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Screening for Posttraumatic Stress Disorder in Children After Accidental Injury

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ABSTRACT

OBJECTIVE. Children who have experienced an accidental injury are at increased risk of developing posttraumatic stress disorder. It is, therefore, essential that strategies are developed to aid in the early identification of children at risk of developing posttraumatic stress disorder symptomatology after an accident. The aim of this study was to examine the ability of the Child Trauma Screening Questionnaire to predict children at risk of developing distressing posttraumatic stress disorder symptoms 1 and 6 months after a traumatic accident.

METHODS. Participants were 135 children (84 boys and 51 girls; with their parents) who were admitted to the hospital after a variety of accidents, including car- and bike-related accidents, falls, burns, dog attacks, and sporting injuries. The children completed the Child Trauma Screening Questionnaire and the Children’s Impact of Events Scale within 2 weeks of the accident, and the Anxiety Disorders Interview Schedule for Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Child Version, was conducted with the parents to assess full and subsyndromal posttraumatic stress disorder in their child 1 and 6 months after the accident.

RESULTS. Analyses of the results revealed that the Child Trauma Screening Questionnaire correctly identified 82% of children who demonstrated distressing posttraumatic stress disorder symptoms (9% of sample) 6 months after the accident. The Child Trauma Screening Questionnaire was also able to correctly screen out 74% of children who did not demonstrate such symptoms. Furthermore, the Child Trauma Screening Questionnaire outperformed the Children’s Impact of Events Scale.

CONCLUSIONS. The Child Trauma Screening Questionnaire is a quick, cost-effective and valid self-report screening instrument that could be incorporated in a hospital setting to aid in the prevention of childhood posttraumatic stress disorder after accidental trauma.
RESEARCH HAS SHOWN that children who have experienced a traumatic event are at increased risk of developing posttraumatic stress disorder (PTSD). These traumatic events include natural disasters, such as wildfires, hurricanes, and earthquakes; interpersonal traumas, such as sexual and physical abuse; and accidental injury because of events such as road traffic accidents (RTAs), burns, falls, and animal attacks.

The reported prevalence of PTSD in children who have experienced an accidental injury varies between 6% and 45%, depending on the type of injury (eg, motor vehicle accident versus sporting injury), measures used (eg, self-report questionnaire versus structured interview), and diagnostic criteria chosen. Several studies report subsyndromal PTSD, because research has shown that although some children may not meet all 3 symptom cluster criteria, they show similar levels of functional impairment and distress to children with a full PTSD diagnosis.

Given the substantial numbers of children admitted to a hospital after injuries and that PTSD symptomatology can have a significant impact on academic and social development, it is essential that strategies are developed to aid in the early identification of children at risk of developing PTSD. If left untreated, PTSD can follow a long insidious course. Therefore, it is important that distressed children are identified early on so that they can receive further assessment and treatment before the problems become entrenched. It is also important to rule out children not at risk, because some research has shown that early prevention, such as psychological debriefing, may have a deleterious effect if provided to people who do not need help.

Screening instruments can be a quick, accurate, cost-effective, and reliable method for identifying children in an acute care setting who are vulnerable to the development of PTSD. Although several studies have been conducted with adults to date there are few screening instruments available for identifying children at risk for poor emotional adjustment after trauma.

Most research to date has focused on the effectiveness of the Impact of Events Scale (IES) as a screen for PTSD symptoms in children. Yule and Udwin administered a screening battery consisting of the IES, Birleson Depression Scale, and the Revised Children’s Manifest Anxiety Scale to teenage survivors of the Jupitor sinking. It was found that teenagers identified as being at high risk by the battery continued to have high scores on the IES 5 months later. However, the teenagers did not undergo a clinical assessment; therefore, conclusions cannot be made about the predictive performance (ie, sensitivity and specificity) of the screening battery.

Research by Stallard et al found that the IES (8- and 15-item versions) correctly identified two thirds of the children with full and subsyndromal PTSD who had been injured in car or sporting accidents. However, the authors concluded that the IES was more accurate when administered as part of the same screening battery suggested by Yule and Udwin. When the IES was combined with the other measures of the battery, screen scores identified 90% of children with concurrent PTSD.

Recently, the predictive validity of the Children’s Revised Impact of Event Scale was examined using a sample of children injured from an RTA or physical assault. The authors then cross-validated the cutoff scores with a clinically referred sample with a high base rate of PTSD. The results revealed that both the 8- and 13-item version of the screen correctly classified 75% to 83% of children in the 2 samples. This screen, however, was used to identify concurrent PTSD rather than risk for developing PTSD.

