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CLINICAL RESEARCH ARTICLE

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Accuracy of the Pediatric Emotional Distress Scale – Early Screener to predict the risk for developing PTSD in young children after accidental injury

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ABSTRACT

Background: Early identification of posttraumatic stress disorder (PTSD) in children is important to prevent chronic symptoms and long-term negative consequences. However, PTSD often goes unrecognized in the emergency setting of hospitals and screening methods for young children are lacking.

Objective: To evaluate the accuracy of an early screening tool for PTSD in a sample of young children (0–7 years) after unintentional injury.

Methods: The Pediatric Emotional Distress Scale – Early Screener (PEDS-ES) was administered to parents of children referred to the Emergency Department within 7 days post-accident (n = 82), and a validated interview for PTSD was administered 3 months after the accident as criterion measure: the Diagnostic Infant and Preschool Assessment (DIPA). Diagnostic accuracy of the PEDS-ES was inspected using area under the curve analyses including sensitivity, specificity, Positive and Negative Predictive Value.

Results: After three months PTSD diagnosis was established in 21% of the children. Use of the PEDS-ES within 7 days after the injury showed fair accuracy with AUC = .727. Sensitivity (0.65) and specificity (0.73) for the suggested cutoff of 8 were moderate for predicting PTSD diagnosis 3 months after the injury. The examination of cutoff values that achieve enhanced sensitivity in a screening context – where sensitivity is prioritized – while maintaining a high level of specificity suggests that a lower cutoff of around 6 points may serve as a more sensitive (sensitivity: 0.82; specificity: 0.56) valid alternative cutoff score.

Conclusions: The PEDS-ES allows for successful early screening of risk for traumatic stress symptoms in young children after single accidental injury. It enables early identification of individuals who are at risk for developing PTSD and need further monitoring of symptoms, diagnostic assessment and treatment.

Precisión de la Escala de Malestar Emocional Pediátrica – Evaluador Temprano para predecir el riesgo de desarrollar TEPT en niños pequeños tras una lesión accidental

Antecedentes: La identificación temprana del trastorno de estrés postraumático (TEPT) en niños es fundamental para prevenir la cronicidad de los síntomas y las consecuencias negativas a largo plazo. Sin embargo, el TEPT a menudo pasa desapercibido en el contexto de urgencias hospitalarias, y actualmente se carece de métodos de tamizaje adecuados para niños pequeños.

Objetivo: Evaluar la precisión de una herramienta de tamizaje temprano para el TEPT en una muestra de niños pequeños (0 a 7 años) tras una lesión no intencional.

Método: Se administró la Escala de Malestar Emocional Pediátrica – Evaluador Temprano (The Pediatric Emotional Distress Scale – Early Screener, PEDS-ES) a los padres de niños derivados al servicio de urgencias dentro de los 7 días posteriores al accidente (n = 82) y luego a los 3 meses del accidente, se aplicó una entrevista validada para el diagnóstico de TEPT como medida de referencia: la Evaluación Diagnóstica para Lactantes y Preescolares (*Diagnostic Infant and Preschool Assessment* [DIPA]). La precisión diagnóstica del PEDS-ES se evaluó mediante análisis del área bajo la curva (AUC), incluyendo sensibilidad, especificidad, valor predictivo positivo y negativo.

Resultados: A los tres meses, se estableció diagnóstico de TEPT en el 21 % de los niños. La aplicación del PEDS-ES dentro de los 7 días posteriores a la lesión mostró una precisión aceptable, con un AUC = 0.727. La sensibilidad (0.65) y especificidad (0.73) para el punto de corte sugerido de 8, muestran un rendimiento moderado para predecir el diagnóstico de TEPT a los 3 meses de la lesión. El análisis de valores de corte que aumentan la sensibilidad en un contexto de tamizaje – en el que se prioriza la sensibilidad – y que al mismo tiempo

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HIGHLIGHTS

- In young children at emergency settings of hospitals, development of PTSD often goes unrecognized, while consequences can be debilitating.
- The Pediatric Emotional Distress Scale-Early Screener (PEDS-ES) for PTSD risk in young children after accidental injury shows fair predictive power.
- Young children at increased risk for PTSD can be identified early and offered secondary preventive interventions.

