Invisible injuries

Posttraumatic stress in children, adolescents and their parents following accidents

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Faculteit der Geneeskunde

Voor Henk, voor Kyra

Young people should live

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List of abbreviations

ADIS C/P	Anxiety Disorders Interview Schedule for DSM-IV Child and parent version
CRIES	Child Revised Impact of Event Scale
DSM	Diagnostic and Statistical Manual of mental disorders
EMDR	Eye Movement Desensitization and Reprocessing
IASP	International Association for the Study of Pain
IES-R	Impact of Event Scale-Revised
NICE	National Institute for Clinical Excellence
NIMH	National Institute of Mental Health
NVvP	Nederlandse Vereniging voor Psychiatrie
PTS symptoms	Posttraumatic Stress symptoms
PTSS	Clinically significant Posttraumatic Stress Symptoms
PTSD	Posttraumatic Stress Disorder
PMTS	Pediatric Medical Traumatic Stress
STEPP	Screening Tool for Early Predictors of PTSD
TF-CBT	Trauma-Focused Cognitive Behavioral Therapy
TIC	Trauma-Informed Care (traumasensitieve zorg)

CHAPTER 1

General introduction

The world stood still...

Accidental injury

Accidents are a major cause of injury in children and adolescents[1] (Brosbe, Hoefling, & Faust, 2011; Kassam-Adams, Marsac, Hildenbrand, & Winston, 2013). Accidental injury can have great impact on the lives of children and their parents. The accident itself, being transported in the ambulance, the injury, the pain, medical procedures and hospitalization – all can be frightening and potentially traumatic (Kahana, Feeny, Youngstrom, & Drotar, 2006; Price, Kassam-Adams, Alderfer, Christofferson, & Kazak, 2016). Furthermore, children and parents may be uncertain about the immediate and long-term outcome and consequences.

After a serious accident, children are often treated in the trauma resuscitation room (trauma room) of the emergency department. In a trauma room, a multi-disciplinary team of medical specialists and nurses provides the initial assessment and treatment of trauma patients. Children are referred to the trauma room in cases with a high-energy trauma mechanism, involving a risk of severe and/or potentially life-threatening injuries. High-energy trauma mechanism refers to injuries associated with high-energy impact such as a fall from height (> 10 ft or 2 to 3 times the height of the child), a high-risk automobile crash or a pedestrian/bicycle vs. automobile collision (American College of Surgeons, 2012). The Netherlands has eleven level 1 trauma centers, which are located in all regions of the country. A level 1 trauma center is staffed and equipped to provide care for patients with one or more major traumatic injuries.

Facts and figures

Generally, four categories of accidents are used in reports of accidents: sports-related, traffic-related, industrial and private. The last category involves all accidents besides sports, traffic and industrial accidents. In the Netherlands, approximately 123,000 children (aged 8–18[2]; 43% girls, 57% boys) per year are injured in an accident and are subsequently treated in the emergency department of a hospital (VeiligheidNL, 2018). In traffic-related accidents 73% of the children were riding a bike and 17% a moped or a scooter. The majority of the children (54%) were individually involved in

1 For reasons of readability, both groups are generally referred to as 'children' in this thesis.
2 Since the main focus of this thesis is on children aged 8-18, only information on children in this age category is presented here.

the traffic accident, for instance by falling. Another 30% were involved in interaction with others, for instance in collisions with cars, other bikes, or pedestrians. In sports-related accidents, the major causes of injuries are falls (58%) and being struck by a ball (15%). In this age group, the industrial category of accidents is the smallest. The most frequent causes are being hit by a moving object, getting trapped or being cut by an object. In private accidents the major causes of injuries are falls (57%) and bumping into an object (9%). After the accident, a relatively small proportion of the children are hospitalized (11% in traffic-related accidents, 4% in sports-related accidents, 5% in industrial accidents and 8% in private accidents).

Accidents entail medical expenses and other costs such as delays in school progress and absence from work. Additionally, results of an explorative study suggest that the financial burden of injuries increases with one third if psychological consequences such as PTSD are included (VeiligheidNL, 2014). Ignoring PTSD leads to a considerable underestimation of the financial burden of injuries, which may negatively influence the identification of prevention priorities and resource allocations (Haagsma et al., 2011).

Psychological impact of accidents and injury on children and their parents

Posttraumatic Stress Disorder (PTSD)[3]

A traumatic event may induce various psychological reactions, such as posttraumatic stress, anxiety or depression. In this thesis, the focus is on posttraumatic stress reactions and posttraumatic stress disorder (PTSD). According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), the first criterion for PTSD is that the person was exposed to death, threatened death, actual or threatened serious injury, or actual or threatened sexual violence in one or more of the following ways: direct exposure, witnessing the trauma, learning that a relative or close friend was exposed to a trauma,

3 DSM-5 criteria were launched in 2013. The studies in this thesis were performed before, therefore, DSM-IV-TR criteria (APA, 2000) were applied. Compared to DSM-IV, the most important changes in DSM-5 are the following: a new qualification of traumatic events (A1); removal of the A2 criterion (a response of intense fear, hopelessness or horror), criterion C (avoidance and numbing) was split into criterion C (avoidance) and criterion D (negative alterations in cognitions and mood). Symptoms were also added in DSM-5: overly negative thoughts and assumptions about oneself or the world, negative affect and risky or destructive behavior. Finally, DSM-5 no longer differentiatiates between acute and chronic PTSD (PTSD can be assessed if symptoms last for more than one month).

or indirect exposure to aversive details of the trauma. PTSD includes symptoms of re-experiencing (i.e. intrusive thoughts, nightmares, emotional distress after traumatic reminders), avoidance of trauma-related stimuli (i.e. thoughts, feelings, reminders), negative alterations in cognitions and mood (i.e. negative affect, decreased interest in activities), increased arousal (i.e. irritability or aggression, difficulty concentrating or sleeping), resulting in substantial distress or impairment in functioning (APA, 2013). Acute Stress Disorder (ASD) can be diagnosed if symptoms persist for no longer than one month after the traumatic event; PTSD can be diagnosed if symptoms persist for longer than one month (APA, 2013).

Posttraumatic stress in children

After an accident, children may develop acute stress symptoms. These symptoms disappear spontaneously in the majority of the children in the weeks following traumatic events, but 8% to 14% develop posttraumatic stress disorder (PTSD) following unintentional injury (Alisic et al., 2014) and up to 18% develop severe posttraumatic stress symptoms (PTSS) (Landolt, Vollrath, Timm, Gnehm, & Sennhauser, 2005). According to the National Institute for Clinical Excellence (NICE, 2018), up to 30% of children who attend an emergency department for a traumatic injury will develop PTSD. PTSD is a debilitating psychiatric disorder, often involving the development of co-morbid disorders (Stallard, Salter, & Velleman, 2004) and affecting children's functioning and physical recovery from injury (Kahana et al., 2006). Posttraumatic stress symptoms in injured children are associated with poorer functional recovery one year or more after the injury (Kassam-Adams et al., 2013). Since ASD or PTSD at a subsyndromal level can also result in substantial impairment in functioning, it is also appropriate to evaluate and treat children reporting clinically significant persistent PTSS (Gold, Kant, & Kim, 2008).

Although the long-term impact of traumatic events can be substantial, research on long-term PTSD after accidental injury is scarce and involves follow-up periods of 1.5 years or less. In a literature review to determine the prevalence of PTSD among children 8 years to 18 years injured in traffic (Olofsson, Bunketorp, & Andersson, 2009), only one study with a 2-month to 18-month follow-up study was included. This study reported 14% PTSD in victims of motor vehicle accidents. In a meta-analytic study on changes in the prevalence of child posttraumatic stress disorder, the follow-up period

was one year. The prevalence decreased from 21% in the acute phase to 11% after one year (Hiller et al., 2016).

Posttraumatic stress in parents

Accidental injury in children also affects the parents and puts them at risk for developing substantial posttraumatic stress symptoms (PTSS) (Kassam-Adams, Fleisher, & Winston, 2009; Le Brocque, Hendrikz, & Kenardy, 2010). The prevalence of PTSS in parents 3-6 months after their child's accidental trauma is 10% to 17%. Kassam-Adams and colleagues found partial or full posttraumatic stress disorder (PTSD) in 15% of the parents (Kassam-Adams et al., 2009) approximately six months following traffic-related pediatric injury. Parents' well-being has an effect on the child's functioning (Alisic, Jongmans, van Wesel, & Kleber, 2011). PTSS in parents is longitudinally related to poorer recovery of PTSS in the child (Landolt, Ystrom, Sennhauser, Gnehm, & Vollrath, 2012). Parental PTSS increases the risk of child PTSD (Kolaitis et al., 2011) and parents' early symptoms are a risk factor for persistent posttraumatic stress in injured children (Kassam-Adams et al., 2013). A meta-analysis reported significant effect sizes for the relationship between parent and child PTSS, suggesting that parental PTSS, especially maternal, may be a risk factor for child PTSS (Morris, Gabert-Quillen, & Delahanty, 2012).

Although parental PTSS clearly has adverse effects and previous research supports the occurrence of long-term PTSS and related impairment in parents (Kazak et al., 2006), there is a lack of long-term follow-up studies. We found only one study with a 1-year and 11-year follow-up period (Bakker, Van Loey, Van Son, & Van der Heijden, 2010) in 48 mothers of children with burns. PTSS was assessed by self-report. At 1 year and 11 years after their child's burn event, 17% of the mothers reported clinically significant PTSS.

Risk factors for PTSD and PTSS

Given the probable adverse consequences for the children and parents, identifying persons at risk for PTSD is important. Screening instruments such as the Screening Tool for Early Predictors of PTSD (STEPP) are suitable for this purpose (Winston, Kassam-Adams, Garcia-Espana, Ittenbach, & Cnaan, 2003). See also the subsection 'Screening for risk of PTSD' below. However, if the setting does not allow for the use of a screening instrument or if no screening method is available, other methods to identify children and parents at risk can be advisable. Therefore, insight into factors possibly associated with PTSD is necessary. Moreover, there are possible individual risk factors that can be

directly addressed or modified after an accident, thus contributing to the prevention of PTSD. An example of such a factor is acute pain following accidental injury, because pain can be assessed easily and treated promptly. So far, studies on the association between acute pain and later PTSD are scarce but the results of one study suggest a relationship between acute pain and PTSS (Hildenbrand, Marsac, Daly, Chute, & Kassam-Adams, 2016). Little is known about risk factors for longer-term child PTSD after accidental injury. Previous studies on PTSD up to 12 months after the accident suggest that physical impairment, trauma history and new traumatic events are associated with the occurrence of long-term PTSD (Copeland, Keeler, Angold, & Costello, 2007; Gillies, Barton, & Di Gallo, 2003; Janssens, Gorter, Ketelaar, Kramer, & Holtslag, 2009; Landolt et al., 2005; Mehta & Ameratunga, 2012; NICE, 2005; Zatzick et al., 2008).

Risk factors for adult PTSS or PTSD after their own trauma are well studied, but less is known about factors associated with parental posttraumatic stress reactions following child accidental trauma or injury (Hiller et al., 2016). Although results are not consistent, suggested risk factors for parental PTSD include prior trauma history (Delahanty & Nugent, 2006), acute stress responses (Bronner et al., 2010) or peritraumatic distress (Allenou et al., 2010), witnessing the event (de Vries et al., 1999) and length of initial hospitalization (Landolt et al., 2012). To date, severe pain in children and permanent physical impairment of injured children have not been studied in relation to parental PTSS. Obviously, parents also experience stress when watching their child in severe pain. Furthermore, permanent physical impairment of children is likely to impact the parents, possibly comparable to the impact of extensive permanent scarring on parents of children with burns (Bakker et al., 2010).

Interventions for PTSD and PTSS

In a recent systematic review and meta-analysis of randomized clinical trials (Khan et al., 2018), Trauma-Focused Cognitive Behavior Therapy (TF-CBT) and Eye Movement Desensitization and Reprocessing (EMDR) were indicated as effective treatments for PTSD and for the reduction of posttraumatic stress symptoms. Both treatments are recommended in national guidelines in the Netherlands and other countries (NICE, 2018; Nederlandse Vereniging voor Psychiatrie NVvP, 2019). Little is known about the choices regarding treatment and the – short and longer term – effect of those choices. Furthermore, if children and parents do receive treatment, the specifics of

the treatment are often unknown (whether this is trauma-focused treatment, and if so, which recommended treatment was used).

A model on the consequences of accidental injury and medical stress

In 2006, the model of Pediatric Medical Traumatic Stress (PMTS) was introduced. PMTS is defined as 'a set of psychological and physiological responses of children and their families to pain, injury, serious illness, medical procedures, and invasive or frightening treatment experiences', often including posttraumatic stress reactions (Kazak et al., 2006). The model was evaluated and adjusted to the Integrative Trajectory Model of Pediatric Medical Traumatic Stress in 2016 (Price et al., 2016).

