	M: 63.1, F: 36.9	M: 61.0, F: 39.0	M: 63.0, F: 37.0
n	103	59	1183
Median age (years)	58	58	51
Mean age±SD (years)	55.0±22.4	55.0±22.7	52.0±23
Race (%)			
White	72.8	78.0	67.0
Black	15.5	10.2	9.8
Asian	3.9	3.4	1.4
Other	7.8	8.5	20.6
Unknown	0.0	0.0	0.8
Ethnicity (%)			
Non-Hispanic	93.2	93.2	77.4
Hispanic	6.8	6.8	20.7
Unknown	0.0	0.0	1.9
Mean ISS±SD	11.68±6.83	11.45±7.08 (collected for 55/59)	10.21±7.72
Mechanism of injury (%)			
Motor vehicle collision	42.7	42.4	36.4
Fall	32.0	30.5	34.1
Pedestrian struck	9.7	8.5	8.5
Motorcycle collision	5.8	8.5	6.3
Bicycle injury	1.0	1.7	3.4
Assault	1.0	1.7	2.8
Other	7.8	6.8	8.5
Proportion of patients with AIS score≥3 (by body region, %)*			
Head	12.6	11.9	17.3
Face	0.0	0.0	0.6
Neck	1.9	0.0	1.5
Thorax	24.3	20.3	20.5
Abdomen	4.9	6.8	3.8
Spine	9.7	6.8	7.6
Upper extremity	1.9	1.7	1.0
Lower extremity	19.4	18.6	12.2
External and other	0.0	0.0	0.0

\* AIS scores: 1, minor; 2, moderate; 3, serious; 4, severe; 5, critical; 6, maximum.  
 AIS, Abbreviated Injury Scale; F, female; ISS, Injury Severity Score; M, male; PSSI-5, Posttraumatic Stress Disorder Symptoms Scale Interview for DSM-5.

(age, gender, and ISS) and the scores for the initial question, NSESS-1, and NSESS-2. Multivariable logistic regression was used to analyze if the initial question, NSESS-1, and NSESS-2 predict PTSD diagnosis. Similarly, multivariable linear regression analyses were used to establish whether scores for the initial question, NSESS-1, and NSESS-2 predict the PTSD severity using the PTSD symptom scale. In addition, using a generalized additive model (GAM), a non-linear multivariable regression analysis was performed to gain a better understanding of the relationship between NSESS-1 and PTSD severity, as well as NSESS-2 and PTSD severity.

## RESULTS

A total of 1633 level II trauma activations occurred at WMC during the time period of this study. A total of 1183 activations had an associated ISS available in the trauma registry. A total of 103 subjects were enrolled in the study (figure 2). The mean (±SD) of the age of enrolled subjects was 55 (±22.4) years.

Although <10% of the eligible patients enrolled in the study, table 1 demonstrates that there were no appreciable differences in gender, age, or ISS between those enrolled, who completed the PSSI-5, and in all level II trauma activations who had an ISS completed.

Of the study sample, 63.1% were male. Of the 103 enrolled subjects, 101 completed the initial question: 28.2% responded 'not at all'; 25.2% responded 'somewhat,' and 44.7% responded 'Intensely.' NSESS-1 was completed at the same time as the initial question. Of the 103 subjects, 102 completed NSESS-1. Sixty-seven of the 103 subjects completed NSESS-2. Forty-five of the 103 subjects completed NSESS-2 and PSSI-5. Fifty-nine of the 103 subjects completed PSSI-5 (figure 2). These subjects also completed the initial question and NSESS-1. None of the results showed a normal distribution of values. Of the 59 (16.9%) subjects, 10 met the criteria for the diagnosis of PTSD. Twenty-five subjects refused to participate after the study was explained to them. Enrolled subjects had a mean (±SD) ISS of