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mantienen un alto nivel de especificidad, sugiere que un punto de corte más bajo, próximo a los 6 puntos, podría constituir una alternativa válida de punto de corte con mayor sensibilidad (sensibilidad: 0.82; especificidad: 0.56).
Conclusión: La PEDS-ES permite un tamizaje temprano exitoso del riesgo de síntomas de estrés traumático en niños pequeños tras una lesión accidental única. Permite la identificación temprana de individuos en riesgo de desarrollar TEPT y que requieren seguimiento adicional de los síntomas, evaluación diagnóstica y tratamiento.

1. Introduction

Young children have a high probability of having an accident. Compared to older children, they have a high risk of drowning, sustaining burns, poisoning, falling accidents or suffocation (Ksinan et al., 2024; WHO, 2024). In the Netherlands, 10,200 children aged 0–11 years are treated annually in an Emergency Department after a fall accident and 3100 after a bicycle accident (Veiligheid, 2023).

Experiencing such accidents can be considered a potentially traumatic event (May et al., 2023). As a result, children are at risk of developing post-traumatic stress symptoms (PTSS).

Many children are resilient and initial symptoms may resolve over time, with support of their caretakers, however in a substantial number of children the symptoms do not disappear and turn into posttraumatic stress disorder (PTSD). Examples of symptoms associated with PTSD in smaller children are: nightmares, being anxious, getting upset at memories of the event, sleeping problems, headaches or stomach aches, irritability, quick anger and difficulty concentrating. PTSD often goes unrecognized and therefore untreated. Untreated PTSD negatively impacts children's development, psychosocial functioning and physical recovery (Danzi et al., 2024; Winston et al., 2003).

Research shows that 14% to 34% of school-age children develop PTSD after an accident (Ehlers et al., 2003). The prevalence in young children is less clear because significantly less research has been conducted in this age group (Gigengack et al., 2015). Meiser-Stedman et al. (2008) found a PTSD prevalence of 10% in young children after accidents. In 2012 a study performed by our research group showed, among other things, a prevalence of PTSD in young children who had had an accident at 9%−12%. This study used an interview with 100 parents by telephone to retrospectively determine the psychological consequences of their child's accident (Meijel van et al., 2015; 2020).

Early identification of PTSD is important to prevent chronic symptoms and long-term negative consequences for children. However, PTSD often goes unrecognized in the hospital because of the limited length of hospitalization and the primary focus on physical recovery. Moreover, children go home immediately after treatment in the Emergency Department or are admitted briefly to the paediatric ward and discharged home fairly soon after. Often there is no or limited follow-up of these children or the follow-up does not involve screening for mental health problems after accidents.

In adults, research showed various predictors of PTSD in traffic accident survivors (Sabahi et al., 2024). Among these are being a woman, having depression and having a history of road traffic accidents pretraumatically, peritraumatic dissociative experiences, acute stress disorder diagnosis, rumination, higher injury severity, and involvement in litigation or compensation after the trauma. Memarzia et al. (2021) performed a meta-analytic review of peritraumatic factors as predictors of development of PTSD in children. Peritraumatic subjective threat yielded a medium effect size estimate, while dissociation and feeling muddled or confused during the trauma yielded smaller effect size estimates for the relationship with PTSD symptoms. Perceived life threat yielded a medium-sized effect in this review. Furthermore, the absence of parents during the accident, emergency room admission and the severity pain also play a role as predictors (Kassam-Adams et al., 2013).

To identify children ages 8–18 who are at risk of developing PTSS, a screening list has been developed. This list, the Screening Tool for Early Predictors of PTSD (STEPP), was developed in the United States by Winston et al. (2003) and subsequently validated for the Netherlands by Meijel van et al. (2015). The study on the STEPP by Kassam-Adams et al. (2015) however showed poor to modest replication of the original predictive performance of this screening tool. A screening list for young children (0–7 years) is not yet available in the Netherlands. If we had a screening list for young children available, we would be able to identify children who are at risk of PTSD at an early stage, continue to support them and monitor their symptoms, and offer treatment to those with persistent symptoms. This may prevent symptoms from becoming permanent complaints and hindering the child's development.