The model describes three consecutive phases, each of which may include potentially traumatic events. Phase I (peritrauma) includes the accident and related events such as transport to hospital, the first medical procedures and communication of the diagnosis of the injury. Phase II includes acute medical care. Phase III (ongoing care or discharge from care) refers to longer-term PMTS and to the potential for traumatic responses to continue for months or years. This phase reflects the need for monitoring changes in PMTS over time. All three phases have implications for assessment and intervention. Screening for risk is appropriate in phase I and phase II. Prevention of traumatic stress and treatment of significant symptoms is also indicated in phase II. Phase III includes screening for traumatic stress and treatment of significant stress. The model may help explain the role of the individual factors in studies on posttraumatic stress following accidents. Furthermore, the model offers a framework for assessment and for specifying treatment needs (Price et al., 2016).

Awareness of psychological consequences of accidental injury: the state of affairs in the Netherlands

In the Netherlands, hospital care and aftercare with regard to physical consequences of accidental injury is integral to hospital policy and the financial compensation structures of health insurers. However, systematic care for the psychological consequences of accidents is still not common practice. Evidence based trauma-focused interventions have been shown to be effective, but many children with PTSD or significant symptoms do not receive any form of psychological treatment (Smith, Dalgleish, & Meiser-Stedman, 2018). An obvious reason is that avoidance is a frequent

symptom of PTSD; it is likely that patients will not spontaneously report symptoms or seek help. Furthermore, injured children who are still undergoing medical treatment (or their parents) may judge treatment for physical problems as more important than treatment for psychological problems (NICE, 2005). Another important reason is that health care practitioners are often unaware of PTSD, so children and parents with posttraumatic stress symptoms remain unidentified. This means they are not given information about PTSD and are not referred for further diagnostics or treatment (National Center for PTSD, 2019).

In response to large accidents or disasters, with dozens or hundreds of victims, psychological assistance is provided almost immediately. Victims are usually informed about normal psychological reactions and how to deal with them, and a monitoring system is set up to ensure adequate short-term and long-term care. For individual accidents, however, such systematic care is absent, even though the total of all victims of accidents is the equivalent of a yearly disaster. Some individual survivors of an accident do get psychological help, but only incidentally; whether this help is offered or not, depends on various circumstances.

Screening for risk of PTSD

Best practice recommendations after acute trauma include 'watchful waiting' and empirically sound screening to identify persons at risk for PTSD who can benefit from monitoring and intervention (Kassam-Adams et al., 2011; NICE, 2005). Watchful waiting includes a periodical professional check of the child and parent's needs, rather than a formal intervention. Watchful waiting may also include web-based resources for children and parents that enable them to measure their own responses and recovery (Kassam-Adams et al., 2011). However, it is unclear who is supposed to do this professional check and monitoring. Currently, standard medical care following accidents does not include psychological care, screening for risk or active monitoring. After an accident, children and parents deal with various medical professionals (medical specialists, nurses, general practitioners) who generally lack knowledge of psychological aspects related to accidental or medical trauma.

Identifying children and parents at risk of PTSD creates an opportunity to monitor them. A system of stepped care, including screening for risk and timely treatment if

needed, can contribute to the prevention of PTSD. In the USA, the STEPP appeared to be effective in identifying children and parents at risk for PTSD after traffic related injury, and in screening out those who are unlikely to develop PTSD (Winston et al., 2003). Australian colleagues tested the STEPP in a mixed single-incident trauma sample but it was not shown to be effective (J. A. Kenardy, Spence, & Macleod, 2006). Prior to our study, the STEPP had not been evaluated in languages other than English.

Research aims

In accordance with the considerations above, the aims of this thesis are (1) to evaluate the utility – in the Netherlands – of the STEPP, a screening instrument to identify children and parents at risk for PTSD following child accidental injury, and (2) to examine short and long-term posttraumatic stress in children and parents following child accidental injury, including possibly associated factors such as acute pain, permanent physical impairment and choices regarding trauma-focused psychotherapy. This thesis describes research to provide scientific knowledge on the above mentioned aspects of posttraumatic stress after accidental injury in children and their parents in the Netherlands. Most of the studies concern children between 8 and 18 years of age — the age group for which reliable and valid psychological instruments are available. But an exploratory study directed at children below the age of 8 is also included.

General outline

In **Chapter 2** we present the three-month prevalence of PTSD and PTSS in a sample of children and parents, and the results of an evaluation of the utility in the Netherlands of a screening instrument to identify children and parents at risk for PTSD. Besides factors included in the screening instrument, we examine the extent to which acute pain contributes to posttraumatic stress three months later. The results are reported in **Chapter 3**. **Chapter 4** describes the results of a 2–4-year follow-up study: the long-term impact of the accidental injury on children, specifically posttraumatic stress and including associated factors such as permanent physical impairment. The short-term and long-term parental posttraumatic stress and associated factors are presented in **Chapter 5**. Due to the scarcity of knowledge on posttraumatic stress symptoms in younger children, we performed an exploratory study to examine algorithms for

posttraumatic stress reactions in accidentally injured children up to 8 years old. The results of this study are outlined in **Chapter 6**. In **Chapter 7**, we discuss the main themes and issues regarding posttraumatic stress following accidental injury in children and their parents that emerged from our findings. This chapter also includes clinical implications of the findings, a reflection on the limitations of the studies, and suggestions for future research.

CHAPTER 2

Predicting posttraumatic stress disorder in children and parents following accidental child injury: evaluation of the Screening Tool for Early Predictors of Posttraumatic Stress Disorder (STEPP)

"And I was just so glad that I didn't remember the accident…"
A child diagnosed with PTSD

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BMC Psychiatry, 2015, 15:113
Slightly adapted for consistency

Abstract

Children and their parents are at risk of posttraumatic stress disorder (PTSD) following injury due to pediatric accidental trauma. Screening could help predict those at greatest risk and provide an opportunity for monitoring so that early intervention may be provided. The purpose of this study was to evaluate the Screening Tool for Early Predictors of Posttraumatic Stress Disorder (STEPP) in a mixed-trauma sample in a non-English speaking country (the Netherlands). Children aged 8-18 and one of their parents were recruited in two academic level I trauma centers. The STEPP was assessed in 161 children (mean age 13.9 years) and 156 parents within one week of the accident. Three months later, clinical diagnoses and symptoms of PTSD were assessed in 147 children and 135 parents. We used the Anxiety Disorders Interview Schedule for DSM-IV - Child and Parent version, the Children's Revised Impact of Event Scale and the Impact of Event Scale-Revised. Receiver Operating Characteristic analyses were performed to estimate the Areas Under the Curve as a measure of performance and to determine the optimal cut-off score in our sample. Sensitivity, specificity, positive and negative predictive values were calculated. The aim was to maximize both sensitivity and negative predictive values. PTSD was diagnosed in 12% of the children; 10% of their parents scored above the cut-off point for PTSD. At the originally recommended cut-off scores (4 for children, 3 for parents), the sensitivity in our sample was 41% for children and 54% for parents. Negative predictive values were 92% for both groups. Adjusting the cut-off scores to 2 improved sensitivity to 82% for children and 92% for parents, with negative predictive values of 92% and 96%, respectively. With adjusted cut-off scores, the STEPP performed well: 82% of the children and 92% of the parents with a subsequent positive diagnosis were identified correctly. Special attention in the screening procedure is required because of a high rate of false positives. The STEPP appears to be a valid and useful instrument that can be used in the Netherlands as a first screening method in stepped psychotrauma care following accidents.

Background

Despite the fact that accidents are widespread, systematic attention for the psychological consequences of accidents is still not common practice. Children who have been injured due to accidental trauma and their parents are at risk of posttraumatic stress disorder (PTSD) (Kazak et al., 2006; Winston et al., 2003). PTSD can cause many symptoms that can be grouped into three clusters: 1) re-experiencing symptoms such as flashbacks or nightmares, 2) avoidance symptoms such as avoiding locations, events or other reminders of the experience, 3) hyperarousal symptoms such as sleep or concentration problems or defiant behavior (APA, 2000; National Institute of Mental Health NIMH, 2014). These symptoms disappear spontaneously in the majority of the children, but up to 37.5% develop full or partial PTSD following motor vehicle accidents or unintentional injury (Alisic et al., 2014; Kahana et al., 2006). PTSD is a debilitating psychiatric disorder, often involving the development of co-morbid disorders (Stallard et al., 2004). If left untreated, PTSD negatively affects children's functioning and physical recovery from injury (Kahana et al., 2006).

In the Netherlands, 240,000 children per year are injured in an accident and are subsequently treated in the Emergency Department of a hospital (VeiligheidNL, 2014). Medical aftercare following accidents is well organized, but until now no systematic monitoring of the psychological well-being of these children has been available during hospitalization or after discharge.

Post-trauma psychological problems of parents are thought to play a role in the prediction and development of child PTSD (Kazak et al., 2006; Kolaitis et al., 2011; Saxe et al., 2005; Trickey, Siddaway, Meiser-Stedman, Serpell, & Field, 2012). Parental symptoms can impact child symptoms in various ways. For effective coping assistance, accurate parental judgment is necessary, but the parents' own symptoms may influence how they judge their child's needs (Kassam-Adams, Garcia-Espana, Miller, & Winston, 2006). Parents with posttraumatic stress symptoms may be less able to support their child (Saxe et al., 2005; Sturms et al., 2005). Moreover, parents' symptoms have been found to increase the risk of their child developing PTSD (Kolaitis et al., 2011). Following injury to their child, parents are at risk for developing substantial posttraumatic stress symptoms (Le Brocque et al., 2010); approximately 15% of the

parents develop partial or full PTSD following pediatric injury (Kassam-Adams et al., 2009). Therefore, parents should also be monitored following their child's accident.

Identifying children and parents at risk of PTSD creates an opportunity to monitor them. A system of stepped care, offering timely treatment if needed, can contribute to the prevention of chronic trauma-related disorders. For this purpose, Winston and colleagues developed the Screening Tool for Early Predictors of PTSD (STEPP), see Figure 2.1 (Winston et al., 2003). The STEPP appeared to be effective in identifying those who are at risk of persistent posttraumatic stress – both children and their parents – following traffic-related injury to children. Since the purpose of the screening is to identify children and parents who are at risk of PTSD, a high sensitivity is required, while those who are unlikely to develop PTSD should be screened out with a high negative predictive value (Winston et al., 2003). STEPP sensitivity in predicting posttraumatic stress was 0.88 for children and 0.96 for parents, with negative predictive values of 0.95 for children and 0.99 for parents (Winston et al., 2003). For a further description of STEPP performance, see *Measures*.

However, in an Australian mixed-trauma sample (all single-incident trauma), the STEPP was no better than chance at identifying positive PTSD status in children at either 3 months or 6 months posttrauma. At 3 months, sensitivity of the original STEPP in the Australian sample was 0.45, specificity was 0.68, with a positive predictive value of 0.17 and a negative predictive value of 0.89. An Australian version of the STEPP for children was then compiled from the 8 best performing items in the original item pool of Winston et al. (Winston et al., 2003). This Australian STEPP (STEPP-AUS) performed well at 3-months posttrauma: sensitivity was 0.73, specificity was 0.69, with a positive predictive value of 0.26 and a negative predictive value of 0.94. Best performance was at 6 months posttrauma: sensitivity was 0.89, specificity was 0.69, with a positive predictive value of 0.24 and a negative predictive value of 0.98 (Nixon, Ellis, Nehmy, & Ball, 2010). Until now, the STEPP has not been validated in other languages or other broader trauma samples.

The purpose of this study was therefore to determine the reliability and predictive performance of the Dutch version of the STEPP in a mixed-trauma sample. If sufficiently predictive, then screening for risk of PTSD would be an effective method to identify those who are at risk: children as well as their parents. In our study we expanded the

scope to include unintentional injury in general; we believe it is important to evaluate the STEPP for all types of accidents, not just traffic-related ones.

Methods

Participants

Children 8 to 18 years were eligible for inclusion if they survived an accident, were subsequently transported to the hospital by ambulance and underwent a trauma screening in the trauma resuscitation room (trauma room) of the Emergency Department. The standard trauma room procedure was as follows: a multi-disciplinary team of medical specialists and nurses made the initial assessment of trauma patients and provided the initial treatment. Patients were referred to the trauma room in cases with a high-energy trauma mechanism involving a risk of severe and/or potentially life-threatening injuries. Excluded were children who were living abroad at the time of the accident, who stayed on Intensive Care Units (pediatric or regular) for more than one week (the inclusion period) or who were incapable of answering the questions or completing the questionnaires due to cognitive limitations.

We used the trauma registry systems of the Trauma Surgery and Emergency Departments to identify children eligible for this study. We usually invited children to participate in the study via their parents. One parent of each child was also invited to participate. If children had already been discharged, we phoned and asked for an appointment at home. If children were hospitalized, we first consulted the responsible nurse. In total, 266 children were eligible to participate in the study, of which 105 did not participate (26 could not be contacted, 68 declined to participate, and 11 could not be included in time). The final sample consisted of 161 children and 156 parents.