**Table 2** Ability of screening tools to predict PTSD diagnosis

	Univariable logistic regression		Multivariable logistic regression (R <sup>2</sup> =0.058)	
	OR (95% CI)	P value	OR (95% CI)	P value
Age (years)	0.997 (0.967 to 1.028)	0.852	0.999 (0.966 to 1.034)	0.961
Gender	1.053 (0.251 to 4.224)	0.942	0.958 (0.210 to 4.373)	0.956
ISS	1.023 (0.931 to 1.123)	0.639	1.024 (0.929 to 1.130)	0.629
Initial question	2.316 (0.831 to 6.456)	0.108	2.360 (0.814 to 6.847)	0.114
	Univariable logistic regression		Multivariable logistic regression (R <sup>2</sup> =0.141)	
Age (years)	0.997 (0.967 to 1.028)	0.852	1.004 (0.967 to 1.042)	0.836
Gender	1.053 (0.251 to 4.224)	0.942	0.834 (0.152 to 4.568)	0.834
ISS	1.023 (0.931 to 1.123)	0.639	1.034 (0.935 to 1.143)	0.513
NSESSS-1 (3–5 days)	2.745 (1.312 to 5.744)	<b>0.007</b>	2.982 (1.326 to 6.705)	<b>0.008</b>
	Univariable logistic regression		Multivariable logistic regression (R <sup>2</sup> =0.125)	
Age (years)	0.997 (0.967 to 1.028)	0.852	0.993 (0.953 to 1.036)	0.752
Gender	1.053 (0.251 to 4.224)	0.942	0.590 (0.084 to 4.159)	0.597
ISS	1.023 (0.931 to 1.123)	0.639	1.052 (0.937 to 1.182)	0.392
NSESSS-2 (2–4 weeks)	2.988 (1.064 to 8.389)	<b>0.038</b>	3.707 (1.137 to 12.841)	<b>0.039</b>

ISS, Injury Severity Score; NSESSS, National Stressful Events Survey Acute Stress Disorder Scale; PTSD, post-traumatic stress disorder.

11.68 (±6.83), similar to subjects who refused to enroll (10.95 (±7.30)). Age, gender, and ISS did not show a significant association in any model with either the diagnosis of PTSD or the PTSD severity using the PTSD symptom scale. None of the enrolled subjects had a documented prior diagnosis of PTSD.

Administering question 1 after 3 days to 5 days was not a predictor for the diagnosis of PTSD in either the univariable or multivariable model (table 2). However, answers to the initial question were predictive of the PTSD severity based on the PTSD symptom scale (p=0.039) (table 3). In contrast, PTSD diagnosis was predicted by NSESSS-1 (p=0.008) (table 2). PTSD severity using the PTSD symptom scale was also predicted by NSESSS-1 (p<0.001) (table 3). PTSD diagnosis was predicted by NSESSS-2 (p=0.039) (table 2). PTSD severity was also predicted by NSESSS-2 (p<0.001) (table 3).

Non-linear multivariable regression analysis by GAM showed significant association (p<0.001) between NSESSS-1 scores and severity on the PTSD severity, and a significant association (p<0.001) between NSESSS-2 and PTSD severity. Of interest,

non-linear multivariable regression analysis indicated that the likelihood of PTSD diagnosis increased significantly after a subject scored more than 14/28 (>50%) on the NSESSS at both 3 days to 5 days and 2 weeks to 4 weeks after trauma. Every average point increase in the average NSESSS score after 2 weeks to 4 weeks showed an increase by 10 points in PTSD symptom scale. This relationship is presented in figure 3A,B.

