Evaluation of an Early Risk Screener for PTSD in Preschool Children After Accidental Injury

**WHAT’S KNOWN ON THIS SUBJECT:** Unintentional injuries lead to a significant number of children suffering from long-lasting posttraumatic stress symptoms. Therefore, early identification of individuals at risk is crucial to provide preventative interventions. However, currently, no early screener has been evaluated in preschool-aged children.

**WHAT THIS STUDY ADDS:** Good sensitivity (85%) and acceptable specificity (63%) were found for an early screening measure for preschool-aged children after accidental injury. Hence, the 21-item Pediatric Emotional Distress Scale–Early Screener, a reliable and valid early screening instrument, is suggested for use within a stepped-care model.

**abstract**

**OBJECTIVES:** To evaluate the effectiveness and most powerful selection of predictors of an early screening tool for posttraumatic stress disorder (PTSD) in a sample of 87 children ages 2 to 6 years after unintentional injury.

**METHODS:** The examined screener was administered within 6 to 13 days post accident and consisted of an adapted version of the Pediatric Emotional Distress Scale (PEDS), the PEDS-ES (PEDS Early Screener), and questions on 5 additional risk factors (preexisting child behavioral problems, parental preexisting chronic mental or physical illness, pretraumatic life events in the family, parental feelings of guilt, parental posttraumatic stress). The PTSD Semi-structured Interview and Observational Record for Infants and Young Children served as criterion measure 6 months after the accident. A case was deemed positive when meeting criteria for full or partial PTSD.

**RESULTS:** Use of the PEDS-ES without the additional risk factors performed best, with good sensitivity (85%) and moderate specificity (63%) for full or partial PTSD.

**CONCLUSIONS:** The PEDS-ES allows for successful early screening of preschool-aged children after single accidental trauma. It may be used within a stepped-care model for early identification of individuals designated for possible secondary preventative interventions.
Unintentional injuries are frequent among young children. In 2011, >10% of all US children up to 6 years old experienced at least 1 accidental trauma that needed to be treated in a hospital emergency department.1 Besides the potential for physical impairment, accidental injuries lead to a significant number of children suffering from long-lasting posttraumatic stress disorder (PTSD).2 For example, at 6 months after a road traffic accident, 13.9% of preschool-aged children met criteria for PTSD.3 Likewise, at 6 and 16 months after a burn injury, 10%4 and 13.2%5 of young children had PTSD, respectively. Unnoticed and/or untreated psychological maladjustment leads to an increased risk of long-term mental disorders and, consequently, to higher risk of long-term mental maladjustment leads to an increased risk of long-term mental disorders and, consequently, to higher risk.6 Therefore, it is of broad interest to identify children at high risk for long-term posttraumatic distress as early as possible. Accurate early risk estimation is the sine qua non for conducting well-directed secondary preventive psychological interventions. This is especially relevant given a recent meta-analysis suggesting that secondary prevention may be helpful in children.7 However, research on early screening instruments in preschool-aged children is in its own infancy. Although short measures for symptoms of traumatic stress are available (Pediatric Emotional Distress Scale [PEDS],8 modified Child Behavior Checklist–PTSD scale,9 Young Child PTSD Checklist10), none has been evaluated in the early aftermath of a traumatic event. Conversely, for schoolchildren, 3 well-validated early screeners are available: the Child Trauma Screening Questionnaire (CTSQ,11 with 5 reexperiencing and 5 hyperarousal items), the Screen ing Tool for Early Predictors of PTSD (STEP-P;12 with 8 risk factors for PTSD), and the Australian Version of the Screening Tool for Early Predictors of PTSD (STEPP-AUS,13 with 5 predictors for PTSD, 2 dissociation symptoms present during the accident, and 1 acute stress symptom). Based on the validation of these instruments for older children, an effective early screener for PTSD should address both acute symptoms11,13 and additional risk factors for PTSD.12,13 However, it remains unclear whether these findings are transferable to younger children. Therefore, the aims of this study were to evaluate the effectiveness of early screening of preschool-aged children to determine their risk of PTSD after unintentional injury and to examine whether acute stress symptoms, additional risk factors, or a combination of both are the best predictors of PTSD at follow-up. We expected that a screening tool combining acute symptoms and additional risk factors would outperform the use of either component alone.