Procedures

This study was performed at two academic hospitals in Amsterdam, the Netherlands: Academic Medical Center (AMC) and VU Medical Center (VUmc), both Level I trauma centers. The study was approved by the Medical Ethical Committees of both hospitals. Two researchers (EM, MRG), both psychologists, were involved in the study. One of the researchers explained the study to the children and parents, provided them with

written information about the study and obtained informed consent. Inclusion was possible only after written informed consent. According to Dutch law, for a child 8-12 years, the parents decide; 12-16 years, parent and child both have to give consent; 16 years and older, the child decides and can give consent autonomously. The inclusion period was between September 2008 and January 2011.

Screening for risk of PTSD was performed within one week of the accident. The STEPP was developed for use in the acute care setting and for assessment by trained nurses. However, this design was not compatible with the routine procedures of the Emergency Departments where we performed the research. For this reason, and to be able to include children who were discharged immediately after the medical screening, assessment was performed by the two researchers. After a general introduction it took about 5 minutes to administer the STEPP questionnaire. To determine intra-rater reliability, the STEPP was assessed twice in a sample of 20 children and 19 parents. When designing the study, we decided to re-administer the STEPP in the second year of the inclusion period to the first 20 children who were discharged. The second assessment was by telephone, within two days after the first assessment. Three months after the accident, PTSD was assessed in an interview conducted at the department of child and adolescent psychiatry in one of the two hospitals. Two different clinically trained psychologists interviewed the child and parent separately. All interviews were audiotaped. Self-report questionnaires were usually completed at home, and in a few cases during the consultation.

To evaluate injury and trauma-related characteristics of the sample, data on duration of hospital stay, trauma type and injury severity were obtained from the trauma registry and the medical records. Information on heart rate upon arrival at the Emergency Department and the type of injury were required to complete the STEPP screening score; this information was obtained from the medical records after finishing the last assessments.

Measures

Injury severity and trauma-related characteristics

The Injury Severity Score (ISS; Baker, O'Neill, Haddon, & Long, 1974) was obtained from the trauma registry. The ISS is a method for describing the severity of injuries in trauma patients. It is related to the likelihood of survival after injury. The ISS is determined by rating the severity of each injury in six body areas (head, neck, face, chest, abdomen, extremity and external) on the six-point Abbreviated Injury Scale (AIS). The ISS is derived from the sum of the squares of the AIS score and has a range of 0-75 (Baker et al., 1974; Saxe et al., 2005). Information on length of hospitalization and trauma type was obtained from the medical records.

Screening for risk of PTSD

The STEPP (see Figure 2.1) is a theoretically derived, empirically validated, stand-alone screening tool (Winston et al., 2003). It consists of 12 questions: 4 questions are asked of the child, 4 questions are asked of the parent and 4 items are obtained from the medical records. Including the items from the medical records, the total score for children is based on 8 items, and the total score for parents is based on 6 items. The items are answered dichotomously with "yes" (= 1) or "no" (= 0). A score of 4 or higher for children and 3 or higher for parents results in a positive screening (Winston et al., 2003). For children, the STEPP has shown a sensitivity of 0.88, a specificity of 0.48, a positive predictive value of 0.25 and a negative predictive value of 0.95. For parents, the STEPP has shown a sensitivity of 0.96, a specificity of 0.53, a positive predictive value of 0.27 and a negative predictive value of 0.99. Test-retest reliability was excellent for children ($\kappa = 0.86$) and very good for parents ($\kappa = 0.67$) (Winston et al., 2003).

After acquiring permission from the authors, the STEPP was translated into Dutch and then back-translated by a native English speaker. The authors informed us in detail about using, scoring and interpreting the STEPP.

Diagnosed children's posttraumatic stress disorder

To diagnose PTSD in children we used the Dutch version of the Anxiety Disorders Interview Schedule for DSM-IV - Child and Parent Version (ADIS-C/P; Siebelink & Treffers, 2001; Silverman & Albano, 1996) with an extended adaptation of the PTSD module, including detailed information on trauma history (Verlinden, van Meijel,

& Lindauer, 2009). The ADIS-C/P is a commonly used diagnostic, semi-structured interview for the assessment of anxiety disorders – including PTSD – and mood and behavioral disorders in children aged 7-17 years. The ADIS-C/P has previously been reported to have good to excellent results regarding test-retest reliability for specific diagnoses (κ = 0.61-1.00) and inter-rater reliability (κ = 0.65-1.0) (Lyneham, Abbott,

Figure 2.1 Screening Tool for Early Predictors of PTSD (STEPP)

Ask Parent:	Yes	No		
1. Did you see the incident (accident) in which your child got hurt?	1	0		
2. Were you with your child in an ambulance or helicopter on the way to the hospital?	1	0		
3. When your child was hurt (or when you first heard it had happened), did you feel really helpless, like you wanted to make it stop happening, but you couldn't?	1	0		
4. Does your child have any behavior problems or problems paying attention?	1	0		
Ask Child:	Yes	No		
5. Was anyone else hurt or killed (when you got hurt)?	1	0		
6. Was there a time when you didn't know where your parents were?	1	0		
7. When you got hurt, or right afterwards, did you feel really afraid?	1	0		
8. When you got hurt, or right afterwards, did you think you might die?	1	0		
Record From Medical Record (Do Not Ask Child or Parent):	Yes	No		
9. Suspected extremity fracture?	1	0		
10. Was pulse rate at emergency department triage >104/min if child is under 12 years or >97/min if child is 12 years or older?	1	0		
11. Is child 12 years or older?	1	0		
12. Is this a girl?	1	0		
Add Total for Each Column:				
			Positive Child Screen [3] 4	Positive Parent Screen [3] 3

PTSD indicates posttraumatic stress disorder. Instructions for completion: Ask questions 1 through 4 of the parent and questions 5 through 8 of the child, and record answers to questions 9 through 12 from the acute care medical record. Circle 1 for yes and 0 for no. Instructions for scoring: The child STEPP score is the sum of responses to questions 4 through 10 and 12. A child score of 4 or higher indicates a positive screen. The parent STEPP score is the sum of responses to questions 1 through 4, 9, and 11. A parent score of 3 or higher indi- cates a positive screen. ©2003, The Children's Hospital of Philadelphia.

& Rapee, 2007; Silverman, Saavedra, & Pina, 2001). For a random sample of children in our study (12%), the audiotaped ADIS child and parent interviews were rated independently for inter-rater reliability. The result showed almost perfect agreement ($\kappa = 0.88$). The ADIS-C/P showed good reliability for the current sample. Cronbach's alphas for ADIS-C/P were 0.84 for the child score and 0.80 for the parent score.

Depending on the answer and the clinical interpretation of the interviewer, symptoms can be rated as present or absent. If the number of symptoms endorsed as 'present' is enough to meet DSM-IV criteria, impairment in daily functioning is rated on a 9-point Likert scale (0-8). A diagnosis of PTSD requires an impairment level of 4 or more and depends also on the clinician's judgment of clinical severity. The diagnosis can be based upon either the child report (C) or the parent report (P). The interview also provides for a combined diagnosis, based on both the child and parent report. In cases of disagreement between the two interviews, the child receives a diagnosis if one of the two interviews yields a diagnosis. Partial PTSD is diagnosed when at least one symptom is present in each of three subscales – re-experiencing, avoidance and hyperarousal – resulting in substantial distress or impairment in one or more areas of functioning (Winston et al., 2003).

The interviewers were extensively trained on administering and scoring the ADIS-C/P and were supervised by an experienced child and adolescent psychiatrist (RJL). The interviewers were blind to the outcome of the STEPP screening.

Self-reported children's posttraumatic stress symptoms

The children completed the Dutch version of the Children's Revised Impact of Event Scale (CRIES; Olff, 2005; Perrin, Meiser-Stedman, & Smith, 2005; Verlinden et al., 2014). This self-report measure gives a good indication of the presence of PTSD. It consists of 13 questions in the subscales re-experiencing, avoidance and hyperarousal, with answers on a 4-point Likert scale. Items are rated according to the frequency of their occurrence during the past week (Not at all=0, Rarely=1, Sometimes=3 and Often=5; range 0-65). We asked the children to focus on their accident when answering the questions. The validation and reliability of the Dutch version of the CRIES was evaluated by Verlinden et al. (2014). Children with PTSD had significantly higher scores than children without PTSD on the total scale of the CRIES (mean score 42.48 versus 19.4; $p < .001$). At a cut-off score of 30, the Dutch CRIES was significantly better than

chance at identifying PTSD as measured by the ADIS (area under the ROC curve = 0.91; 95% CI, 0.88-0.94). The CRIES showed excellent test-retest reliability (κ = 0.85) and good reliability: Cronbach's alpha for the total score was 0.89 (Verlinden et al., 2014). For the current sample Cronbach's alpha was 0.87. The CRIES showed good agreement with the ADIS-C/P for the current sample. On the CRIES, 16% of the children scored positively; on the ADIS-C/P, 12% of the children were diagnosed with PTSD. These percentages were not significantly different from each other based on the results of the McNemar test of dependent proportions ($p = .18$).

Self-reported parental posttraumatic stress symptoms

The parents completed the Dutch version of the Impact of Event Scale-Revised (IES-R; Horowitz, Wilner, & Alvarez, 1979; Weiss, 2007). The IES-R consists of 22 questions and contains the subscales re-experiencing, avoidance and hyperarousal. Scoring is on a 5-point Likert scale. Items are rated according to the frequency of their occurrence during the past week (Not at all=0, A little bit=1, Moderately=2, Quite a bit=3, Extremely=4; range 0-88). The focus is on the child's accident. A total score of 23 or above indicates the likely presence of PTSD (Mouthaan, Sijbrandij, Reitsma, Gersons, & Olff, 2014). The Dutch IES-R showed adequate similarity with the total score of the Clinician-administered PTSD scale (CAPS; $r = .75$, $p < .001$) (Hovens et al., 1994; Mouthaan et al., 2014; Weathers, Keane, & Davidson, 2001) and good reliability for the current sample; Cronbach's alpha was 0.96.

Statistical analyses

We used descriptive statistics to summarize the demographic, trauma-related and clinical characteristics of the sample. Differences between participants and non-participants were analyzed with Mann-Whitney tests for age and injury severity and a Pearson Chi-Square test for sex. Differences between those who completed the second assessment and those who dropped out after the first assessment were analyzed with Mann-Whitney tests for age and injury severity, a Pearson Chi-Square test for sex and a t-test for the STEPP scores.

To evaluate the performance of the STEPP at predicting child and parent PTSD, Receiver Operating Characteristic (ROC) curve analyses and cross-tabulations were conducted. An ROC curve analysis represents the changes in accuracy (sensitivity and specificity)

with different positivity thresholds, and thus allows determination of the optimal cut-off point in a sample for a clinically optimal discriminative ability of a test. At the lowest cut-off point, all subjects are classified as test-positive (including the diseased), resulting in 100% sensitivity but 0% specificity. On the other end, at the highest cut-off point, all subjects (including the diseased) are classified as non-diseased, resulting in 0% sensitivity and 100% specificity. The area under the ROC curve (AUC) reflects the overall predictive performance of a test. The maximum value is 1, which means a 100% accurate test, whereas an AUC of 0.50 indicates the test does not perform better than chance. We used the STEPP score as the index test. Diagnosed PTSD and a positive score on the self-report PTSD measures were used as the reference tests. Results of the index test and the reference tests were cross-classified in 2-by-2 tables, and sensitivity, specificity, positive and negative predictive values were calculated. The optimal cut-off score for the STEPP for our sample was based on the decision to maximize both sensitivity and negative predictive values. Intra-rater reliability was tested for the STEPP: the Kappa statistic was used to determine consistency between the first and the second assessment by the same rater.

Statistical analyses were performed using SPSS 18 and 19 (IBM Statistical Product and Service Solutions, Chicago, Ill).

Results

A total of 161 children and 156 parents completed the first assessment within one week of the accident. Demographic, trauma-related and clinical characteristics of this sample are reported in Table 2.1. There were no significant differences between participants and non-participants with regard to age ($U = 8170$, $Z = -.467$, $p = .64$), sex ($\chi^2 = 1.21$, $p = .27$) or injury severity ($U = 5419$, $Z = -1.367$, $p = .17$).

Three months after the accident, 146 children and 139 parents completed the second assessment. Those who dropped out after the first assessment did not differ significantly from those who completed the second assessment in terms of age ($U = 908$, $Z = -.736$, $p = .46$), injury severity ($U = 939$, $Z = -.429$, $p = .67$), sex ($\chi^2 = .02$, $p = .88$) or STEPP score ($t(159) = -1.92$, $p = .06$).

Table 2.1 Demographic, trauma-related and clinical characteristics

	No (%)	Mean (SD)	Min-max
Sex children			
Female	66 (41)		
Male	95 (59)		
Age	161	13.9 (2.8) years	8-17 years
Sex parents			
Female	120 (77)		
Male	36 (23)		
Trauma type			
(Road) traffic accident	115 (71.4)		
Sports accident	20 (12.4)		
Other, including falls	26 (16.2)		
ISS		6.8 (7.7)	0-43
Admitted to hospital	113 (70)		
Days in hospital		4.9 (6.1)	< 1-33
Admitted to (P)ICU	22 (14)		
Days on (P)ICU		1.8 (1.5)	< 1-6

ISS - Injury Severity Score, (P)ICU - (Pediatric) Intensive Care Unit.