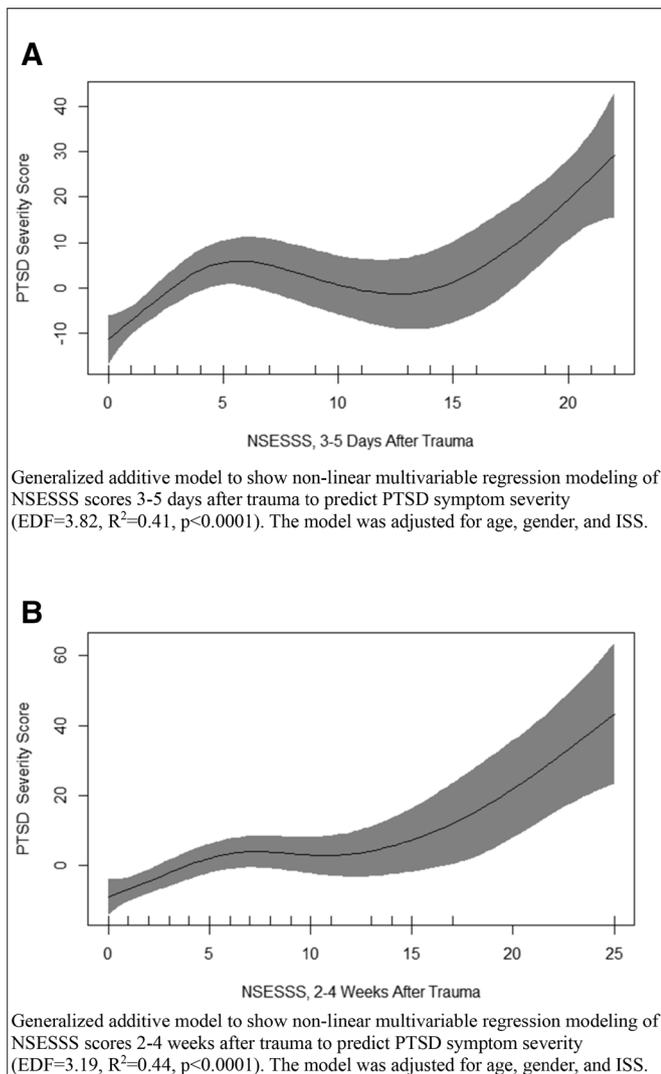
### DISCUSSION

A recent study has shown that only 7% of adult Level-1 trauma centers<sup>20</sup> and 36.17% of pediatric trauma centers had a protocol for assessing PTSD; 12.5% of Level I adult centers and 27.66% of pediatric trauma centers had an assessment protocol for ASD.<sup>21</sup> In this study, we found 4x as many subjects (16.9%) qualified for a diagnosis of PTSD compared with the 1 year prevalence for PTSD (3.5%) in the general population, and almost 1.5x higher than what has previously been reported among trauma patients.<sup>12</sup> Individuals who were hospitalized after a trauma are

**Table 3** Ability of screening tools to predict PTSD symptom scale (severity)

	Univariable linear regression		Multivariable linear regression (R <sup>2</sup> =0.111)	
	Beta estimate (95% CI)	P value	Beta estimate (95% CI)	P value
Age (years)	-0.046 (-0.206 to 0.114)	0.567	-0.061 (-0.236 to 0.113)	0.484
Gender	-3.140 (-10.516 to 4.235)	0.397	-3.718 (-11.787 to 4.350)	0.359
ISS	0.035 (-0.517 to 0.588)	0.899	0.058 (-0.481 to 0.597)	0.83
Initial question	5.047 (0.833 to 9.260)	<b>0.02</b>	5.012 (0.268 to 9.757)	<b>0.039</b>
	Univariable linear regression		Multivariable linear regression (R <sup>2</sup> =0.312)	
Age (years)	-0.046 (-0.206 to 0.114)	0.567	-0.034 (-0.188 to 0.120)	0.659
Gender	-3.140 (-10.516 to 4.235)	0.397	-3.426 (-10.511 to 3.658)	0.336
ISS	0.035 (-0.517 to 0.588)	0.899	0.068 (-0.406 to 0.542)	0.775
NSESSS-1 (3–5 days)	8.095 (4.634 to 11.556)	<b>0.000018</b>	8.480 (4.712 to 12.247)	<b>0.000038</b>
	Univariable linear regression		Multivariable linear regression (R <sup>2</sup> =0.391)	
Age (years)	-0.046 (-0.206 to 0.114)	0.567	-0.064 (-0.228 to 0.100)	0.433
Gender	-3.140 (-10.516 to 4.235)	0.397	3.554 (-11.574 to 2.826)	0.226
ISS	0.035 (-0.517 to 0.588)	0.899	0.200 (-0.270 to 0.669)	0.394
NSESSS-2 (2–4 weeks)	9.954 (5.758 to 14.151)	<b>0.000021</b>	10.134 (5.317 to 13.881)	<b>0.000066</b>