METHODS

Participants and Procedures

The sample for the current study was enlisted within a randomized controlled trial on the effectiveness of early psychological interventions based on a stepped procedure. Before data collection, the study was approved by the local ethics committee. Recruitment was conducted between May 2010 and June 2012 by means of electronic hospital records. Children aged 2 to 6 years who sustained a road traffic or burn accident were included if medically treated as outpatients or inpatients at University Children’s Hospital in Zurich, Switzerland. Additional inclusion criteria were Swiss residence and having ≥1 German-speaking parent. Children were excluded in cases of severe head injury (Glasgow Coma Scale score <9) or if there was previous evidence of intellectual impairment (physician’s rating). Participant flow is illustrated in Fig 1. If the child met inclusion criteria and the parents agreed to participate by signing the written informed consent form, parents completed the screening questionnaire within 6 to 13 days after the accident (mean 8.83, SD 1.58). A child was considered “high risk” when either the cutoff score of the PEDS–Early Screener (PEDS-ES) was exceeded (score > 15) or ≥1 of the 5 risk factors was present. Otherwise, the child was allocated to the “low-risk” group. Children considered to be at high risk were randomly assigned either to receive specific psychological intervention or to be controls with medical treatment alone. For the current analysis, the former were excluded. All families were contacted for a follow-up assessment at 6 months after the accident (mean 183.08 days, SD 9.33 days).

Of the 256 children treated during the study period, 46 (17.8%) were excluded (reasons are given in Fig 1). Ultimately, 121 (57.6%) of 210 families agreed to participate. Comparisons between nonparticipants and participants displayed no significant differences in age (t = 0.625, P = .533), gender (χ² = 0.353, P = .552), outpatient versus inpatient treatment (χ² = 0.006, P = .938), type of accident (χ² = 0.002, P = .964), or injury severity (t = −1.792, P = .075). However, significantly more Swiss (102/152) than non-Swiss subjects (17/53) agreed to participate (χ² = 19.802, P < .001). The final sample size for evaluation of the screening instrument consisted of 87 children (64 subjects at low risk and 23 individuals at high risk randomly allocated to the control condition; Fig 1).

Measures

PEDS-ES

To assess the child’s symptoms of acute stress, we administered the PEDS,8 a parent-reported instrument that assesses the frequency of 21 problem behaviors. Each item is rated on a 4-point Likert scale, ranging from 1 (“almost never”) to 4 (“very often”). The
original validation study included both a trauma-exposed and a non–trauma-exposed sample of 2- to 10-year-old children. The PEDS was capable of correctly identifying 78% of children who had experienced a traumatic event. Internal consistency was \( \alpha = .85 \) for the overall sample. However, as the PEDS has never been administered in the immediate aftermath of a traumatic event, it has not yet been validated as an early screening instrument, nor has its predictive performance ever been estimated.

For the current study, we used a German version of the PEDS that we translated according to international guidelines. To ensure the measurement of reactive symptoms rather than preexisting conduct problems, the scale’s phrasing was altered to change sensitive wording: “equal or less often” (0), “a little more often” (1), “much more often” (2), and “very much more often” (3). This altered version of the PEDS was called the PEDS-ES (PEDS Early Screener, online Supplemental Table 3). By adding up the values of each of the 21 items, a sum score was computed, ranging from 0 to 63. Acceptable internal consistency was identified (\( \alpha = .76 \)).

**Additional Risk Factors**

In addition to the PEDS-ES, 5 risk factors were assessed in accordance with current literature. Due to very limited evidence in preschool-aged children, however, research in schoolchildren had to be additionally consulted to select important risk factors. The following risk factors were included: (1) preexisting child behavioral problems, (2) parental preexisting chronic mental or physical illness, (3) pretraumatic life events in the family, (4) parental feelings of guilt, and (5) parental posttraumatic stress. Parents had to rate risk factors 1 and 2 dichotomously (“yes/no”), whereas factors 3 through 5 were judged on 4-point Likert scales, ranging from 0 (“no effect”) to 3 (“large effect”) with regard to the current effect of the problem on the family’s or parent’s life (Supplemental Table 4). An answer was deemed positive when the current effect was rated no less than “moderate.” (score 2)

**PTSD**

At 6 months, parents were interviewed with the German version of the PTSD Semi-structured Interview and Observational Record for Infants and Young Children (PTSDSSI). The PTSDSSI assesses both the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* and the alternative criteria for PTSD in preschool-aged children. For the latter, 5 items (recollections, flashbacks, diminished interests, detachment, and irritability) were alternatively worded to ensure developmental sensitivity for young children.