Posttraumatic stress

PTSD interview-based data were available for 147 children. A combined child/parent informed diagnosis was made for 135 children. For one child, a diagnosis was derived only from the parent report, and for 11 children only from the child report. With the ADIS-C/P, 17 children (11.6%) were diagnosed with PTSD, 9 of them with full PTSD (6.1%) and 8 of them with partial PTSD (5.4%).

A total of 144 children completed the self-report measure CRIES (mean score = 15.67, SD = 13.41). The scores of 23 children (14.3%) were above the cut-off score, indicating serious posttraumatic stress symptoms (mean score = 39.91, SD = 8.16).

In total, 135 parents completed the IES-R (mean score = 9.39, SD = 13.64). Of this group of parents, 13 (9.6%) scored 23 or above (mean score = 45.23, SD = 15.48) which indicates the likely presence of PTSD.

Performance of the STEPP

The STEPP showed moderate discriminative ability for child PTSD, with areas under the curve for diagnosed PTSD of 0.68 (95% CI 0.53-0.82) and for self-reported PTSD symptoms 0.69 (95% CI 0.56-0.81). The parent score resulted in an AUC of 0.59 (95% CI 0.43-0.75) for self-reported PTSD symptoms, which is too low to discriminate. Results of the ROC analyses are presented in Table 2.2, showing the accuracy (sensitivity and specificity) and the positive and negative predictive values for different cut-off values for the STEPP. Because a screening instrument should basically identify all cases (maximize sensitivity), the STEPP showed optimal performance in detecting children and parents with PTSD at a cut-off value of 2. High negative predictive values should screen out those who are unlikely to develop PTSD. We therefore had to accept poor specificity, which could lead to false positives.

Intra-rater reliability was tested for a categorical score ('At risk' or 'not at risk') based on the cut-off score. At the original cut-off scores (4 for children and 3 for parents), intra-rater reliability showed moderate agreement for both the child and parent part ($\kappa = 0.46$ and 0.45 respectively). The differences in answering question 4 ("Does your child have any behavior problems or problems paying attention?") and question 7 ("When you got hurt, or right afterwards, did you think you might die?) were responsible for two additional cases with positive scores at the second assessment. We found no systematic pattern of discrepancy between test and re-test assessment for either of the items. In one of the cases, even question 2 ("Were you with your child in an ambulance or helicopter on the way to the hospital?") was answered differently. When using the adjusted cut-off scores of 2, intra-rater reliability improved to substantial for the child part ($\kappa = 0.66$) and to almost perfect for the parent part ($\kappa = 0.83$).

Table 2.2 Performance of the STEPP in predicting PTSD at 3 months, at different cut-off scores

Cut-off	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
Child diagnosis (ADIS-C/P)				
2	0.82 (0.57-0.96)	0.28 (0.20-0.36)	0.13 (0.07-0.21)	0.92 (0.79-0.98)
3	0.65 (0.38-0.86)	0.62 (0.53-0.70)	0.18 (0.09-0.30)	0.93 (0.85-0.97)
4	0.41 (0.19-0.67)	0.87 (0.80-0.92)	0.29 (0.13-0.51)	0.92 (0.86-0.96)
Child self-report (CRIES)				
2	0.87 (0.66-0.97)	0.29 (0.21-0.38)	0.19 (0.12-0.28)	0.92 (0.79-0.98)
3	0.61 (0.39-0.80)	0.62 (0.53-0.71)	0.23 (0.13-0.36)	0.89 (0.81-0.95)
4	0.43 (0.23-0.65)	0.89 (0.82-0.94)	0.43 (0.23-0.65)	0.89 (0.82-0.94)
Parent self-report (IES-R)				
2	0.92 (0.64-0.99)	0.21 (0.14-0.30)	0.11 (0.06-0.19)	0.96 (0.81-0.99)
3	0.54 (0.25-0.81)	0.57 (0.48-0.66)	0.12 (0.05-0.23)	0.92 (0.84-0.97)
4	0.23 (0.05-0.54)	0.88 (0.81-0.93)	0.17 (0.04-0.41)	0.91 (0.85-0.96)

STEPP - Screening Tool for Early Predictors of PTSD, PTSD - Posttraumatic Stress Disorder, AUC - Area Under the Curve, CI - Confidence Interval, PPV - Positive Predictive Value, NPV - Negative Predictive Value, ADIS - Anxiety Disorders Interview Schedule-Child/Parent, CRIES - Children's Revised Impact of Event Scale, IES-R - Impact of Event Scale-Revised.

Discussion

In a large mixed-trauma sample, we determined that the Dutch version of the STEPP is reliable and predictive. At the originally recommended cut-off scores, the performance of the STEPP in the study of Winston and colleagues was not replicated; the STEPP appeared to perform only moderately in our sample (Winston et al., 2003). However, adjusting the cut-off scores improved the predictive performance substantially: 82% of the children and 92% of the parents at risk were correctly identified. This high sensitivity supports the use of the STEPP as a screening tool. The high negative predictive values make the STEPP useful to screen out those who are least likely to develop PTSD. Lower positive predictive values are consistent with the results of other studies and may be a consequence of the low prevalence of PTSD in our sample (11.6% in children, 9.6% in parents) (Nixon et al., 2010; Winston et al., 2003).

There are several possible explanations for the deviant performance of the STEPP when using the originally recommended cut-off scores. First, in our study we used different measures and a different time frame than in the study of Winston and colleagues

(Winston et al., 2003). In the latter study, the CAPS-CA was used for the assessment of PTSD, while in our study we used the ADIS-C/P. Winston and colleagues administered the STEPP within one month of the accident, and assessment of PTSD was 3 to 13 months after the accident (Winston et al., 2003). In our study we administered the STEPP within one week of the accident and assessment of PTSD was 3 months after the accident. As a consequence, children and parents with delayed onset of PTSD were not included in our study. Furthermore, the STEPP was originally developed in a sample of children who were injured in traffic accidents. In our study we included children who were injured in all types of accidents; it is possible that the various types of accidents have a different impact on the children and parents.

The results of our study are in line with the results of the study of Nixon et al. (2010) who compared the effectiveness of various screening instruments following accidental injury in an Australian mixed-trauma sample. As in our study, the STEPP did not accurately predict PTSD in the Australian sample using the original cut-off scores. Because the Australian colleagues at the same time wished to reduce the screening time and effort by not using items from hospital files, they developed a new, alternative screening instrument for children, the STEPP-AUS (Nixon et al., 2010).

Although the results of our study are promising, there is still a challenge for improvement and future research. It would be interesting to investigate the possibilities and benefits of alternative methods to administer the STEPP, for instance by telephone or online. This might be interesting particularly if children are discharged from the hospital immediately after treatment at the Emergency Department.

There are also a few limitations of our study to mention. First, the performance of the STEPP with adjusted cut-off scores requires replication in a larger and independent sample to improve the generalizability. Second, an inherent limitation of STEPP is its lack of specificity combined with high sensitivity. If used in practice, too many children and parents will therefore need monitoring. This is a potential disadvantage in terms of healthcare costs and may negatively influence the possibilities of implementing the instrument. In a future stepped care model this disadvantage can be addressed by using a brief questionnaire like CRIES or IES-R to determine if children or parents probably have developed PTSD. Only in case of a positive screen would they be referred to further screening and diagnostics. False positive screenings increase

the necessity to act very carefully when introducing and supporting the screening procedure. Screening for risk or for symptoms is often seen as an intervention; the challenge is to use the screening procedure in a way that it is supportive for children and parents.

Conclusions

Screening and monitoring children and parents at risk, preferably integrated in hospital care, can contribute to the prevention of chronic PTSD after accidental injury. A stepped model of psychotrauma care will – in a timely fashion – benefit people who are likely to develop PTSD. Although further improvement and research are needed, a screening tool like the STEPP can be a useful instrument in the first phase of stepped care in the Netherlands.

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CHAPTER 3

The association between acute pain and posttraumatic stress symptoms in children and adolescents 3 months after accidental injury

"I'm not going to tell them how much pain I have.
I'm afraid that they will keep me here if I tell them."
A child in hospital

Els P.M. van Meijel
Maj R. Gigengack
Eva Verlinden
Alida F.W. van der Steeg
J. Carel Goslings
Frank W. Bloemers
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Slightly adapted for consistency

Abstract

Previous research suggests that acute pain is a risk factor for later posttraumatic stress symptoms (PTSS). In a prospective cohort study, we examined the association between acute pain from accidental injury and PTSS in children and adolescents, taking into account factors potentially related to pain or posttraumatic stress. Participants were 135 children and adolescents, 8-18 years old. We measured the worst experienced pain since the accident took place with a visual analogue scale. Three months after the accident, posttraumatic stress was assessed with a self-report measure. We found a positive association between acute pain and posttraumatic stress. The amount of pain was negatively associated with injury severity in girls and positively associated with the presence of an extremity fracture in boys. In children who reported severe pain, this pain was significantly associated with PTSS and may account for around 10% of the variance in the severity of PTSS. Although the experience of pain is subjective, our study indicates that severe pain is associated with the severity of later PTSS. Timely management of pain according to acute pain protocols in all phases and disciplines after accidental injury is therefore recommended.

Introduction

Every year, many children and adolescents (both groups are referred to as "children" in our study) are injured in accidents and they are often treated in the trauma resuscitation room (trauma room) of the Emergency Department. In a trauma room, a multidisciplinary team of medical specialists and nurses take care of the initial assessment and treatment of trauma patients. Patients are referred to the trauma room in cases with a high-energy trauma mechanism involving a risk of severe and/or potentially life-threatening injuries. A high-energy trauma mechanism refers to mechanisms of injury associated with a high-energy impact such as a fall from height (> 10 ft or 2 to 3 times the height of the child) or a high-risk automobile crash or a pedestrian/bicycle versus automobile collision (American College of Surgeons, 2012). The accident itself, the injury, the pain and medical procedures can all be frightening and potentially traumatic (Kahana et al., 2006; Price et al., 2016). As a result, children may develop acute stress symptoms. These symptoms disappear spontaneously in the majority of the children in the weeks following traumatic events, but 8–14% develop posttraumatic stress disorder (PTSD) following unintentional injury (Alisic et al., 2014; van Meijel et al., 2015) and up to 18% develop severe posttraumatic stress symptoms (PTSS) (Landolt et al., 2005). According to the DSM-5 classification, PTSD includes symptoms of re-experiencing, avoidance, negative alterations in cognitions and mood and increased arousal, resulting in substantial distress or impairment in functioning (APA, 2013). Acute Stress Disorder (ASD) can be diagnosed if symptoms persist for no longer than 1 month after the traumatic event; PTSD can be diagnosed if symptoms persist for longer than 1 month (APA, 2013). PTSD is a debilitating psychiatric disorder, often involving the development of co-morbid disorders (Stallard et al., 2004) and affecting children's functioning and physical recovery from injury (Kahana et al., 2006). Since ASD or PTSD at a subsyndromal level can also result in substantial impairment in functioning, it is appropriate to also evaluate and treat children reporting clinically significant persistent PTSS (Gold et al., 2008).

Most injured patients experience pain, either as a direct consequence of the accident or later on from medical diagnostics and treatment (Baxt, Kassam-Adams, Nance, Vivarelli-O'neill, & Winston, 2004; Keene, Rea, & Aldington, 2011; Melby, McBride, & McAfee, 2011). In a study examining the relationship between acute pain and PTSS in children 8–17 years following traffic-related injury, acute pain was a predictor of PTSS

six months after the injury, even after controlling for demographic and empirically based risk factors (age, gender, ethnicity, heart rate at triage, prior trauma history, acute stress symptoms and perceived life threat (Hildenbrand et al., 2016). Pain was identified as a risk factor for ASD in 7- to 18-year-old children after intentional and unintentional injury (Saxe et al., 2005). In turn, ASD is considered to be a risk factor for PTSD (Dalgleish et al., 2008; Saxe et al., 2005). A study of young children with burns identified pain as a factor positively associated with posttraumatic stress outcome (Stoddard et al., 2006). The association between acute pain and later PTSS may be based on shared neurobiological stress mechanisms, enhanced hypothalamic–pituitary–adrenal axis and noradrenergic activation (Asmundson, Coons, Taylor, & Katz, 2002; Hildenbrand et al., 2016; McLean, Clauw, Abelson, & Liberzon, 2005; Norman, Stein, Dimsdale, & Hoyt, 2008). These stress mechanisms, which trigger acute pain, may also serve to encode the memory of the trauma and trigger a posttraumatic stress-related process. Memories of painful events are readily retrievable, indicating that strong encoding occurs at the time the pain was experienced (Morley, 1993; Norman et al., 2008). Pain associated with traumatic injury may act as a reminder of the traumatic event, which may further reinforce memories associated with the traumatic event (Gold et al., 2008). Additionally, the finding that aggressive pharmacological pain management can reduce the likelihood of PTSD lends further support to the relationship between pain and later PTSD development (Gold et al., 2008).