ISS, Injury Severity Score; NSESSS, National Stressful Events Survey Acute Stress Disorder Scale; PTSD, post-traumatic stress disorder.



**Figure 3** Non-linear multivariable regression modeling. ISS, Injury Severity Score; NSESS, National Stressful Events Survey Acute Stress Disorder Scale; PTSD, post-traumatic stress disorder EDF, estimated degrees of freedom.

at a significantly elevated risk for developing PTSD compared with the general population. As such, it is important to screen this population for developing PTSD. Of note, we found that ISS was not a predictor for PTSD for patients who are hospitalized after a level II trauma. This is consistent with previous literature that has shown that ISS is not a predictor for PTSD or PTSD severity.<sup>22, 23</sup> It should be noted that ISS is primarily a marker of injury severity in blunt trauma (as that suffered by our study sample). This finding may not be replicated when working with ISS in patients who have penetrating trauma.

Our findings indicate that although using a simple screening question assessing the experience of fear, helplessness, or horror predicted PTSD severity, it was not effective for predicting PTSD diagnosis. Administering a multifaceted screening tool such as the NSESS at either 3 days to 5 days or 2 weeks to 4 weeks after the trauma was an effective predictor for both the diagnosis of PTSD and PTSD severity. This suggested that there is utility in administering the NSESS for trauma patients who were admitted to the hospital as early as 3 days to 5 days after their trauma. To our knowledge, this is the first study that demonstrates a relationship between NSESS scores and PTSD severity.

Using a simple linear regression, we saw that for every average point increase in the average NSESS score at 3 days to 5 days, we see an increase in PTSD symptom scale score by 8 points. Similarly, every average point increase in the average NSESS score after 2–4 weeks showed an increase by 10 points in the PTSD symptom scale score.

The current study evaluated the relationship between NSESS and PTSD severity. We demonstrated that if a subject scores below 14 on the NSESS at either 3 days to 5 days or 2 weeks to 4 weeks after the trauma, then there would be a low chance to experience greater PTSD severity after 2 months. However, if they scored above 14 on the NSESS at either 3 days to 5 days after trauma or 2 weeks to 4 weeks after trauma, then the chance of experiencing greater PTSD severity would increase substantially and linearly. As such, it may be beneficial to pre-emptively establish outpatient psychiatric follow-up for individuals who score more than 14 on the NSESS for acute stress symptoms.

This study not only highlighted the fact that level II trauma patients were at an increased risk of PTSD but also established that the diagnosis and severity of PTSD can be predicted with the use of a simple screener in this population at an early stage of the hospital course. We successfully identified an early time frame for administering the NSESS, established the utility of using the NSESS for ASD to predict PTSD diagnosis and severity, and found a threshold for establishing outpatient care to help improve the quality of life of these patients.

Prior studies have demonstrated that PTSD diagnosis can be predicted after injury using different screeners such as the Injured Trauma Survivor Screen (9-item), Posttraumatic Stress Disorder Checklist for DSM-5 (20-item), and Posttraumatic Adjustment Scale (10-item).<sup>24–26</sup> We chose to use the NSESS as not only did it have a shorter screener with only seven items but also it validated to assess severity of symptoms. Our study is unique in comparison to previous studies as none of the prior studies assessed for predicting symptom severity.