The preliminary draft of the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* proposes a subtype of PTSD in preschool-aged children. Compared with the alternative criteria, items “inability to recall trauma” and “sense of foreshortened future” were deleted. The item “restricted affect” was limited to positive emotions. For this new fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* algorithm, first studies have identified good validity and developmental sensitivity. Consequently, this algorithm was used.

PTSD severity was computed by summing the number of symptoms present. Four symptoms were set as a clinically relevant limit, because this cutoff was recently used as inclusion criterion within a randomized controlled trial. Partial PTSD was deemed present when 2 of the 3 clusters were apparent. In the present sample, Cronbach’s \( \alpha \) for the PTSDSSI’s total number of symptoms was .82.

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**FIGURE 1**

Participant flowchart.

Excluded (n = 46)
- Non German speaking (n = 22)
- Sibling of a study participant (n = 7)
- Absent due to a holiday (n = 6)
- Other reasons (n = 11)

Non-participants (n = 89)
- Could not be contacted (n = 37)
- Lack of time/interest (n = 41)
- Other reasons (n = 11)

Treated during study period (n = 256)
Eligible (n = 210)
Participants (n = 121)
Early risk screening
High risk group (n = 53)
Low risk group (n = 68)

Loss to follow-up before randomization (n = 5)
Randomly allocated to intervention group (n = 19)
Loss to follow-up in intervention group (n = 5)
Loss to follow-up in control group (n = 1)

Follow-up at 6 months (n = 23)
Control and low risk group (n = 87)
Complete data available (n = 84)
Demographics

Demographics were recorded by either asking parents or reviewing medical records. To compute socioeconomic status, paternal occupation and maternal education were assessed on 6-point ordinal scales and summed. Using this score, parents were allocated to a lower (2–5) middle (6–9) or upper social class (10–12); this measure is a proved valid indicator of socioeconomic status. Injury severity was rated using the Modified Injury Severity Score, ranging from 1 to 75.

Statistical Analyses

Data were analyzed by using SPSS 20 (IBM SPSS Statistics, IBM Corporation, Chicago, IL). First, receiver operator characteristic (ROC) analysis was performed to indicate the area under the curve (AUC) as a measure of effect size and to compute sensitivity and specificity for different cutoff scores for full or partial PTSD. By examining the ROC coordinates, the cutoff value achieving highest sensitivity, while maintaining reasonable specificity, was determined. Second, using the macro proposed by Domenech, predictive performance (in terms of full or partial PTSD diagnosis and PTSD severity) was computed for all possible combinations of the PEDS-ES and the 5 additional risk factors. Predictive performance was indicated by sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), along with 95% confidence intervals (CIs) for each. Drop-out analyses were conducted by using χ² and Student’s t tests.

RESULTS

Sample Characteristics

Complete data for both risk screening and PTSDSSI parent reports were available for 84 (97%) of 87 participants. Details on sample characteristics are summarized in Table 1. Drop-out analyses revealed no differences in these sample characteristics between study completers and those lost to follow-up (data not shown). Twenty (23%) children met diagnostic criteria for full or partial PTSD at 6 months after trauma.

ROC Analysis

A cutoff score of 8 for the PEDS-ES was identified to enable maximum sensitivity (85%) and reasonable specificity (63%) to predict full or partial PTSD. In comparison, a value of 9 would have lowered sensitivity to 80% while increasing specificity to 67%, whereas a value of 7 would not have increased sensitivity but decreased specificity to 53%. The ROC curve is shown in Fig 2. The AUC was significantly greater than that predicted by chance (AUC 0.79, 95% CI 0.67–0.90, P < .001).

Predictive Performance

Use of the PEDS-ES on its own achieved the best results for both sensitivity (85%) and specificity (63%) for full or partial PTSD and for sensitivity (77%) and specificity (56%) for PTSD severity (Table 2). Adding the 5 supplemental risk factors to the PEDS-ES, sensitivity for full or partial PTSD and for PTSD severity remained stable, but specificity decreased to 53% and 48%, respectively. Likewise, PPV and NPV decreased slightly when the risk factors were included. For the 5 risk factors without the PEDS-ES, the highest degree of sensitivity achieved was only 38% for PTSD severity; however, specificity was excellent, being ~80% for full or partial PTSD and PTSD severity. The results for combining all 5 risk factors, as well as the results for combining the PEDS-ES with all 5 risk factors, are shown in Table 2.