The Post Traumatic Stress Disorder Reaction Index has also been administered as part of a school-based screening program for PTSD 6 months after a wildfire disaster. Nine percent of the children were classified as experiencing severe to very severe PTSD. However, the Post Traumatic Stress Disorder Reaction Index was not compared with a gold standard clinical interview. Therefore, information on the level of false-positives and false-negatives associated with the screen is not available.

To our knowledge, the only other PTSD screen for use with children is the Screening Tool for Early Predictors of PTSD, which was derived from a risk factor survey developed by Winston et al. The results revealed that the Screening Tool for Early Predictors of PTSD had high sensitivity and moderate specificity in predicting persistent traumatic stress in children and parents 3 months after an RTA.

The previous studies demonstrate the feasibility of screening instruments; however, more research is needed to examine the concurrent and predictive validity over multiple time points and to directly compare the diagnostic accuracy of the existing screens using gold standard structured interviews. Furthermore, because the screens have been used primarily with children who have been involved in RTAs, additional research is necessary to demonstrate their applicability across a range of accidents. Given the limited number of accepted, reliable, and valid screens available for children and the limited research so far, additional work is warranted.

The aim of the present study was to examine the validity of the Child Trauma Screening Questionnaire (CTSQ) at predicting children at risk of developing PTSD 1 and 6 months after accident-related injury. The criteria generally used to assess the predictive performance of a screen are sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). It is important that the purpose of the screen is considered, in terms of clinical and resource issues, before deciding on how to balance these criteria when selecting the optimum predictive cutoff point. Therefore, the pur-
pose of this screen is to maximize sensitivity (to identify children at risk of developing PTSD so they can be targeted for early intervention) and NPV (to screen out children unlikely to experience PTSD). The final aim of the study was to compare the predictive performance of the CTSQ with the Children’s Impact of Events Scale (CIES).

**METHODS**

**Participants**

Children and their parents were recruited as part of a large-scale prospective study investigating the effect of accidental injury on children’s emotional functioning. The participants were recruited from 3 hospitals in South East Queensland, Australia, and were included in the study if the child was admitted to a hospital for a minimum of 24 hours because of an accidental physical injury and if they were between 7 and 16 years of age. Both parent and child also needed to speak fluent English. To avoid confounds, children were excluded if they had an intellectual impairment, had sustained a head injury (Glasgow Coma Scale at admission ≤13 and/or evidence of head injury in medical charts), if the child was in foster care, or if the injury was a result of child abuse.

As can be seen in Fig 1, 76% of the families who were approached agreed to participate in the study. Of the families who were eligible for the study and could be contacted, 47.9% completed the time 1 assessment (CTSQ and CIES) within the 2-week time frame. Of these participants, 83.9% completed the follow-up assessment at 1 month, and 78.3% completed the 6-month assessment. Refer to Table 1 for the demographic and injury severity characteristics of the sample at 1 month. Unfortunately, because of privacy regulations, data were not collected for families who did not participate in the study. However, on the data available, no significant differences were found for age, gender, or length of hospitalization between participants who completed the study compared with participants who withdrew.

The most common type of accident leading to hospitalization was falls (37%), followed by RTAs (32%), sporting accidents (13%), burns (8%), dog attacks (2%), and other (8%). Fractures and dislocations were by far the most common type of injury with 73% of the sample admitted for this reason. Other injuries sustained included burns (8%), internal injuries (6%), lacerations (7%), multiple injuries (2%), eye injuries (1%), and other injuries (3%).

**Measures**

**CTSQ**

The screen used in this study was adapted from the 10-item Trauma Screening Questionnaire (TSQ). This screen was chosen because Brewin et al found that the screen was an excellent predictor of PTSD in adult survivors of a rail crash (sensitivity: 0.86; specificity: 0.93; PPV: 0.86; NPV: 0.93; overall efficiency: 0.90). The TSQ was adapted for this study by rewording the questions to make them more comprehensible for children. The screen was given to a pilot sample to test for comprehension, and no problems were identified.