For the reason of early identification of children at risk, a screening tool needs to be highly sensitive, in other words, not miss any children at risk. This does not imply that all children who screen positive would go on to develop problematic outcomes in terms of PTSS. Subsequently, the most appropriate

outcome of a positive early screen is to be continued with follow-up and monitoring (Kassam-Adams et al., 2015). Therefore, a monitoring is needed which is neither labour-intensive nor costly. Ideally, such a follow-up for PTSS may be integrated within a medical follow-up for injury that is routinely carried out by the Emergency Department physician or the child's general practitioner. Alternatively, it may be delivered online based on evidence-based self-report tools for parents. At www.kidtrauma.com such a PTSS screening list is available, for the Netherlands an online screening questionnaire would need to be implemented.

Short measures for symptoms of traumatic stress in young children are available: Pediatric Emotional Distress Scale (PEDS; Saylor et al., 1999) and Young Child PTSD Checklist (Scheeringa, 2019). However, these have not been evaluated in the early aftermath of a traumatic event. Scheeringa (2019) developed the tool aiming at rapid and brief screening of PTSD based on empirical data that focused on sensitivity and face validity for children aged 3–6 years. This Young Child PTSD Screen needs additional research to examine its psychometric properties as a stand-alone PTSD screen, which includes test-retest reliability and replication in other samples and settings. Kramer and colleagues developed the Pediatric Emotional Distress Scale – Early Screener (PEDS-ES); based on the screening list for the risk of PTSD in young children developed by Saylor et al. (1999). The PEDS-ES aims at early detection of the risk of developing long-term PTSD in preschool-aged children shortly after a single accidental injury. The research of Kramer et al. (2013) in Switzerland showed first promising indications of the validity of the tool in a sample of 87 children ages 2–6 years after unintentional injury. The PEDS-ES performed with good sensitivity (85%) and moderate specificity (63%) for full or partial PTSD, using a cutoff of 8 points. The ROC curve showed an AUC of 0.79 (95% CI 0.67–0.90, $p < .001$). An acceptable internal consistency was identified ($\alpha = .76$).

Although these promising screening tools for acute injured young children exist, none has emerged as the gold standard yet (Kassam-Adams et al., 2015). Too little replication data are available regarding their performance. The primary aim of our present study is to replicate the validation study of the PEDS-ES, a screening questionnaire for the risk of developing PTSD in young children after experiencing an accident, and to make it available for use in the Netherlands.

2. Methods

2.1. Study design

This is a prospective, observational validation study on psychometric properties of a screening questionnaire. The study protocol was approved by the Ethical Review Board (Amsterdam UMC) and participants were asked to give written informed consent for study participation.

2.2. Sample

Children and one of their parents were recruited through the Emergency Departments of the Amsterdam University Medical Center, location AMC and VUmc, between October 2014 and April 2017. The children had a serious accident, were brought to the hospital by ambulance or trauma helicopter and were treated in the trauma room. Inclusion criteria were: age of child 0–8 years; child has been in an accident; child was taken to the hospital by ambulance or trauma helicopter; and child has been treated in the trauma room. Exclusion criteria were: parents do not speak sufficient Dutch to be able to answer the questions; child has been admitted to Intensive Care for more than 1 week; family lives more than 1.5 h travel from the hospital; children with pervasive developmental disorders.

2.3. Measurement instruments

We used validated and reliable measurement instruments, which are widely used within youth mental health care and similar research projects. General demographic data were collected by a short questionnaire.