For all outcomes, PPV was low, ranging from 21% to 41%. NPV was universally high, with highest values for full or partial PTSD (93%) and PTSD severity (93%) predicted by the PEDS-ES alone. Administering the PEDS-ES alone resulted in 51% of the patients being classified as at low risk for long-term PTSD.

DISCUSSION

The current study is the first to evaluate an early screening instrument for PTSD risk in preschool-aged children after accidental trauma. The examined instrument consisted of an adapted version of the PEDS, the PEDS-ES, and 5 additional risk factors (preexisting child behavioral problems, parental preexisting chronic mental or physical illness, pretraumatic life events in the family, parental feelings of guilt, parental posttraumatic stress). We hypothesized that combining the PEDS-ES with the risk factors would improve screening accuracy for PTSD, relative to the isolated use of either. Surprisingly, this hypothesis was not affirmed: the PEDS-ES performed best when used alone. Given the evidence in school-children that acute stress reactions...
have a large influence on later PTSD, the good predictive power of the PEDS-ES is not that surprising. Although there is previous evidence in young children for some of our risk factors (ie, child/parental pretrauma psychopathology, parental acute distress), all of the factors were found to be weak predictors in this study. Four possible explanations should be considered. First, assessing each of the risk factors with 1 to 3 items might have been too rudimentary. A more comprehensive assessment with a short scale for each risk factor would probably be more accurate; however, this would lengthen the screener. Second, the use of >5 risk factors might be better able to predict PTSD. For instance, including variables like having witnessed life threat to a caregiver, family functioning, or parenting skills might have enhanced the predictive power of the risk factors.

Third, to our knowledge, only 1 study has investigated predictors for PTSD in a similar sample of children with accidental injuries. Hence, the previously reported risk factors in the literature on preschool-aged children might not be generalizable to injured children. Fourth, the current prospective study’s findings on the relative unimportance of the examined risk factors question the mainly cross-sectional previous research in this field in preschool-aged children.

For the present sample, the PEDS-ES alone was both highly sensitive (85%) and acceptably specific (63%) for full or partial PTSD. Likewise, the PPV (41%) and NPV (93%) were reasonable in combination. These results are clearly comparable to the findings for early screening measures for schoolchildren after accidental injuries: for instance, sensitivity has ranged from 82% for the CTSQ to 89% for the STEPP-AUS. Meanwhile, specificity has exhibited a broader range, from 48% for the STEPP-AUS to 74% for the CTSQ. While PPV has been as low as 23%, 24%, and 25% for the CTSQ, STEPP-AUS, and STEPP, respectively, NPV has been excellent for all 3 of these screening tools (CTSQ, 98%; STEPP-AUS, 98%; and STEPP, 95%).

Despite good sensitivity for full or partial PTSD, PPVs were no better than mediocre. This means that while >80% of children who potentially needed help would receive it, only 41% of those receiving help actually would need it. NPV and PPV are the indicators of interest for predicting whether a screening instrument is able to correctly diagnose an individual. One might argue that any screening measure with a PPV as low as 40% is ineffective. However, it must be