The TSQ was designed for use with a range of traumatic events and assesses for reexperiencing (5 items) and hyperarousal symptoms (5 items). The response

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<th>TABLE 1 Demographic and Injury Severity Characteristics of Sample</th>
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<td>Length of stay in hospital, mean (SD)</td>
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format requires participants to respond with yes (scored 1) or no (scored 0) to whether they have experienced the symptoms since the event. Avoidance items were not incorporated in the final version of the TSQ, because Brewin et al. reasoned that some avoidance items (ie, amnesia and foreshortened future symptoms) are not easily comprehended by respondents.

Reliability analysis for the CTSQ revealed the item-total correlations for each of the items ranged from .14 to .50, and the internal consistency was acceptable (α = .69). The CTSQ is available on request to the authors.

CIES (Short Form)
The 8-item CIES is based on factor analytic data on the IES, which is one of the most commonly used measures reported in the adult PTSD literature. The CIES consists of 2 subscales that are related to intrusion (4 items) and avoidance symptoms (4 items). Children are required to rate the frequency of symptoms they have experienced during the past week (not at all = 0, rarely = 1, sometimes = 2, and often = 3). Stallard et al. found that a cutoff score of 17 on the 8-item IES correctly identified 69.2% of children with PTSD. In addition, Perrin et al. examined a range of cut scores on the 8-item Children’s Revised Impact of Event Scale and found that a cutoff score of 17 maximized the balance between sensitivity (1.0) and specificity (0.71) in a sample of children injured during an RTA or assault. The CIES was administered to assess the convergent validity of the CTSQ and to compare the predictive performance of these 2 measures.

Anxiety Disorders Interview Schedule for DSM-IV, Child Version, Parent Interview Schedule
The Anxiety Disorders Interview Schedule for Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Child Version, Parent Interview Schedule (ADIS-C/P) was used to assess full and subsyndromal PTSD 6 months after the accident. The ADIS-C/P is a diagnostic semi-structured interview that is conducted with parents to assess for childhood emotional and behavioral disorders. The ADIS-C/P has been reported to have good test-retest reliability (κ from 0.75 to 0.96) and moderate-to-high interrater reliability (κ from 0.59 to 0.92).

Interviewers in this study received extensive training on administration and scoring of the ADIS-C/P. As part of training, they were required to observe the ADIS-C/P conducted with parents by an experienced interviewer. In addition, all of the interviewers were also observed and evaluated for competence before they conducted the ADIS-C/P on their own. Any problems that arose during administration or scoring were resolved during supervision meetings.

For the purpose of this article, only the PTSD category of the ADIS-C/P is reported. Given that some children who do not meet full PTSD criteria still experience significant ongoing problems after an accident, a subsyndromal PTSD diagnosis was also used to validate the CTSQ. The criteria used was the same as that reported by Winston et al., which states that subsyndromal PTSD is present when ≥1 symptom of avoidance, reexperiencing, and hyperarousal are present and that these symptoms cause significant interference with ≥1 areas of functioning. Collateral information for the subjective experience of trauma was also obtained from the child, and this information was used to guide the diagnosis of PTSD.

Injury Severity Score
Injury severity score (ISS) was obtained from medical charts to assess the severity of injury in the current sample. ISS is a widely used objective measure of injury severity and has demonstrated good reliability and validity with children. There is inconsistency in the literature regarding which categorization cutoffs to use for ISS. For this study, we defined mild injury as an ISS between 1 and 8 and moderate-to-severe injury as an ISS of ≥9. The rationale for this is that ISS is determined by squaring and then summing the highest abbreviated injury scale in each of the 3 most severely injured body regions. Given that an abbreviated injury scale of 3 is defined as serious but not life-threatening, we argue that an ISS of 9 should be classed as a “moderate” rather than a “minor” injury.

Procedures
Members of the research team approached children and their parents before the child was discharged from hospital. The details of the study were explained, and if both parent and child were interested in being involved, written informed consent was obtained. The child was given the CTSQ and the CIES to complete and send back within 2 weeks of their injury. To increase questionnaire return rates, participants were followed up via a reminder telephone call 1 week after the accident. If the questionnaires were not received within the required time frame, the child was excluded from the study.