Studies on prediction of, and risk factors for, PTSD generally use clusters of factors and study their combined predictive value or combined risk for PTSD. So far, acute pain has not been included in a screening instrument for risk for PTSD in children following accidental injury (Brosbe et al., 2011; van Meijel et al., 2015; Winston et al., 2003) nor has it been used as stand-alone screener for risk of PTSS. However, the assessment of acute pain is, or easily can be, included in ambulance and emergency care protocols, thus offering an opportunity to identify children at risk for PTSD or PTSS.

Research on the relationship between acute pain and PTSS following child accidental injury is still scarce. If we confirmed or further clarified the above-mentioned initial research findings on the role of acute pain in later child PTSS, we would be able to contribute to screening methods for identifying children at risk and consequently to the prevention of PTSD and PTSS. The aim of this study was to examine the association between acute pain after accidental child injury and PTSS 3 months later, taking into

account clinical and demographic factors (gender, presence of an extremity fracture, injury severity, length of hospitalization) potentially related to pain or posttraumatic stress. As the prevalence and the risk of PTSD differs between boys and girls (Alisic et al., 2014; Stallard et al., 2004; Winston et al., 2003), we also examined associations between the variables of interest separately for boys and girls.

Methods

Participants and procedures

For the current study, we used data that were collected as part of the STEPP study in the Netherlands. In the STEPP study we evaluated a screening instrument (Screening Tool for Early Predictors of PTSD; STEPP) for risk of PTSD in children who had been injured due to accidental trauma (van Meijel et al., 2015). The STEPP study was performed at two academic hospitals in Amsterdam, the Netherlands: Academic Medical Center (AMC) and VU Medical Center (VUmc). Both hospitals are Level 1 trauma centers. The Medical Ethical Committees of both hospitals approved the study. We used the registry systems of the Trauma surgery and Emergency Departments to identify children eligible for this study. We contacted children from 8 to 18 years old (usually via their parents), who had been injured in an accident and were screened for trauma in the trauma room of the emergency department. If children had already been discharged from the hospital, we phoned and asked for an appointment at home. If children were hospitalized, we first consulted the responsible nurse. Participation was only possible after written informed consent was obtained from parents (until the age of 16) and children themselves (from the age of 12). Children were excluded if they had stayed on Intensive Care Units (pediatric or regular) for more than one week, or if they were incapable of answering the questions or completing the questionnaires due to cognitive limitations. The first assessment took place after consent was provided. The mean number of days between the accident and the first assessment was 5.8 (SD = 3, range 1–14). The first two authors (EM and MRG) recruited participants, completed informed consent procedures and collected the data. The sample size for the STEPP study was 161; for the current study, 135 participants with pain data were included in the analysis. Details on recruitment and retention are provided in (van Meijel et al., 2015). Demographic and clinical child characteristics are reported in Table 3.1.

Measures

Acute pain

At the first assessment we asked children to rate the worst pain since the accident. For this purpose, we used the Visual Analogue Scale (VAS), a small ruler with a 10-cm line, marked with "no pain" on the left, and "the worst possible pain" on the right. The children used a sliding gauge to mark the location corresponding to the amount of pain they had experienced. The reverse side of the instrument shows the corresponding values from 0 to 100 mm. This instrument was used according to internal hospital guidelines (Baas & Kramer, 2008). In the analyses we used the total pain score; a higher score indicates greater pain intensity. Scores can also be rounded to the nearest integer and categorized as *no or mild pain* (0–3), *moderate pain* (4–7), and *severe pain* (8–10). We used these categories to describe the distribution of pain severity in the sample and to examine associations with severity of posttraumatic stress per category.

Posttraumatic stress

Three months after the accident, children completed the Dutch version of the Children's Revised Impact of Event Scale (CRIES; Children and War Foundation, 1998; Olff, 2005; Verlinden et al., 2014). The Dutch version of the English CRIES was obtained through a standard forward–backward translation procedure by independent health professionals ((Verlinden et al., 2014). This self-report measure is based on the definition of PTSD according to DSM-IV-TR criteria and gives a good indication of the presence of PTSD (APA, 2000; Verlinden et al., 2014). It consists of 13 questions in the subscales re-experiencing, avoidance and hyperarousal, with answers on a 4-point scale. Examples of typical CRIES items are: "Do you startle more easily or feel more nervous than you did before it happened?" and "Do pictures about it pop into your mind?". We asked the children to focus on their accident when answering the questions. Items are rated according to the frequency of their occurrence during the past week (*Not at all*=0, *Rarely*=1, *Sometimes*=3 and *Often*=5). The Dutch CRIES is an effective and valid tool for screening of PTSD and shows moderate to good reliability: Cronbach's alpha for the total score is .89 and for the subscales of re-experiencing, avoidance and hyperarousal .82, .77 and .74, respectively (Verlinden et al., 2014). In the current study, we used the CRIES total score. The total score can range from 0 to 65, and is an indicator of the child's perception of posttraumatic stress; a higher total score indicates higher severity.

The cut-off score for a positive test is 30. The outcome correlates highly with the PTSD diagnosis according to the Anxiety Disorders Interview Schedule for DSM-IV, Child and Parent Version (ADIS C/P) (Verlinden et al., 2014). For the current sample Cronbach's alpha was .87 (van Meijel et al., 2015).

Clinical information

Information on the presence of an extremity fracture and the length of hospitalization was obtained from the medical records, including the ambulance and Emergency Departments reports. The Injury Severity Score (ISS) was obtained from the trauma registry. In the trauma registry, part of a national trauma registry system, trained data managers register prehospital, in-hospital and discharge data on injury mechanism, vital signs, type and severity of injuries, treatment and outcome. The purpose of the national registry system is to be able to evaluate and improve quality of trauma care in the Netherlands. The ISS is a method for describing the severity of injuries in trauma patients. It is related to the likelihood of survival after injury. The ISS is determined by rating the severity of each injury in six body regions (head, neck, face, chest, abdomen, extremity and external) on the six-point Abbreviated Injury Scale (AIS). The AIS score per body region has a range of 1 (*minor injury*) to 6 (*unsurvivable injury*). The ISS is derived from the sum of the squares of the AIS score of the three most severely injured body regions and has a range of 0–75 (i.e., $5^2+5^2+5^2$). If an injury is assigned an AIS of 6 (*unsurvivable injury*), the ISS score is automatically set to 75. Injury severity can be divided into six categories: *minor* (1–8), *moderate* (9–15), *serious* (16–24), *severe* (25–49), *critical* (50–74) and *maximum* (75) (Baker et al., 1974; Saxe et al., 2005).

Statistical analyses

The data we have presented here originated from a previous study (van Meijel et al., 2015) that aimed to validate the STEPP using responses from 150 participants. This sample size was based on three assumptions: that there would be a prevalence of PTSD of 25%, that the STEPP would have a sensitivity of 90% to identify children at risk for PTSD, and that a 95% confidence interval with limits of 75% and 97% for the sensitivity was required. A total of 161 participants were included. As this paper describes a convenience sample from the earlier STEPP study, no formal power analysis was performed for the current study. However, a post-hoc power analysis assuming one sample and a correlation of .3 showed that a sample of 135 patients is sufficient to estimate the correlation coefficient

and associated 95% confidence interval with a lower bound of 0.14 and an upper bound of 0.45 (nQuery Advisor Version 7.0, Statsols, Cork, Ireland).

We used descriptive statistics to summarize demographic and clinical information on the participants. The differences between boys and girls were tested with Mann–Whitney *U* test for age, injury severity, worst pain, length of hospitalization, and severity of PTSS (total score CRIES) at 3 months, and with Fisher's exact test for the presence of an extremity fracture. In addition, we calculated effect sizes using Cohen's *d*. We examined whether variables followed a normal distribution by visually inspecting histograms. As the pain and CRIES scores clearly did not follow normal distributions, we used Spearman's rho correlation coefficient to present the associations between variables. The following variables were included in the analyses: gender (as a fixed variable before the accident), the presence of an extremity fracture, the injury severity, the worst experienced pain, the length of hospitalization, and the total score of self-reported PTSS at 3 months (variables ordered in time from the moment of the accident). Correlation coefficients can be interpreted as .0 to (–).3 = *negligible*; (–).3 to (–).5 = *low*; (–).5 to (–).7 = *moderate*; (–).7 to (–).9 = *high*; (–).9 to –(1) = *very high* (Hinkle, Wiersma, & Jurs, 2003). A *p* value of less than .05 was considered statistically significant. Analyses were performed using SPSS 24 (IBM Statistical Product and Service Solutions, Chicago, IL).

Results

Sample characteristics

Table 3.1 summarizes the sample characteristics for the total group of 135 children included in this study, and for boys and girls separately, and shows the differences and effect sizes between both groups on all variables. We found no significant differences between boys and girls, except on the severity of posttraumatic stress: girls had a higher CRIES score than boys. In total 94 children (70%) were hospitalized. ISS's were available for 134 children. Injury severity was classified as zero for 31 children (23%), minor for 58 children (43%), moderate for 28 children (21%), serious for 12 children (9%) and severe for 5 children (4%). The number of days between the accident and the first assessment was not associated with the amount of pain (r_s = .04; p = .62) nor with the severity of PTSS (r_s = .04; p = .68).

Table 3.1 Sample characteristics and differences between boys and girls

	Total group (n = 135)				Girls (n = 56, 41.5%)				Boys (n = 79, 58.5%)				Difference	Effect size d
	M	SD	Median	Min-Max	M	SD	Median	Min-Max	M	SD	Median	Min-Max	p Value[a]	
Age[b]	14.0	2.9	15.0	8–18	13.8	2.8	14.0	8–17	14.1	3.0	16.0	8–18	.34[c]	.10
CRIES score	15.2	13.3	12.0	0–61	18.9	15.1	16.5	0–61	12.5	11.3	11.0	0–47	.01[c]	.48
Worst pain	6.8	2.4	7.0	0–10	7.2	2.5	7.3	0–10	6.6	2.3	6.8	2–10	.10[c]	.25
ISS[d]	6.5	7.4	4.0	0–34	5.5	7.0	4.0	0–25	7.3	7.7	5.0	0–34	.06[c]	.24
Days in hospital	3.4	5.5	1.0	0–33	2.7	4.6	0.8	0–22	3.9	6.0	1.0	0–33	.08[c]	.22
Extremity fracture (n, %)	38	28			11	20			27	34			.08[e]	.57

CRIES Children's Revised Impact of Event Scale, *ISS* Injury Severity Score, *M* mean, *SD* standard deviation

[a] p Value of the difference between boys and girls

[b] Age at the time of posttraumatic stress assessment

[c] Mann–Whitney U test was used

[d] ISS score of 1 boy is missing

[e] Fisher's Exact test was used

Acute pain

When asked to rate the worst pain since the accident, the majority of the children reported moderate (n = 67, 50%) or severe (n = 58, 43%) pain, while ten children (7%) reported no to mild pain, including one child reporting no pain. The mean and median pain values are shown in Table 3.1. Severe pain was reported across all categories of injury severity. Ten children specifically reported medical procedures, like insertion of peripheral venous cannula or urethral catheterization, as very painful or most painful ever. The worst pain children reported referred to pain shortly after the accident while in the ambulance, during treatment in the trauma room, or during hospitalization.

Posttraumatic stress

On the self-report measure CRIES, the scores of 20 children (15%) were above the cut-off point (≥30), indicating serious PTSS. Additional information on the CRIES scores is reported in Table 3.1.

Acute pain and posttraumatic stress

The findings on the association between acute pain, child characteristics and posttraumatic stress are summarized in Table 3.2. In the total group, the continuous pain score had a positive correlation (r_s = .28; p = .001) with the total score on the self-report measure CRIES. In girls, we found no significant association between acute pain and the total score on the CRIES (r_s = .23; p = .09). In boys, however, acute pain was significantly associated with the total score on the CRIES (r_s = .27; p = .02). After splitting the sample into pain categories, we found no significant association between continuous pain scores and the severity of posttraumatic stress for children with "no or mild pain" (r_s = .14; p = .71) or "moderate pain" (r_s = .13; p = .30). However, for children with "severe pain" this association was statistically significant (r_s = .32; p = .02). Separate examination of data for girls (r_s = .22; p = .28) and boys (r_s = .33; p = .07) revealed no statistically significant association between severe pain and posttraumatic stress, although these results are based on small subgroups.

None of the other factors were associated with the total score of the CRIES, but two factors were associated with pain. In girls, injury severity was negatively associated with pain (r_s = –.34; p = .01); the more severe the injury was, the less pain the girls reported. In boys the presence of an extremity fracture was positively associated with pain (r_s = .29; p = .01); an extremity fracture was thus associated with more pain in boys but not in girls. Injury severity and the presence of an extremity fracture were associated factors, in the total group as well as in boys and girls separately.