As screening for substance abuse has become standard practice among trauma centers, this study suggests screening for PTSD should also become routine practice for all systems of trauma-related patient care. Given both the ease and predictive power of PTSD screening as demonstrated in our study, we suggest the development of both institutional and societal guidelines where all trauma patients should undergo screening as part of the multidisciplinary care that trauma patients are expected to receive. Incorporating PTSD screening as standard trauma care will allow for earlier diagnosis with minimal additional requirements for healthcare resources. In turn, this will lead to earlier opportunities for interventions that may significantly improve quality of life and reduce morbidity. There remain multiple systemic barriers in obtaining quality long-term outpatient mental healthcare, particularly for individuals without insurance. Earlier and more effective identification of PTSD in the civilian population may alert policymakers and healthcare systems to the unrealized demand for mental health resources.

### Limitations

As with most longitudinal studies, this analysis was hampered by difficulty with follow-up as less than half of the enrolled subjects completed all three screeners. Another limitation was that factors that have been found to be associated with PTSD such as prior psychiatric diagnoses (including prior history of PTSD), socioeconomic status, childhood abuse, anxiety, or substance use were not ascertained through a psychiatric history at the time of administering the screener.<sup>27–29</sup> The effect of injury

mechanism, particularly penetrating trauma and traumatic brain injuries has been correlated with the development of PTSD.<sup>30</sup> Both of these groups were under-represented in our sample population. Although assessing the effect of injury mechanism and functional status of the patient is outside the scope of this study, these are important factors that have been correlated with the development of PTSD.<sup>31</sup> This study is limited in its scope in that it focuses on level II trauma patients who were hospitalized. It would be instrumental to see whether these results could be replicated in Level I trauma patients who are more likely to suffer from greater injury severity, a traumatic brain injury, gun-shot wounds, and penetrating trauma, and are more likely to suffer medical trauma. We did not conduct psychiatric evaluations after discharge and did not assess the development of affective disorders, but this may be appropriate for future investigations. It would be equally important to assess trauma patients who were discharged directly from the emergency department and, to broaden the study, to include all trauma patients regardless of activation level using a similar protocol.

## CONCLUSIONS

We demonstrate a higher prevalence of PTSD in hospitalized trauma patients than in the general population, suggesting increased screening for PTSD among this patient population. We confirm that ISS is not predictive of PTSD diagnosis or severity. Using a simple, but multifaceted, screener such as the NSESSS as a screener at either 3 days to 5 days or 2 weeks to 4 weeks after the trauma is an effective method for predicting the diagnosis and the severity of PTSD symptoms. In addition, we show that patients who score higher than 14 on the NSESSS for Acute Stress Symptoms may need closer follow-up.

**Acknowledgements** The authors thank Rida Khan.

**Contributors** JV, MK, YS, and RD designed the study. JV and SR participated in enrollment and data collection. SR, JV, MF, RD, AS, KP, PR and YS participated in data analysis and interpretation. All authors read and approved the final submission.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** None declared.

**Patient consent for publication** Not required.

**Ethics approval** The study was approved by the New York Medical College Institutional Review Board and the Clinical Research Institute of Westchester Medical Center (approval ID: L12004). Written informed consent was obtained for all subjects before taking part in the study.

**Provenance and peer review** Commissioned; externally peer reviewed.

**Data availability statement** Data are available upon reasonable request. The deidentified participant data (including demographics, scores on the screening questionnaires, and the original screening questionnaires) are available from Dr Yvette Smolin by contacting Yvette.Smolin@wmchealth.org.

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

## ORCID iDs

Saad Rahmat <http://orcid.org/0000-0002-1656-3137>

Kartik Prabhakaran <http://orcid.org/0000-0002-9837-999X>

## REFERENCES

1 Goldstein RB, Smith SM, Chou SP, Saha TD, Jung J, Zhang H, Pickering RP, Ruan WJ, Huang B, Grant BF. The epidemiology of DSM-5 posttraumatic stress disorder in the United States: results from the National epidemiologic survey on alcohol and related Conditions-III. *Soc Psychiatry Psychiatr Epidemiol* 2016;51:1137–48.