2.3.1. Pediatric Emotional Distress Scale-Early Screener (PEDS-ES)

The PEDS-ES (Kramer et al., 2013) is a screening list for the risk of developing PTSD in young children after experiencing an accident. The examined instrument consisted of an adapted version of the PEDS (Saylor et al., 1999). To ensure the measurement of reactive symptoms rather than preexisting conduct problems, the PEDS-ES asks parents to report on their child's current behaviours relative to what they observed before the injury. By adding up the values of each of the 21 items, a sum score is computed, ranging from 0 to 63. Acceptable internal consistency was identified ($\alpha = .76$). In the initial validation study in Switzerland it showed good predictive performance using a cutoff score of 8 points, was both highly sensitive (85%) and acceptably specific (63%) for full or partial PTSD. Likewise, the PPV (41%) and NPV (93%) were reasonable. The questionnaire is completed by parents of children aged 0–8 years who have had an accident. The administration time is 10–15 min.

For use in the Netherlands, with permission of the Swiss research group, the PEDS-ES was translated into Dutch by two child psychologists and one child

psychiatrist (all native speakers in Dutch). To confirm its accuracy, the Dutch translation was reverse translated by a professional translator (a native speaker of American English). The internal consistency in the current sample was good with Cronbach α = .88.

2.3.2. Diagnostic Infant and Preschool Assessment (DIPA)

The DIPA (Scheeringa & Haslett, 2010) is a semi-structured diagnostic interview which measures 13 mental disorders according to the DSM-5. In previous studies of the research group, the DIPA was translated into Dutch and tested on psychometric performance (Gigengack et al., 2020). The interview can be administered to parents of children late in their first year to 8 years. The administration time of the complete DIPA is 1–1.5 h, but for the current study only the PTSD module was administered. The DIPA was used to assess PTSD after 3 months.

2.4. Procedure

Participants in the study are parents of children ages 0–8 who have had an accident. One of the parents are asked to participate in the entire study (participating parent). The child itself does not actively participate in the study. The study consists of 2 measurement moments. At T1, parents are contacted for participation, within 1 week after the accident. If parents agree to participate and informed consent is signed, demographic data are collected and the PEDS-ES is administered to the participating parent. Measurements take place at the hospital (if the child is still hospitalized) or at the family home (if the child has already been discharged home). At T2, the DIPA was conducted with the participating parent. The measurements were administered by experienced psychologists.

Table 1. Descriptive characteristics of the final sample ($n = 82$).

Characteristic	M (SD) or *N* (%)
Age	3.38 (2.14)
0 years	9
1 year	11
2 years	20
3 years	15
4 years	13
5 years	12
6 years	8
7 years	9
Gender (female)	26 (31.7)
Birth Country (Netherlands)	79 (96.3)
Birth Country Mother (Netherlands)	59 (72.0)
Birth Country Father (Netherlands)	55 (67.1)
Single parent household	13 (15.9)
Gross annual income	
< 25.000€	18 (22.0)
25.000–35.000€	15 (18.3)
> 35.000€	47 (57.3)
missing	2 (2.4)
Type of accident: fall	42
Type of accident: traffic	31
Type of accident: near drowning / suffocation	5
Type of accident: burn	2
Type of accident: other household accident	2
Mean PEDS-ES score at T1 (Screening)	8.88 (9.34)
PTSD Diagnosis (DIPA: after 3 months)	17 (20.7)

Note: Values represent M (SD) or *N* (%) as appropriate.

2.5. Statistical analyses

The characteristics of the children and parents are studied with descriptive statistics. For continuous variables, the mean and standard deviation are reported. In the case of categorical variables, the frequency is reported. Drop-out analyses were conducted by using 2 × 2 and Student's t tests.

Data were analysed by using SPSS (IBM SPSS Statistics, IBM Corporation, Chicago, IL). The diagnostic accuracy of the PEDS-ES regarding PTSD diagnosis was investigated three months after the screening using receiver operating characteristic (ROC) analyses. The DIPA interview was utilized as the gold standard for assessing PTSD diagnosis in young children, against which the PEDS scale was evaluated. First, we tested the performance using the cutoff score of 8 points identified by Kramer et al. (2013). To identify potential alternative cutoff values for the PEDS-ES scale, we examined sensitivity, specificity, positive predictive value, negative predictive value, and Youden's J statistic (Youden, 1950). Youden's J index combines sensitivity and specificity into a single measure (Sensitivity + Specificity −1) and has a value between −1 and 1. In a perfect test, Youden's index equals 1, a Youden's J index of 0 means that the test operates by chance. This overall methodology facilitates a comprehensive assessment of the diagnostic performance of the PEDS-ES in detecting PTSD in young children 3 months post-accident/injury.