Table 3.2 Correlations between acute pain, child characteristics and posttraumatic stress

Total group (n = 135)	**1**	**2**	**3**	**4**	**5**
1. Pain score	-				
2. Extremity fracture	.17	-			
3. Injury severity	–.14	.50***	-		
4. Days hospitalized	.02	.49***	.83***	-	
5. Total score CRIES	.28**	.01	–.08	–.09	-
Girls (n = 56)	1	2	3	4	5
1. Pain score	-				
2. Extremity fracture	.04	-			
3. Injury severity	–.34*	.45**	-		
4. Days hospitalized	–.09	.44**	.78***	-	
5. Total score CRIES	.23	.11	–.11	–.02	-
Boys (n = 79)	1	2	3	4	5
1. Pain score	-				
2. Extremity fracture	.29*	-			
3. Injury severity	.04	.52***	-		
4. Days hospitalized	.15	.51***	.83***	-	
5. Total score CRIES	.27*	.00	–.03	–.09	-

Values are Spearman's rho correlation coefficients (r_s). *CRIES* Children's Revised Impact of Event Scale
*p < .05
**p < .01
***p < .001

Discussion

In this study, we found an association between acute pain after accidental injury and PTSS 3 months later. The findings of our study confirm the findings of other studies, in that pain after accidental injury contributes to or is a risk factor for later PTSD or PTSS in children and adolescents (Hildenbrand et al., 2016; Saxe et al., 2005). However, the difference in outcome related to gender had not been specified previously. Furthermore, the association between acute pain and severity of posttraumatic stress was strongest in the group of children that reported severe pain. This result supports the finding of Hildenbrand et al. (2016) that the most severe pain predicted subsequent PTSS. In the group of children with severe pain, pain may account for around 10% of the variance in the severity of the PTSS after 3 months.

In our study, girls reported more severe PTSS than boys. This finding is consistent with a previous study which found that girls have a greater risk for PTSD then boys (Alisic et al., 2014). Injury severity and the presence of an extremity fracture were moderately associated and influenced the amount of acute pain. In boys, we found an association between the presence of an extremity fracture and pain. A possible explanation is that an extremity fracture causes more pain than other injuries. This is in line with the findings of Baxt et al. (2004) in which extremity fracture was associated with greater "worst pain" ratings. Pain management may not always fit the need for pain medication that accompanies the presence of an extremity fracture, at least not immediately. Except for the gender difference that emerged from our study, our results are in line with previous findings (Winston et al., 2003), i.e., that the presence of one or more extremity fractures is considered to be a risk factor for persistent posttraumatic stress. Although previous research has shown that injury severity is not a predictor of PTSD (Brosbe et al., 2011), we found a negative association between injury severity and pain. A possible explanation might be that more severely injured children are likely to receive more adequate pain medication. The negative association was only found in girls.

Research on gender differences in pain suggests a difference between genders in their response to pain. Gender has been reported as a critical factor in the perception of pain; males and females experience pain differently (Paller, Campbell, Edwards, & Dobs, 2009). In that study, increased pain sensitivity and risk for clinical pain were

more common in women. The specific basis for the differences between genders is still unknown, but research suggests that multiple biological and psychosocial processes are involved (Bartley & Fillingim, 2013). Furthermore, differences between genders might be related to a difference in communication and openness about the degree of pain. This is in line with the suggestion in Paller et al. (2009) that boys and girls are reinforced differently for their expression of pain-related experiences. Another possible explanation is that medical staff evaluates the degree of pain differently in boys and girls. Although girls generally have a greater risk for PTSD than boys (Alisic et al., 2014; Stallard et al., 2004; Winston et al., 2003), our results suggest that the risk for PTSD in injured children might be influenced by injury severity, pain and pain management.

In the context of our findings, the subjectivity of reported pain should be addressed. Besides the injury itself, psychological mechanisms, like fear and loss of control, play a role in mediating the pain. Many people report pain for psychological reasons (International Association for the Study of Pain [IASP], 2017). There is no way to distinguish the subjective reporting of pain from pain that is due to tissue damage. According to the IASP, if people regard their experience as pain, it should be accepted as pain. This definition avoids tying pain to the stimulus. This clearly indicates the importance of pain measurement and subsequent pain medication according to the patient's report as stated in pain protocols. In a review of the availability and content of acute pain protocols in emergency departments in the Netherlands, the authors emphasized the importance of adequate acute pain control, not only from the perspective of good patient care, but also due to adverse physical effects and the risk of developing chronic pain (Gaakeer, van Lieshout, & Bierens, 2010). The latter is strongly associated with chronic PTSD (Chossegros et al., 2011). From the responding Dutch emergency departments, 35% did not have a pain management protocol for children (Gaakeer et al., 2010), which heightens the risk of misjudgment and undertreatment. Several studies lend further support to the relationship between pain and later PTSD development by describing how aggressive pharmacological pain management at the time of initial hospitalization can reduce the likelihood of PTSD development (Gold et al., 2008).

In addition to medication, the use of psychological strategies (e.g., distraction) by the medical staff can be of great help in reducing the subjective experience of pain,

whether or not mediated by relief of anxiety. They can be applied dependent on the situation and the child's characteristics and preferences (Koller & Goldman, 2012; Langeland & Olff, 2008). Furthermore, Trauma-Informed Care (TIC) offers a multidisciplinary approach to reduce the risk for persisting posttraumatic stress and PTSD following injury (Marsac et al., 2016; Weiss et al., 2017). TIC is characterized by realizing the effect of trauma, recognizing how trauma can affect those involved, bringing trauma-related knowledge into practice and preventing further negative reactions (Marsac et al., 2016). Implementing TIC can increase medical staff awareness of stressors following injury and can provide them with strategies that can help minimize the adverse effect of these stressors.

Strengths and limitations

Due to the nature of our study and the acute situation after an accident, a retrospective pain rating was used, which increases the chance of unreliable ratings. Some of the children may have reported less reliably on the worst experienced pain, due to a period of unconsciousness or amnesia. Since we only used a single pain scale, we could not perform sensitivity analyses using another instrument. Moreover, pain medication could have had a confounding effect on the outcome but we were unable to account for this possible effect. The administration of pain medication was reported in the medical records, but children reported the worst experienced pain retrospectively. They did not report the exact moment in time that they experienced this pain. Therefore we were unable to relate pain to information on pain medication. Additionally, we did not assess pain over time, although this could have provided more insight into the relationship between pain and the other variables. Furthermore, only the presence or absence of an extremity fracture was specifically registered as part of the STEPP study. We therefore did not include other types of injury classifications as an independent variable in the current study. Baseline acute stress may have contributed to the report of pain at baseline and to posttraumatic stress at 3 months but this was not assessed in our study.

Ideally, we would have examined the relationship between acute pain and a diagnosis of PTSD or significant PTSS. In this case, logistic regression analysis would have been appropriate. We would then have examined differences between the relationships

between these variables for boys and girls using interaction effects. However, the number of children with significant PTSS ($n = 20$) or PTSD (van Meijel et al., 2015) in our sample was too low to perform logistic regression analysis, including a correction for gender and other potentially relevant factors (Peduzzi, Concato, Kemper, Holford, & Feinstein, 1996). Because of skewness of the data (many children without symptoms and few children with low pain scores), a transformation of the data offered no solution. The use of bivariate correlation precludes corrections for multiple factors. However, the use of Spearman's rho correlation coefficients was the best alternative to obtain a reliable answer to the research question, certainly because there is a definite ordering of most of the variables in time. Although correlation coefficients should be interpreted as associations, the succession in time of the variables creates possibilities for additional interpretations. However, only an association, and not causation, can be inferred from cross-sectional data (Sedgwick, 2014). An advantage of the method we used was that pain and severity of posttraumatic stress were reported directly by the children and therefore were not biased by the interpretation of parents or professionals.

Conclusions and clinical implications

This study contributes to the knowledge of factors related to the risk of posttraumatic stress following accidental injury, specifically regarding acute pain. The experience of pain may be subjective, but severe acute pain is associated with the severity of later PTSS. We therefore recommend timely measurement and management of pain according to acute pain protocols in all phases and disciplines after accidental injury. Further research is needed to investigate the role of gender, to clarify the interaction between pain, injury and injury severity, and to examine the usefulness of acute pain in screening tools.

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CHAPTER 4

Long-term posttraumatic stress following accidental injury in children and adolescents: results of a 2–4-year follow-up study

"For 4 years after the accident, everything in our lives was turned upside down, although accidents like this aren't even reported in the newspapers."

A parent

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Maj R. Gigengack
Eva Verlinden
Alida F.W. van der Steeg
J. Carel Goslings
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Slightly adapted for consistency

Abstract

In this study, we determined the long-term prevalence of posttraumatic stress disorder (PTSD) in children and adolescents after accidental injury and gained insight into factors that may be associated with the occurrence of PTSD. In a prospective longitudinal study, we assessed diagnosed PTSD and clinically significant self-reported posttraumatic stress symptoms (PTSS) in 90 children (11–22 years of age, 60% boys), 2–4 years after their accident (mean number of months 32.9, SD 6.6). The outcome was compared to the first assessment 3 months after the accident in 147 children, 8–18 years of age. The prevalence of PTSD was 11.6% at first assessment and 11.4% at follow-up. Children with PTSD or PTSS reported significantly more permanent physical impairment than children without. Children who completed psychotherapy had no symptoms or low levels of symptoms at follow-up. Given the long-term prevalence of PTSD in children following accidents, we recommend systematic monitoring of injured children. The role of possible associated factors in long-term PTSS needs further study.

Introduction

Accidents such as traffic accidents, sports accidents and falls are a major cause of pediatric unintentional injury (Brosbe et al., 2011; Kassam-Adams et al., 2013; van Meijel et al., 2015). Besides physical injuries, children can suffer from posttraumatic stress symptoms following accidents. The majority of the children recover within a few weeks, but if the symptoms persist for more than 1 month and cause significant impairment in one or more areas of functioning, posttraumatic stress disorder (PTSD) can be diagnosed. PTSD is a debilitating psychiatric disorder. If left untreated, PTSD negatively affects children's functioning and physical recovery from injury (Kahana et al., 2006; Kassam-Adams et al., 2013). Evidence-based psychological treatments for PTSD are available and have proven to be effective in children with multiple types of trauma (Cohen et al., 2010; Morina, Koerssen, & Pollet, 2016; Smith et al., 2018). However, it is likely that PTSD in many children and adolescents remains undiagnosed and that not everyone with a PTSD diagnosis receives adequate trauma-focused therapy (Mehta & Ameratunga, 2012; NICE, 2005; Smith et al., 2018). Without treatment, symptoms can be prolonged or worsen significantly over time. Moreover, they are often associated with other severe, long-term effects such as psychosocial problems and learning difficulties (NICE, 2005).

Although the long-term impact of traumatic events can be substantial, research on the long-term psychological consequences of accidental injury is scarce. Regarding long-term prevalence of posttraumatic stress reactions, we found only one recent study that assessed posttraumatic stress reactions following accidents beyond two years (Arnberg, Rydelius, & Lundin, 2011). This study examined seven survivors of a bus crash—all 12 year-old schoolchildren—with multiple injuries. This group still reported posttraumatic stress symptoms, such as sadness, feelings of guilt, intrusions and avoidance, 20 years after the accident. They reported significantly more symptoms than a group of 33 indirectly affected persons. The findings of this study suggest that traumatic accidents are associated with long-term posttraumatic stress reactions, but the limitations of the small sample and lack of representativeness on age preclude further conclusions.

Other studies had a follow-up period of 2 years or less after an accident (Alisic et al., 2014; Brosbe et al., 2011; Gillies et al., 2003; Hiller et al., 2016; Olofsson et al., 2009).

In their meta-analysis, Alisic et al. (2014) found a prevalence of 9.7% PTSD for non-interpersonal trauma, including accidents. In this meta-analysis, PTSD was assessed by clinical interview and the age range was 2–18 years. In a follow-up study of road accident victims (aged 6 to 20 years) that was conducted up to 18 months after the accident, Gillies et al. (2003) found that 19% of the participants had ongoing problems with physical injury. Measured by child self-report, 34% of the children had continuing or delayed onset symptoms of PTSD. In a literature review to determine the prevalence of PTSD among 5–18-year-old children and adolescents injured in traffic, Olofsson et al. (2009) reported a prevalence of 13% at 3–6 months after the accident. PTSD in the included studies was assessed by diagnostic interview and/or self-report. They included only one study with a 2–18-month follow-up of victims of motor vehicle accidents, which reported 14% PTSD. In a meta-analytic study on changes in the prevalence of child posttraumatic stress disorder in the year following trauma, the prevalence decreased from 21% in the acute phase to 11% after 1 year (Hiller et al., 2016). The majority of the studies included in this meta-analytic study focused on accidental injury and non-intentional trauma exposure in children 5–18 years old. Measurement of PTSD was done by self-report with a cut-off value, or by diagnostic interview.