At 4 to 6 weeks posttrauma, a trained interviewer conducted the ADIS-C/P with the parent at their home. Follow-up was subsequently conducted with the parent 6 months after the accident, and the PTSD section of the ADIS-C/P was conducted over the telephone. The decision to conduct the ADIS-C/P over the telephone at 6 months was based on research that has found very high agreement between face-to-face- and telephone-administered versions of the ADIS-C/P. Duration of hospital stay and ISS information was obtained from medical charts. The study was conducted in accordance with the National Health and Medical Research Council of Australia Ethical Guidelines.
The area under the ROC curve determines whether the diagnostic accuracy of the measure is better than chance.\textsuperscript{29} The optimum cutoff score for the CTSQ was selected based on the a priori decision to maximize sensitivity while still maintaining reasonable specificity. The reasoning behind this decision was that the purpose of the CTSQ is to identify as many at-risk children as possible so they can receive further assessment and help if needed. The procedure ROCCOMP in Stata version 9 (Stata Corp, College Station, TX) was used to directly compare the areas under the curve (AUCs) of the 2 measures. This comparison provides a $\chi^2$ and $P$ value that reflects the comparative validity of the measures across their full range of cut points. This method takes into account the correlations of the measures within cases and noncases.

Finally, cross-tabulations were conducted between the CTSQ and CIES at the cut points, and PTSD diagnosis and the following criteria were calculated: sensitivity (proportion of children who the screen correctly predicts as having PTSD), specificity (proportion of children who the screen correctly predicts as not having PTSD), PPV (proportion of children who test positive on the screen who do have PTSD), NPV (proportion of children who test negative on the screen who do not have PTSD), and overall efficiency (percentage of cases that are correctly classified by the screen).

RESULTS

A total of 135 participants were included in time 2 (1 month) analyses and 126 at time 3 (6 months). On the basis of the ADIS-C/P, 4 children (3%) met full PTSD criteria, and 9 children (7%) met subsyndromal PTSD criteria at 1 month. At 6 months, 1 child (1%) met PTSD criteria, and 10 children (8%) met subsyndromal PTSD criteria. Given the low prevalence of full and subsyndromal PTSD, the 2 groups were combined for all of the analyses. Therefore, a positive case was defined as meeting criteria for either PTSD or subsyndromal PTSD. Children with full or subsyndromal PTSD did not differ significantly from children with no PTSD symptoms with regard to age, gender, injury severity, or length of hospitalization.

Validity

Convergent validity was assessed by examining the relationship between the CTSQ and the CIES. As expected, the CTSQ was significantly correlated with the CIES ($r[163] = 0.56; P < .01$).

Predictive Performance

ROC curve analyses for the CTSQ and the CIES revealed that the predictive performance of both screens at 1 month was significantly better than chance (AUC = .80, \(P < .0001\) and .71, \(P < .05\), respectively). However, the ROC curve analyses presented in Fig 2 indicate that only the CTSQ was significantly better than chance at predicting distressing PTSD symptoms at 6 months (AUC = .78, \(P < .001\), and .64, \(P\) not significant, respectively). Direct comparisons between the AUCs for the 2 measures revealed no significant differences at predicting PTSD symptoms at 1 month ($\chi^2 = 2.34; P$ not significant). However, the AUCs at 6 months were significantly different ($\chi^2 = 4.11; P < .05$), with the CTSQ being more accurate than the CIES.

Inspection of the various cut scores on the CTSQ revealed that a score of \(\geq 5\) offered the optimum predictive cutoff point. That is, the cutoff maximized the balance between sensitivity and specificity. Using this cutoff, the performance criteria were calculated, and the results are presented in Table 2.

To maintain consistency with other studies, the predictive performance of the CIES was evaluated using a cutoff score of 17.\textsuperscript{19,20} Refer to Table 3 for the results. However, posthoc analyses revealed that a cutoff of 14 provided the best balance between sensitivity (.77) and specificity (.52) in this sample. As can be seen in Tables 2 and 3, the CTSQ was more accurate than the CIES at predicting persistent traumatic stress both 1 and 6 months after accidental injury.

DISCUSSION

The aim of this study was to validate a self-report screening instrument designed to identify children who are at risk of developing PTSD symptomatology \(\leq 6\) months after accidental injury.
after an accidental injury. Specifically, the main purpose of the CTSQ is to correctly predict as many children as possible who are at risk of developing PTSD (sensitivity) and to screen out children who are unlikely to experience any distressing symptoms (NPV). Analyses of the screen revealed that when using a cutoff of 5, the CTSQ was sensitive to predicting distressing PTSD symptoms and demonstrated excellent NPV at both 1 and 6 months. The specificity and overall efficiency of the screen were also acceptable.