### TABLE 2 Predictive Performances for Full or Partial PTSD and PTSD Severity at 6 Months After the Trauma

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<tr>
<td><strong>Full or Partial PTSD</strong></td>
<td><strong>Symptom Severity</strong></td>
<td><strong>Full or Partial PTSD</strong></td>
<td><strong>Symptom Severity</strong></td>
</tr>
<tr>
<td>Absent</td>
<td>Present</td>
<td>Absent</td>
<td>Present</td>
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<tr>
<td>Positive, n (%)</td>
<td>24 (29)</td>
<td>17 (20)</td>
<td>31 (37)</td>
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<tr>
<td>Negative, n (%)</td>
<td>40 (48)</td>
<td>3 (4)</td>
<td>40 (48)</td>
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<tr>
<td>Sensitivity (95% CI)</td>
<td>0.85 (0.64–0.95)</td>
<td>0.77 (0.50–0.92)</td>
<td>0.35 (0.18–0.57)</td>
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<tr>
<td>Specificity (95% CI)</td>
<td>0.63 (0.50–0.73)</td>
<td>0.56 (0.45–0.67)</td>
<td>0.80 (0.68–0.88)</td>
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<td>PPV (95% CI)</td>
<td>0.41 (0.28–0.57)</td>
<td>0.24 (0.14–0.39)</td>
<td>0.35 (0.18–0.57)</td>
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<tr>
<td>NPV % (95% CI)</td>
<td>0.93 (0.81–0.98)</td>
<td>0.93 (0.81–0.98)</td>
<td>0.80 (0.68–0.88)</td>
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* Cutoff ≥4 symptoms.
* Positive when ≥1 of the risk factors was present.
taken into consideration that, first, the validity of PPV and NPV is limited, as both depend on the criterion-in-question’s prevalence in the sample being tested. Because prevalence of full or partial PTSD in the present sample was rather low (23%), it is inevitable that low PPV and high false-positive rates would result, even if the instrument’s sensitivity and specificity are high. Consequently, an instrument’s PPV must be interpreted while considering the examined sample’s prevalence rates. Moreover, one may speculate that the PEDS-ES would even perform better in a sample with higher morbidity. Hence, the PEDS-ES’s predictive performance is probably underestimated rather than overestimated. Second, a screening instrument’s main purpose is to identify individuals who potentially need a specific treatment. Thus, sensitivity and specificity would be the appropriate indicators. This raises the question whether a specificity of 63% is effective. Given that a recent meta-analysis showed that secondary prevention may be helpful in children and does not do any harm, moderate specificity is an economic rather than a health concern. In summary, isolated use of the PEDS-ES performed well for full or partial PTSD. However, for PTSD severity, performance was merely moderate. Consequently, in clinical practice, we recommend that the PEDS-ES be used as stand-alone early screening tool. Notably, prediction should mostly be made for full or partial PTSD. Finally, the PEDS-ES proved to be both an economically and a clinically valid screening instrument. On the one hand, 51% of children would screen negative and, therefore, likely not receive unnecessary early psychological support, which would significantly lower the costs of psychological treatment. Thus, the PEDS-ES can be used within a stepped-care model for early identification of preschool-aged children for whom early psychological support should be provided. On the other hand, a sensitivity of 85% indicates that <1 in 5 children demonstrating full or partial PTSD at 6 months after an accident will be missed for early intervention. Because of the low PPV, clinicians should carefully communicate to parents that the present screening instrument is not meant for diagnostic purposes: even with a positive test result, at 6 months after an accident, only 41% of children still suffered clinically relevant symptoms. For the clinician, it is good to know that, by applying the PEDS-ES, >80% of children exhibiting either full or partial PTSD at 6 months after trauma can be identified accurately at a very early stage.

Study Limitations

Although this is the first study to successfully evaluate an early screener in a homogeneous sample of accidentally injured preschool-aged children, some limitations merit note. First, our sample was small, jeopardizing its representativeness. To better generalize the results, the PEDS-ES must be reevaluated in larger sample populations and with other types of trauma (eg, assaults or natural disasters). Second, the generalizability of our results may be limited due to the low response rate. A possible reason for this response rate could be that the current study was primarily an intervention study, as such, parents might have been discouraged by the large commitment required for participation. Notably, previous studies on early screening instruments in schoolchildren have yielded very similar response rates.

Third, significantly fewer non-Swiss than Swiss families participated in the study. Although parents provided other reasons for nonparticipation than insufficient German language skills, this might have been an important reason. Therefore, the present findings must be applied with caution to individuals who have emigrated from foreign countries.

CONCLUSIONS

This study has been the first to evaluate an early screening instrument assessing the risk of developing long-term PTSD in preschool-aged children after a single accidental injury. Analyses revealed that assessing acute stress symptoms alone is the best predictor of full or partial PTSD at 6 months after an accident. Thus, with the PEDS-ES, a short, valid, and reliable screening instrument is in clinicians’ hands. We suggest using the PEDS-ES within a stepped-care model for early identification of preschool-aged children for whom early psychological interventions should be provided.

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18. Scheeringa MS, Zeanah CH. PTSD Semi-structured Interview and Observational Record for Infants and Young Children. New Orleans, LA: Tulane University Health Sciences Center; 2005.


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Didier N. Kramer, Matthias B. Hertli and Markus A. Landolt

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