Previous studies suggest that physical impairment, psychosocial consequences, trauma history, new traumatic events and trauma-focused psychotherapy are associated with the occurrence of long-term PTSD (Copeland et al., 2007; Gillies et al., 2003; Janssens et al., 2009; Landolt et al., 2005; Mehta & Ameratunga, 2012; NICE, 2005; Zatzick et al., 2008). Pain after accidental injury contributes to later PTSD or PTSS in children and adolescents (Hildenbrand et al., 2016); in particular, severe acute pain is associated with PTSS 3 months later (van Meijel et al., 2019). The long-term effects of acute pain in accidentally injured children have not been reported as yet.

Although non-injured or mildly injured children can also develop PTSD (Olofsson et al., 2009), serious injury with long-term physical impairment as a consequence may be associated with long-term health and mental health problems. A long-term follow-up study in children 7 years after major trauma revealed that about 40% of the children were physically impaired and half of this group was restricted in daily activities (Janssens et al., 2009). Gillies and colleagues suggested that continuing physical problems may contribute to ongoing psychological distress (Gillies et al., 2003).

Zatzick and colleagues found an association between high levels of recurrent traumatic life events before the injury and PTSD in injured adolescents 12 months after the accident (Zatzick et al., 2008). Additionally, they suggested that traumatized adolescents are at risk for recurrent posttraumatic life events, including reinjury. PTSD and comorbid disorders (e.g., depression) have been shown to have a negative effect on social relationships, which can lead to social withdrawal, break up of significant relationships and problems in the family (Mehta & Ameratunga, 2012; NICE, 2005). In the general population of children, multiple trauma exposure results in posttraumatic stress symptoms after a next potentially traumatic event (Copeland et al., 2007).

Natural recovery of posttraumatic stress symptoms in children can be promoted and facilitated by mechanisms such as post-trauma social support and family cohesiveness (Kazak et al., 2005). These mechanisms can be seen as protective factors and may reduce the risk of persistent PTSS. Furthermore, the resilience of parents appears to play a key role in their children's emotional recovery; children of resilient parents were most likely to be resilient themselves (Le Brocque et al., 2010). Early screening to identify parents and families that are in need of support in the acute stage following a child's accident can expedite the recovery of children (Muscara et al., 2018). As indicated above, evidence-based psychological treatments, including trauma-focused psychotherapy, have proven to be effective for children with significant symptoms or chronic PTSD. The association between the long-term consequences of accidental injury and whether or not children have received adequate trauma-focused psychotherapy is still unknown.

If we could determine the long-term prevalence of PTSD in children following accidents and confirm identifying factors that are associated with the long-term occurrence of PTSD, this would provide valuable insight with regard to treatment efforts and prevention of long-term negative consequences for children injured in accidents.

The aims of the present study were twofold: 1) to measure the prevalence of PTSD in children and adolescents, 2–4 years after accidental injury compared with 3 months after the accident; 2) to gain insight into individual factors that are associated with the occurrence of PTSD at follow-up: permanent physical impairment, acute pain, trauma history and new traumatic events and trauma-focused psychotherapy between the first and follow-up assessment.

Methods

Participants and procedures

For reasons of brevity and readability, we decided to use one term for the participants in this manuscript, instead of specifying various age groups of children, adolescents and young adults. Since parents were also involved in the study to report about their children, we considered it appropriate to use "parents and children".

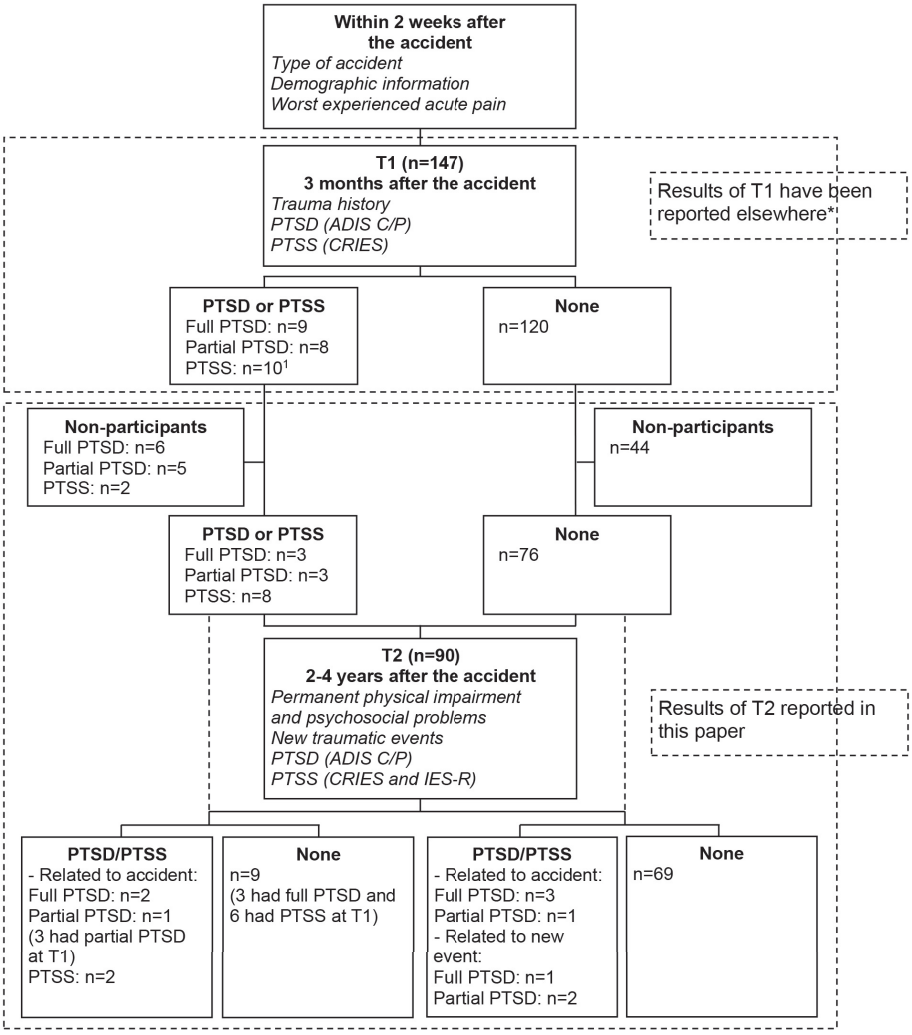
From 2008 to 2010, we conducted a study in which we evaluated the Screening Tool for Early Predictors of PTSD (STEPP; Winston et al., 2003), a screening instrument to determine the risk of PTSD in children who had been injured due to accidental trauma (van Meijel et al., 2015). The STEPP study concluded with the assessment of PTSD 3 months after the accident (T1). The follow-up assessment was not scheduled in the design of the initial study. In 2012, we had the opportunity to conduct a follow-up assessment but we were limited in time. Despite resulting variability due to the range of 2 to 4 years in follow-up, we decided to use this opportunity.

For the current follow-up study, we approached the families (the children and one of their parents) who had participated in the first study and we assessed child PTSD 2 to 4 years after the accident (T2). The families received a letter in which the follow-up study was announced, including an explanation of the purpose of the study. Subsequently, we contacted the families via telephone. They were invited to participate in a telephone interview and to complete one questionnaire sent by email. Consent was given either in writing (by email) or during the initial telephone conversation (in which case this part of the conversation was audiotaped). The current study was approved by the Medical Ethical Committees of both hospitals of the Amsterdam UMC in Amsterdam, the Netherlands, and was performed from October 2012 to March 2013.

Of the 147 participating families in the first study, 90 families (61%) participated in the follow-up study. See Figure 4.1, Flowchart of participation. Of the initial group, 33 families could not be reached (4 telephone numbers were no longer in use and 29 did not answer the call) and 24 declined to participate. Reasons for declining participation were serious medical and/or psychological problems (3 families) and lack of time or no interest (21 families). Of this group of 90 participants, 62 (69%) had been involved in a

traffic accident, 15 (17%) in a sports accident and 13 (14%) in other types of accidents, including falls.

Figure 4.1 Flowchart of study participation, measures and PTSD/PTSS at T1 and T2



* See van Meijel et al. (2015). *PTSD* diagnosed posttraumatic stress disorder, *PTSS* clinically significant self-reported posttraumatic stress symptoms, *ADIS-C/P* Anxiety Disorders Interview Schedule for DSM-IV—Child and Parent Version, *CRIES* Children's Revised Impact of Event Scale, *IES-R* Impact of Event Scale-Revised.

[1] Children with both PTSD and PTSS were included only in the PTSD group.

The mean time between T1 and T2 was 32.9 months (SD = 6.6, range 22 to 49 months); the median was 33 months. In total, 54 boys (60%) and 36 girls (40%) participated at T2. Mean age of the children at T2 was 17.4 years (SD = 2.9, range 11 to 22 years). There were no significant differences between participants and non-participants with regard to age ($U = 2564$, $Z = -0.004$, $p = 0.99$) or sex ($\chi^2 = 0.064$, $p = 0.80$). Follow-up participants reported significantly fewer posttraumatic stress symptoms at T1 than non-participants did ($U = 1809$, $Z = -2.628$, $p < 0.01$).

Measures

Demographic information, type of accident, acute pain and trauma history

Demographic information and information on the type of accident was obtained from the medical records shortly after the accident. Within two weeks after the accident, children reported the worst acute pain since the accident with the Visual Analogue Pain Scale (VAS). The VAS has a good reliability (intraclass correlation = 0.79), good correlation with the Faces Pain Scale-Revised scale ($r = 0.72$) and strong correlation with the Colour Analogue Scale ($r = 0.92$) (Le May et al., 2018). The VAS scores range from 0 to10 and can be classified as *no or mild pain* (0–3), *moderate pain* (4–7), and *severe pain* (8–10). See van Meijel et al. (2018) for full details of pain assessment and the VAS. Trauma history from before the accident was assessed at T1.

Posttraumatic stress disorder

At both T1 and T2, diagnostic interviews were conducted with both the parent and child to determine the severity of PTSD symptoms in the children. In the Netherlands, the Dutch version of the Anxiety Disorders Interview Schedule for DSM-IV—Child and Parent Version (ADIS-C/P) is used to diagnose PTSD in children (Siebelink & Treffers, 2001; Silverman & Albano, 1996). The ADIS-C/P is a commonly used diagnostic, semi-structured interview for the assessment of anxiety disorders—including PTSD—and mood and behavioral disorders in children aged 7–17 years. The ADIS-C/P has a good to excellent test–retest reliability for specific diagnoses ($\kappa = 0.61–1.00$) (Silverman et al., 2001) and inter-rater reliability (Lyneham et al., 2007). Although the ADIS C/P was not designed for young adults 17–22 years old, we used this interview because it is child and parent informed and because it enabled us to compare T1 and T2 results

more effectively. Cronbach's alphas were 0.84 for the child score and 0.77 for the parent score.

Depending on the answer and the clinical interpretation of the interviewer, symptoms can be rated as present or absent. If the number of symptoms endorsed as 'yes' is enough to meet DSM-IV-TR PTSD criteria (APA, 2000), impairment in daily functioning is rated on a 9-point Likert scale (0–8). A diagnosis of PTSD requires an impairment level of 4 or more and depends also on the clinician's judgment of clinical severity. The diagnosis can be based upon either the child report (C) or the parent report (P), or a combination of both reports. Partial PTSD is diagnosed when at least one symptom is present in each of three subscales – re-experiencing, avoidance and hyperarousal – resulting in substantial distress or impairment in one or more areas of functioning (Winston et al., 2003). The PTSD module of the ADIS C/P was administered with regard to the accident. If indicated it was also administered with regard to any new traumatic event that had happened between T1 and T2. In the present study, PTSD refers to diagnosed PTSD, including diagnosed partial PTSD.

Clinically significant self-reported posttraumatic stress (PTSS)

At T1, children completed the Dutch version of the Children's Revised Impact of Event Scale (CRIES; Children and War Foundation, 1998; Olff, 2005; Verlinden et al., 2014). This self-report measure gives a good indication of the presence of PTSD. It consists of 13 questions in the subscales re-experiencing, avoidance and hyperarousal, with answers on a 4-point scale. Items are rated according to the frequency of their occurrence during the past week (not at all=0, rarely=1, sometimes=3 and often=5; range 0–65). We asked the children to focus on their accident when answering the questions. The cut-off score for a positive test is 30 (Verlinden et al., 2014). The outcome correlates highly with the PTSD diagnosis according to the Anxiety Disorders Interview Schedule for DSM-IV, Child and Parent Version (ADIS C/P) (Verlinden et al., 2014). The CRIES has excellent test–retest reliability ($\kappa = 0.85$) and good reliability (Cronbach's alpha = 0.89) (Verlinden et al., 2014). For the current sample Cronbach's alpha = 0.91.

At T2, we used two self-report measures: one for children under 18 and one for children 18 years and older. The children under 18 completed the CRIES (see T1 above) and children 18 years and older completed the Dutch version of the Impact of Event Scale-Revised (IES-R; Horowitz et al., 1979; Weiss, 2007). The IES-R consists of 22

questions and contains the subscales re-experiencing, avoidance and hyperarousal. Scoring is on a 5-point Likert scale. Items are rated according to the frequency of their occurrence during the past week (not at all=0, a little bit=1, moderately=2, quite a bit=3, extremely=4; range 0–88). The focus is on the child's accident. A total score of 23 or above indicates the likely presence of PTSD (Mouthaan et al., 2014). The Dutch IES-R showed adequate similarity with the total score of the Clinician-administered PTSD scale (CAPS; $r = 0.75$; $p < 0.001$) (Hovens et al., 1994; Mouthaan et al., 2014; Weathers et al., 2001) and good reliability for the current sample; Cronbach's alpha = 0.93. In the present study PTSS (posttraumatic stress symptoms at a clinically significant level) refers to self-reported posttraumatic stress symptoms at a score of 30 or above (CRIES) or 23 or above (IES-R).