- 2 Bisson JI, Cosgrove S, Lewis C, Roberts NP. Post-Traumatic stress disorder. *BMJ* 2015;26:h6161.
- 3 O'Donnell ML, Creamer M, Bryant RA, Schnyder U, Shalev A. Posttraumatic disorders following injury: an empirical and methodological review. *Clin Psychol Rev* 2003;23:587–603.
- 4 Cohen BE, Marmar CR, Neylan TC, Schiller NB, Ali S, Whooley MA. Posttraumatic stress disorder and health-related quality of life in patients with coronary heart disease: findings from the heart and soul study. *Arch Gen Psychiatry* 2009;66:1214–20.
- 5 Ahmadi N, Hajsadeghi F, Mirshkarlo HB, Budoff M, Yehuda R, Ebrahimi R. Post-Traumatic stress disorder, coronary atherosclerosis, and mortality. *Am J Cardiol* 2011;108:29–33.
- 6 Kessler RC. Posttraumatic stress disorder: the burden to the individual and to Society. *J Clin Psychiatry* 2000;61 Suppl 5:4–12.
- 7 Bell TM, Vetter AN, Zarzur BL. Prevalence and treatment of depression and posttraumatic stress disorder among trauma patients with non-neurological injuries. *J Trauma Acute Care Surg* 2018;85:999–1006.
- 8 American Psychiatric Association. *Diagnostic and statistical manual of mental disorders*. 5. Arlington, VA: Author, 2013.
- 9 Cahill SP, Pontoski K. Post-Traumatic stress disorder and acute stress disorder I: their nature and assessment considerations. *Psychiatry* 2005;2:14–25.
- 10 Brewin CR, Andrews B, Rose S, Fear RS. Fear, helplessness, and horror in posttraumatic stress disorder: investigating DSM-IV criterion A2 in victims of violent crime. *J Trauma Stress* 2000;13:499–509.
- 11 Bernat JA, Ronfeldt HM, Calhoun KS, Arias I. Prevalence of traumatic events and peritraumatic predictors of posttraumatic stress symptoms in a nonclinical sample of college students. *J Trauma Stress* 1998;11:645–64.
- 12 Brunet A, Weiss DS, Metzler TJ, Best SR, Neylan TC, Rogers C, Fagan J, Marmar CR. The Peritraumatic distress inventory: a proposed measure of PTSD criterion A2. *Am J Psychiatry* 2001;158:1480–5.
- 13 Rotondo MF, Cribari C, Smith RS. *Resources for optimal care of the injured Patient-American College of surgeons: Committee on trauma*, 2014, 2019.
- 14 Trauma Activation Guidelines. Texas EMS Trauma & Acute Care Foundation. 2013. <http://tetaf.org/wp-content/uploads/2016/03/trauma-activation-guidelines.pdf>.
- 15 Baker SP, O'Neill B, Haddon W, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. *J Trauma* 1974;14:187–96.
- 16 Kilpatrick DK, Resnick HS, Friedman MJ. *Severity of acute stress Symptoms-Adult (NSESSS)*: American Psychiatric Association, 2013.
- 17 Foa EB, Capaldi S. *Manual for the administration and scoring of the PTSD symptom Scale-Interview for DSM-5 (PSS-I-5)*, 2013.
- 18 Foa EB, Riggs DS, Dancu CV, Rothbaum BO. Reliability and validity of a brief instrument for assessing post-traumatic stress disorder. *J Trauma Stress* 1993;6:459–73.
- 19 Kessler RC, Chiu WT, Demler O, Merikangas KR, Walters EE. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National comorbidity survey replication. *Arch Gen Psychiatry* 2005;62:617–27.
- 20 Love J, Zatzick D. Screening and intervention for comorbid substance disorders, PTSD, depression, and suicide: a trauma center survey. *Psychiatr Serv* 2014;65:918–23.
- 21 Guess KE, Fifolt M, Adams RC, Ford EW, McCormick LC. Life after trauma: a survey of level 1 trauma centers regarding posttraumatic stress disorder and acute stress disorder. *J Trauma Nurs* 2019;26:223–33.
- 22 Quale AJ, Schanke A-K, Frøslie KF, Roise O. Severity of injury does not have any impact on posttraumatic stress symptoms in severely injured patients. *Injury* 2009;40:498–505.
- 23 Gabert-Quillen CA, Fallon W, Delahanty DL. Ptsd after traumatic injury: an investigation of the impact of injury severity and peritraumatic moderators. *J Health Psychol* 2011;16:678–87.
- 24 Hunt JC, Sapp M, Walker C, Warren AM, Brasel K, deRoon-Cassini TA. Utility of the injured trauma survivor screen to predict PTSD and depression during hospital admission. *J Trauma Acute Care Surg* 2017;82:93–101.
- 25 Geier TJ, Hunt JC, Nelson LD, Brasel KJ, deRoon-Cassini TA. Detecting PTSD in a traumatically injured population: the diagnostic utility of the PTSD checklist for DSM-5. *Depress Anxiety* 2019;36:170–8.
- 26 Jaramillo S, Suffoletto B, Callaway C, Pacella-LaBarbara M. Early screening for posttraumatic stress disorder and depression among injured emergency department patients: a feasibility study. *Acad Emerg Med* 2019;26:1232–44.
- 27 Brewin CR, Andrews B, Valentine JD. Meta-Analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *J Consult Clin Psychol* 2000;68:748–66.
- 28 Sareen J. Posttraumatic stress disorder in adults: impact, comorbidity, risk factors, and treatment. *Can J Psychiatry* 2014;59:460–7.
- 29 Kessler RC, Aguilar-Gaxiola S, Alonso J, Bromet EJ, Gureje O, Karam EG, Koenen KC, Lee S, Liu H, Pennell BE, et al. Who world mental health survey Collaborators. The associations of earlier trauma exposures and history of mental disorders with PTSD after subsequent traumas. *Mol Psychiatry* 2018;23:1892–9.
- 30 Roitman P, Gilad M, Ankri YLE, Shalev AY. Head injury and loss of consciousness raise the likelihood of developing and maintaining PTSD symptoms. *J Trauma Stress* 2013;26:727–34.