The results of this study are promising for a number of other reasons. First, the CTSQ has the following ideal characteristics: the CTSQ is short, the items are simple for children to understand, respondents do not need to decide between alternative scale points, the CTSQ was able to detect children at risk of future PTSD, and it can be scored by nonspecialists, because the decision rule for caseness is very simple. Second, the applicability of the CTSQ was demonstrated across a broad range of accidental traumas, whereas other studies have looked primarily at the use of screens after RTAs. In addition, to date no studies have directly compared the predictive performance of 2 screens. This study found that when using the same sample of children, the CTSQ was more accurate at identifying traumatic stress symptoms than the commonly used CIES, particularly at 6 months. The specificity and overall efficiency of the screen were also acceptable.

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A screen with the above properties has significant clinical and research implications. In a clinical context, the CTSQ could be used in a hospital setting to identify children who warrant a more intense and costly clinical assessment. After this, the children who are identified as experiencing significant distress can then be monitored and, if needed, referred to the appropriate early intervention. This is important, because if left untreated, PTSD can cause significant ongoing problems with normal psychological development. The CTSQ was also able to correctly screen out the majority of children who did not demonstrate a vulnerability to PTSD. This is necessary, because some research has shown that early prevention, such as psychological debriefing, may have a detrimental effect if provided to people who are not experiencing any psychopathology. In addition, screening out children who are not at risk allows efficient allocation of scarce resources to children who actually need help. In a research context, the screen could also be used to quickly and reliably identify children at risk of PTSD symptomatology who would be eligible for treatment in intervention studies.

Although the predictive performance of the CTSQ is...
promising, there are still a few limitations to consider. To begin with, because of time constraints, only parent report was used to determine PTSD caseness. Therefore, it is possible that the parents may have underestimated the extent of intrusive symptoms experienced by their child. However, collateral information for the subjective experience of the trauma was also obtained from the child to guide the diagnosis of PTSD. Thus, the diagnosis of PTSD incorporated both parent- and child-derived information. In addition, research has shown that parents can provide reliable reports of Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, anxiety symptoms and disorders on the ADIS-C/P. Nevertheless, it is essential that future studies evaluate the performance of the CTSQ using both parent and child reports. It would also be valuable to examine the predictive validity of the CTSQ using a clinical diagnostic instrument that focuses in more depth on PTSD symptoms, such as the Clinician-Administered PTSD Scale for Children.

The low base rate of PTSD in this sample is also notable. However, there was sufficient power to detect significance in the ROC curve analyses. In addition, the confidence intervals for sensitivity, specificity, PPV, NPV, and overall efficiency are not unreasonable. The participation rate of 47.9% could also potentially limit the generalizability of the results in this study. Unfortunately, because of privacy regulations, data were not collected for families who did not participate in the study; therefore, it is impossible to determine reasons for nonparticipation. However, participation rates are consistent with those found in other studies investigating the impact of accidental injury (eg, 56%, 54%, and 42.8%).

Finally, the screen incorrectly ruled out 18.2% of children who met full or subsyndromal PTSD criteria; thus, if only the screen was used, these children would not receive help. In addition, 26.1% of the children tested positive on the screen, although they did not meet criteria 6 months after the accident. However, the aim of the screen was to identify as many vulnerable children as possible, so although some time would be spent following-up with these children, this number is more manageable than assessing every child after an accident. It is also difficult to get a high PPV, because the occurrence of PTSD is a low-frequency event. On the other hand, it is possible that the NPV may have been inflated by the low prevalence rate. Therefore, given that PPV and NPV are base-rate sensitive, additional research should examine the performance of the CTSQ using a sample with a high base rate of PTSD.

Additional research also needs to be conducted to determine whether it is feasible for staff within a busy hospital setting to implement the screen, follow up on its return, and refer identified children to the appropriate assessment and intervention. Also, to date, there is no reliable evidence regarding the type of intervention that is most effective in preventing emotional and behavioral problems after accidental injury. Screening instruments are only of value if evidence-based intervention programs are developed and accessible. Finally, because the cutoff on the CTSQ was decided posthoc, additional research is needed to validate the screen using the cutoff with other traumatic events and with samples with varying base rates of PTSD.

CONCLUSIONS

The aim of the CTSQ is to identify children at risk of developing PTSD symptomatology after an accidental injury. The results of this study are promising, because they suggest that the CTSQ is a quick, reliable, and valid self-report instrument that could be incorporated in a hospital setting to aid in the prevention of childhood PTSD after accidental trauma.

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