3. Results

3.1. Sample description

The initial sample who completed the sociodemographic variables and the screening measure PEDS-ES consisted of $N = 97$ children and their caregivers. Of these $N = 97$ children and caregivers 15 (15.5%) could not be reached again after 3 months and thus did not provide any outcome data (DIPA). Those children with missing data in the follow-up-assessment had significantly lower screening measure results (PEDS-ES) compared with those whose caregivers provided follow-up data (DIPA), indicating loss to follow up for less impacted children within one week after the accident ($M = 3.73$, $SD = 5.24$ vs. $M = 8.88$, $SD = 9.34$; $t(95) = 3.02$, $p = .005$). The final sample for the analyses consisted of $N = 82$ children and caregivers with complete outcome data (DIPA), of which 68.3% ($n = 56$) were male and 31.7% ($n = 26$) were

female. Children were 0–7 years old at screening on T1 (Age: M = 3.38, SD = 2.12) (See Table 1).

3.2. Diagnostic accuracy analyses

In the final sample, $n = 17$ (20.7%) were diagnosed with PTSD and $n = 65$ (79.3%) were not diagnosed with PTSD according to the DIPA after 3 months. Overall performance was examined by Receiver operating characteristic (ROC) analysis of the PEDS-ES total score validated against the DIPA PTSD Diagnosis (3 months) and demonstrated fair accuracy (AUC = .727, $n = 82$, see Figure 1).

The evaluation of performance using the cutoff score of 8 suggested by Kramer et al. (2013) revealed a sensitivity of 0.65, a specificity of 0.68, a positive predictive value (PPV) of 0.35, a negative predictive value (NPV) of 8, and a Youden's J value of 0.33. The examination of cutoff values that achieve enhanced sensitivity in a screening context – where sensitivity is prioritized – while maintaining a high level of specificity suggests that a lower cutoff of around 6 points may serve as a more sensitive valid alternative, yielding a higher Youden's J value than the suggested cutoff of 8 by Kramer and colleagues (2013) (Table 2).

4. Discussion

The current study is, to our knowledge, the first in the Netherlands and the second in Europe to evaluate an early screening instrument, the PEDS-ES, for the risk of developing PTSD in young children shortly after accidental injury. The PEDS-ES showed good predictive power. In the present sample, the PEDS-ES demonstrated moderate sensitivity (0.65) at the suggested cutoff of 8. Inspecting potential cutoffs for an enhanced sensitivity in a screening context – where sensitivity is prioritized – while maintaining a high level of specificity suggests that a lower cutoff of around 6 points may serve as a more sensitive valid alternative. The PPV and NPV were both mediocre, which can be related to the proportion of the condition PTSD of 20.7% in the whole sample and the confined size of the sample. The 15 children that were lost to follow-up had significantly lower scores on the PEDS-ES compared to those that were included in the DIPA after 3 months, which might have caused some overrepresentation of children with PTSD in the final sample and may therefore have affected the AUC curve and indices, as lower baseline prevalence has shown to be linked with overestimation of the performance of diagnostic tests (Ozenne et al., 2015). Overall, the results demonstrate the good predictive power of the PEDS-ES, but at the same time that there is still room for improvement in the prediction of the development of PTSD with measuring predictive factors one week after the accident.

This study results are in line with the findings of Kramer et al. (2013), who identified a cutoff score of 8 for the PEDS-ES to enable maximum sensitivity (0.85) and reasonable specificity (0.63) to predict full or partial PTSD. Also, these results are comparable to the findings for early screening measurements for primary schoolchildren from the age of 8 years old after accidental injuries: for instance, a sensitivity of 0.82 was demonstrated for the CTSQ (Kenardy et al., 2006) and equally 0.82 for the STEPP (Meijel van et al., 2015).