31 Baecher K, Kangas M, Taylor A, O'Donnell ML, Bryant RA, Silove D, McFarlane AC, Wade D. The role of site and severity of injury as predictors of mental health outcomes

following traumatic injury. *Stress Health* 2018;34:545–51.

## Correction for post-traumatic stress disorder can be predicted in hospitalized blunt trauma patients using a simple screening tool

---

Rahmat S, Velez J, Farooqi M, *et al.* Post-traumatic stress disorder can be predicted in hospitalized blunt trauma patients using a simple screening tool. *Trauma Surgery, Acute Care Open* 2021;6:e000623. doi: 10.1136/tsaco-2020-000623.

This article has been updated since it was published online to include Maria Khan as the seventh author. Her affiliation is as follows:

5. New York Medical College, Saint Vincent's Medical Center, Harrison, New York, USA



### OPEN ACCESS

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

© Author(s) (or their employer(s)) 2023. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

*Trauma Surg Acute Care Open* 2023;8:e000623corr1. doi:10.1136/tsaco-2020-000623corr1



## Level 1 Trauma

### **Physiologic Criteria:**

- Traumatic Cardiopulmonary arrest
- GCS  $\leq 12$  **OR** GCS  $< 14$  currently taking anticoagulants (ASA and Plavix included)
- Any confirmed SBP  $\leq 100$  from scene to WMC arrival
- Any patient with a HR  $>$  than SBP
- Respiratory distress (rate  $\geq 10$  or  $\geq 29$ ) **AND/OR** airway compromise
- Any ongoing blood or blood products transfusing for hemodynamic maintenance
- ANY and **ALL** intubated patients- **OR**-patients in need of emergent airway

### **Anatomic Criteria:**

- Penetrating injury to the head, torso, neck, or groin area
- Uncontrolled external bleeding
- Clinically **unstable** pelvic fractures: Diastasis symphysis pubis  $\geq 5$ cm; SI joint widening; Butterfly fragment fracture (all 4 pubic rami fractured), base deficit  $\geq 10$
- **Two or more** long bone fractures
- Amputations of any extremity (excluding digits)
- Poly-Trauma (**2 or more** involved systems)
- **ALL PREGNANT PATIENTS  $\geq 28$  weeks** gestation after major trauma
- Significant Burns  $\geq 15\%$  TBSA associated with trauma injury (including inhalation injury)
- High Speed Collision ( $\geq 30$  MPH) Age  $\geq 65$  years of age with gross injury
- Spinal Cord injury/paralysis

## Level 2 Trauma

### **Mechanism of Injury:**

- High Speed Collision ( $\geq 30$  MPH) **without** gross injury
- Unrestrained Passenger involved in a rollover
- Pedestrian, motorcycle or bicycle impacted at  $\geq 20$  MPH
- Falls  $\geq 10$  feet-**OR**-any fall with a (+) LOC  $\geq 65$  years of age
- Motorist/Cyclist/Rider separated from object (motorcycle/bicycle/ATV/horse/snow mobile/dirt bike)
- Vehicular Ejection **OR** prolonged extrication ( $\geq 20$  min)
- Death of another occupant in the same vehicle

### **Physiologic Criteria:**

- GCS 13-15

### **Anatomic Criteria:**

- Clinically **stable** pelvic fracture
- **One** long bone fracture

Supplementary Figure 1: Westchester Medical Center Adult Trauma Activation Criteria

**Severity of Acute Stress Symptoms—Adult\***  
**\*National Stressful Events Survey Acute Stress Disorder Short Scale (NSESSS)**

Name: \_\_\_\_\_ Age: \_\_\_\_\_ Sex: Male  Female  Date: \_\_\_\_\_

Please list the traumatic event that you experienced: \_\_\_\_\_

Date of the traumatic event: \_\_\_\_\_

**Instructions:** People sometimes have problems after extremely stressful events or experiences. How much have you been bothered during the PAST SEVEN (7) DAYS by each of the following problems that occurred or became worse after an extremely stressful event/experience? **Please respond to each item by marking (✓ or x) one box per row.**

						Clinician Use	
		Not at all	A little bit	Moderately	Quite a bit	Extremely	Item score
1.	Having "flashbacks," that is, you suddenly acted or felt as if a stressful experience from the past was happening all over again (for example, you reexperienced parts of a stressful experience by seeing, hearing, smelling, or physically feeling parts of the experience)?	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	
2.	Feeling very emotionally upset when something reminded you of a stressful experience?	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	
3.	Feeling detached or distant from yourself, your body, your physical surroundings, or your memories?	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	
4.	Trying to avoid thoughts, feelings, or physical sensations that reminded you of a stressful experience?	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	
5.	Being "super alert," on guard, or constantly on the lookout for danger?	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	
6.	Feeling jumpy or easily startled when you hear an unexpected noise?	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	
7.	Being extremely irritable or angry to the point where you yelled at other people, got into fights, or destroyed things?	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	
<b>Total/Partial Raw Score:</b>							
<b>Prorated Total Raw Score: (if 1 item left unanswered)</b>							
<b>Average Total Score:</b>							

Kilpatrick DG, Resnick HS, Friedman, MJ. Copyright © 2013 American Psychiatric Association. All rights reserved. This measure can be reproduced without permission by researchers and by clinicians for use with their patients.

Supplementary Figure 2: National Stressful Events Survey Acute Stress Disorder Short Scale