However, prior research has not provided clear evidence for the utility of including exactly which early PTS, ASD or depression symptoms for prediction of longer term psychological distress after injury. Or, instead or in addition, other risk markers could be needed. Some research provides evidence that acute stress reactions in young children have a large influence on the development of later PTSD (Trickey et al., 2012). Other studies, however, have found that a diagnosis of ASD is not an optimal predictor of later PTSD diagnosis. Authors argue that various combinations of ASD symptoms are seen to be useful in predicting PTSD outcomes (Dalgleish et al., 2008; Kassam-Adams & Winston, 2004; Meiser-Stedman et al., 2005).

Kramer et al. (2013) explored in their PEDS-ES research the value of joining additional items to the PEDS-ES. This risk factors included preexisting child behavioural problems, parental preexisting chronic mental or physical illness, pretraumatic life events in the family, parental feelings of guilt and parental posttraumatic stress. Adding this 5 supplemental risk factors to the PEDS-ES, sensitivity for PTSD severity remained stable, but specificity, PPV and NPV decreased. For the 5 risk factors alone, without the PEDS-ES, the highest degree of sensitivity achieved was only 38% for PTSD, although specificity was excellent. The authors concluded that the PEDS-ES performed best when used alone.

Kassam-Adams et al. (2015) evaluated a three-component screening protocol, which included different types of predictive tools. The screening composed of the STEPP, the Child PTSD Symptom Scale (CPSS) (Foa et al., 2001) and the Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977). The screening protocol demonstrated excellent sensitivity (1.00) and good specificity (0.73) for prediction of PTSS after 6 months and excellent negative predictive value for PTSS. The study showed that most of the value of this three-component protocol for prediction of PTS outcomes appears to derive from assessment of early traumatic stress symptoms. This supports the concept of including early PTS symptoms as key early risk markers in screening tools. In contrast, early depression symptoms did not emerge as clear predictors of psychological outcomes.

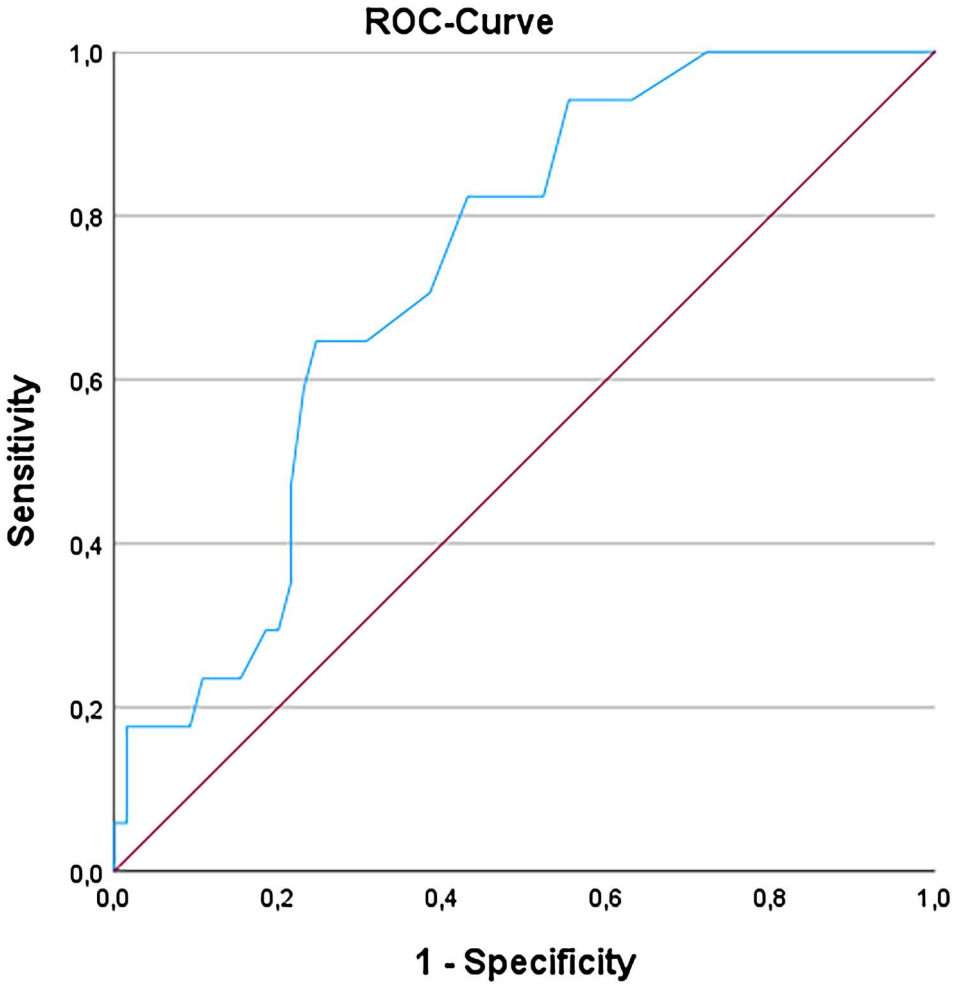

Figure 1. Receiver Operating Characteristic Curve (ROC-Curve).

Early detection of children at risk for developing PTSD offers the option for secondary prevention interventions, which have shown to be helpful in children (Kramer & Landolt, 2011). For children who recently experienced a stressful life event, the Watchful Waiting protocol has been developed (Covers et al., 2021). This protocol stipulates screening for PTSS at least two times during the first month post-event and, if indicated, subsequent referral for diagnostic testing and evidence-based treatment.

Table 2. Sensitivity, specificity, positive predictive value and negative predictive value for different PEDS-ES cut-off values ($n = 82$).

Cut-off (≥)	Sensitivity	Specificity	PPV	NPV	Youden's J
2	1	0.27	0.26	1	0.27
3	0.94	0.36	0.28	0.96	0.30
4	0.94	0.44	0.30	0.95	0.38
5	0.82	0.48	0.29	0.91	0.30
6	0.82	0.56	0.33	0.92	0.38
7	0.71	0.60	0.32	0.89	0.31
8	0.65	0.68	0.35	0.88	0.33
9	0.65	0.73	0.39	0.89	0.38
10	0.65	0.75	0.40	0.89	0.40
11	0.59	0.76	0.39	0.88	0.35
12	0.47	0.78	0.35	0.85	0.25
13	0.41	0.78	0.33	0.84	0.19
14	0.35	0.78	0.29	0.82	0.13
15	0.29	0.79	0.27	0.81	0.08

Note: Outcome Interview = Diagnostic Infant and Preschool Assessment (DIPA); PPV = Positive Predictive Value; NPV = Negative Predictive Value.

4.1. Limitations

Some limitations need to be noted, although this is the second study to evaluate an early screener in a sample of accidentally injured preschool-aged children successfully. First, our sample size was small and homogeneous, which may limit the generalizability to other types of trauma in young children. Second, we lost a few children to follow up for the second measurement. This might have caused overrepresentation of children with PTSD in the final sample and may therefore have led to some overestimation of the performance of the test (Ozenne et al., 2015). Third, because of the young age of the victims, the study had to rely on reports from parents. For children under 7 unfortunately there is no other option available for screening up till now. For children of 7 years and older, the Child and Adolescent Trauma Screen 2 (CATS-2; Sachser et al., 2022) might be a valuable option for children to report themselves on PTSS in future studies. Furthermore, future studies are needed into early secondary preventive

interventions to address effectiveness at mitigating PTSD and promoting healthy mental development for those children with a score above the cutoff on the PEDS-ES.

5. Conclusion

In summary, the PEDS-ES performed fair for identifying children at risk for developing PTSD at a very early stage. Consequently, in clinical practice, we recommend that the PEDS-ES be used as an early screening tool. Children at risk could be monitored by offering early psychological support. 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. However, the PEDS-ES should not be used for diagnostic purposes and clinicians should interpret and communicate outcomes carefully, as not all children with a positive test result will go on to have persistent distress or clinical relevant symptoms at 3 months after an accident.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

The data that support the findings of this study are available on request from the corresponding author, IH. The data are not publicly available due to restrictions, as their containing information that could compromise the privacy of research participants.

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