Health and mental health and new traumatic events

The follow-up interviews were composed by EM, MRG and RL and are available on request from the first author. Parents and children were interviewed separately by telephone. Parents were interviewed about their child. The interview started with the following open-ended questions: "How are things going? What has happened since we last met?" The purpose of this initial part of the interview was to become informed about the interviewee's perception of the course of posttraumatic stress reactions over time and about any other relevant health and mental-health related information. We explicitly asked whether the child still experienced physical impairment and/or psychosocial consequences as a result of the accident. In our study, permanent physical impairment was defined as loss or abnormality of parts of the body, resulting in restrictions or inability to perform activities that were considered normal before the accident and are normal for children of that age. Examples of permanent physical impairment are chronic or frequent pain, walking with a limp and chronic fatigue. Besides physical impairment, details of psychosocial consequences of the accident (such as delay in school career, change of future plans, limitations in social life) were also assessed. A specific question was included regarding any new traumatic or life events: 'Since the accident, have other stressful things happened to you?' If necessary, we asked supplementary questions to assess whether an event was traumatic according to DSM-IV-TR criteria (APA, 2000). If a child experienced one or more new traumatic events, we asked the child if help in any form was needed. If applicable, the choices regarding trauma-focused psychotherapy between T1 and T2 and its outcome were discussed.

PTSD

The second part of the interview consisted of the PTSD module of the ADIS-C/P (see the previous subsection "Posttraumatic stress disorder").

Figure 4.1 provides an overview of measures used at the different time points.

Statistical analysis

Answers to questions on permanent physical impairment, psychosocial consequences and new traumatic events were classified by the first author and confirmed by the second author. Differences were discussed until consensus was reached. According to the definitions (see "Measures, health and mental health…"), answers were coded dichotomously: present 'yes' or 'no'. Thereafter we quantified the answers. The frequencies were used to compare the groups with and without PTSD or PTSS. Information on trauma-focused treatment between T1 and T2 was described in relation with PTSD or PTSS outcome at T2.

Differences between follow-up participants and non-participants were analyzed with Mann–Whitney *U* tests for age and posttraumatic stress at the time of the first assessment, and a Fisher's exact test for sex. The statistical significance of differences between children with and without PTSD was determined with Mann–Whitney *U* tests for the mean acute pain scores and the number of traumatic events until follow-up and with Fisher's exact test for the other items: the number of children (1) with trauma history before the accident (2) that experienced a new traumatic event between T1 and T2 (3) that reported severe acute pain and (4) with permanent physical impairment. Statistical significance was set at an alpha level of 0.05. Confidence intervals were calculated with Confidence Interval Analysis (Bryant, 2018). Other statistical analyses were performed using SPSS 24 (IBM Statistical Product and Service Solutions, Chicago, IL).

Results

Participants

In total, we included 90 children in this follow-up study. We interviewed 75 parents and 80 children at T2, resulting in interview-based-data for 88 children. Of this latter group, 75 children completed the questionnaire and 73 also participated in the interview. The remaining two children completed the questionnaire but did not participate in the interview. In total, data on 90 children were available.

The prevalence of PTSD and PTSS at T1 and T2

At T1, 3 months after the accident, PTSD was diagnosed with the ADIS interview in 17 of 147 children (11.6%; 95% confidence interval (CI) 7.3–17.7%). The scores of 23 of 144 children (16%; 95% CI 10.9–22.8%) were above the cut-off score of the self-report measure CRIES. Of these children, 13 also received a PTSD diagnosis and 10 did not. At T2, the follow-up assessment, 10 of 88 children (11.4%; 95% CI 6.3–19.7%) were diagnosed with PTSD. On the self-report measures, the scores of eight of 75 children (10.7%; 95% CI 5.5–19.7%) were above the cut-off score, indicating the presence of PTSD. Of these children, six also received a PTSD diagnosis and two did not. At T2, in seven children, PTSD was related to the accident, and in three children it was related to a new event (sexual abuse, traumatic family circumstances and interpersonal violence, respectively). Moreover, two of these three children still suffered from substantial posttraumatic stress symptoms due to the accident. Figure 4.1 illustrates the course of participation of children with and without PTSD or PTSS from T1 up to and including T2.

Factors associated with the occurrence of PTSD or PTSS at follow-up

Permanent physical impairment

At T2, children reported several types of permanent physical impairment as a consequence of the accident, such as chronic or frequent pain, disability of the back, a leg or a knee, walking with a limp, infertility, partial deafness, chronic fatigue, dysfunctioning of an eye and numbness of an arm, hand or fingers. In total, 27 of 88 children (31%; 95% CI 22–41%) reported permanent physical impairment; two of these

children reported planned surgery due to ongoing physical problems. Of this group of 27 children, 9 had PTSD or self-reported PTSS and 18 did not.

Moreover, as a result of the accident and/or the permanent physical impairment, 23 of these 27 children were confronted with one or more major, primarily psychosocial, consequences. These included concentration problems due to headaches, delay in finishing a study program or dropping out, changing to lower level or type of education, serious limitations in participating in sports, inability to tolerate commotion or noise, inability to multitask, limitations in work or social life, no longer feeling at ease with peers, loss of friends and loneliness. Three children specifically mentioned a change of future plans due to physical limitations and chronic pain. These children had planned to become a professional athlete, a sports teacher and a plumber, respectively.

In the group with PTSD or PTSS at T2, a significantly higher percentage of children reported permanent physical impairment including psychosocial consequences, than the group without PTSD or PTSS. See Table 4.1 for more details and *p* values.

Acute pain

Acute pain scores of 84 children were available. In total, seven children reported no or mild pain, 40 children reported moderate pain, and 37 children reported severe pain. We found no significant difference between the groups with and without PTSD or PTSS at T2 regarding acute pain. See Table 4.1 for more details and *p* values.

Trauma history and new traumatic events between T1 and T2

The mean number of traumatic events children experienced from before the accident until T2 was 3.6 in children with PTSD or PTSS and 2.6 in children without. Between T1 and T2, 16 children experienced one new traumatic event, and one child experienced two new traumatic events. The following traumatic events were reported: life-threatening intoxication, fire, sexual abuse, life-threatening illness of parent, severe (chronic) illness (3x), traffic accident (3x), life-threatening bleeding after surgery, interpersonal violence (2x), unknown (does not want to say), severe bullying over a long period of time, several suicide attempts of a friend, traumatic family circumstances and witnessing a severe traffic accident. There was no difference between the groups with and without PTSD or PTSS at T2 regarding trauma history

before the accident or experiencing a new traumatic event between T1 and T2. More details and *p* values are provided in Table 4.1.

Table 4.1 Differences between children with and without PTSD or PTSS at T2

	Children with PTSD or PTSS	Children without PTSD or PTSS	Difference *p* value
N[a]	12	78	
Sex—male	7 (58%)	47 (60%)	0.90[b]
Number of children with trauma history before the accident	10 (83%)	47 (60%)	0.32[b]
Number of children with new traumatic event between T1 and T2	4 (33%)	13 (17%)	0.24[b]
Mean number of traumatic events until T2 (SD, min–max)	3.6 (2.3, 1–10)	2.6 (1.8, 1–8)	0.06[c]
Mean acute pain score (SD, min–max)	8.0 (1.7, 5–10)	6.7 (2.5, 0.7–10)	0.12[c]
Number of children with severe acute pain	6[d] (60%)	31[e] (42%)	0.32[b]
Number of children with permanent physical impairment	9 (75%)	18[f] (24%)	0.001*[b]

T2 at follow-up, *PTSD* diagnosed posttraumatic stress disorder, *PTSS* clinically significant self-reported posttraumatic stress symptoms, *SD* standard deviation

* Statistically significant difference between groups

[a] Children with both PTSD and PTSS were included only in the PTSD group

[b] Mann–Whitney *U* test was used

[c] Fisher's Exact test was used

[d] Pain ratings for two children were missing

[e] Pain ratings for four children were missing

[f] Information for two children was missing

Psychological treatment and recovery in follow-up participants

All three children who were diagnosed with full PTSD at T1 completed psychological trauma-focused therapy. One child received Eye Movement Desensitization and Reprocessing (EMDR); two others received Trauma-Focused Cognitive Behavioral Therapy (TF-CBT). At T2, they were fully recovered and reported no symptoms or low levels of symptoms. There was no indication from the interview that there were any other mental health problems. The three children who were diagnosed with partial PTSD at T1 were also advised to take trauma-focused therapy after the diagnosis was made. Two of the three children started therapy (one child EMDR, the other TF-CBT) but did not complete it; the third did not want to participate in psychological therapy.

These three children still reported high levels of symptoms and were still diagnosed with PTSD at T2. In two of the children the partial PTSD developed into full PTSD between T1 and T2.

None of the eight children with self-reported PTSS at T1 received trauma-focused therapy; six children recovered spontaneously and two children still met criteria for self-reported PTSS at T2. Children who no longer fulfilled self-reported PTSS criteria at T2 retrospectively attributed the high score at T1 to stressful circumstances other than the accident.

Discussion

The prevalence of PTSD at first assessment and at long-term follow-up was 11.6% and 11.4%, respectively. Our findings are consistent with those of Hiller et al. (2016). In their meta-analytic study they reported a prevalence of 11% at 1 year after non-intentional trauma exposure. Compared to children without PTSD or PTSS, children with PTSD or PTSS reported significantly more permanent physical impairment. Our findings indicate that there may be an association between permanent physical impairment and long-term PTSD or PTSS but an association between the other individual factors and PTSD or PTSS is not indicated.

Although some of the children in our study recovered from PTSD following a successful trauma-focused therapy, in other children symptoms developed later on, continued at the initial level, or worsened from partial to full PTSD. Some children developed PTSD following new traumatic events, while still suffering from posttraumatic stress symptoms associated with the accident. The prevalence of PTSD at follow-up demonstrates the importance of being aware of the long-term consequences of accidents. It also indicates that long-term monitoring of children following accidents is appropriate, in line with the "best practice" following acute trauma, as proposed by the NICE (2005). The NICE guideline recommends "watchful waiting" including screening to identify those at risk who will benefit from further monitoring and timely therapeutic intervention (NICE, 2005). These recommendations could be applied in practice by implementing Trauma-Informed Care (TIC), a multidisciplinary approach to reduce the risk for persisting posttraumatic stress and PTSD after injury (Marsac et

al., 2016; Weiss et al., 2017). TIC uses trauma-related knowledge in medical practice, and can facilitate the implementation of a hospital monitoring system after injury, including timely interventions if needed. Our findings regarding self-reported PTSS and spontaneous recovery are in line with those of (Verlinden et al., 2014), who showed that self-report measures are a good indication for PTSD, but cannot replace clinical interviews that yield a diagnosis based on more detailed information, severity of symptoms and level of impairment in functioning.

With regard to permanent physical impairment, our results indicate a comparable outcome to the study of (Zatzick et al., 2008), in which long-term physical impairment was associated with the occurrence of PTSD at 12 months follow-up. Furthermore, the outcome confirms the suggestion that continuing physical problems can contribute to ongoing psychological distress (Gillies et al., 2003).

With regard to acute pain, in our previous research (van Meijel et al., 2019) we found that severe acute pain was associated with the severity of posttraumatic stress 3 months later. These findings were not confirmed in our long-term results. A possible explanation is the use of dichotomous outcomes in the current study, instead of the continuously measured severity of symptoms in the previous study. The latter may be a more sensitive measure. Future research in larger samples may show whether acute pain is associated with longer-term PTSD or whether the long-term outcome is associated with different factors or a combination of factors.

The role of experiencing a new traumatic event is not clear. Delahanty and Nugent (2006) suggested that prior trauma history can increase vulnerability for PTSD in children and adults after experiencing a new traumatic event. In our study, children in the group with PTSD or PTSS reported more traumatic events in the past than those in the group without, and the percentage of children that experienced a new traumatic event was substantially higher in the affected group. However, the difference between the groups was not statistically significant.

For the three children in our sample who completed trauma-focused therapy, the therapy had a positive impact in the long term, although other factors may also have facilitated the reduction of PTSD symptoms. The group was too small to draw conclusions about an association between completing trauma-focused psychotherapy

and long-term PTSD or PTSS. A recent systematic review and meta-analysis on trauma-focused psychotherapy emphasized the effectiveness of both Cognitive Behavior Therapy and EMDR in reducing posttraumatic stress symptoms (Khan et al., 2018), which is all the more reason to promote evidence-based trauma-focused psychotherapy.

Some children (or their parents on their behalf) do not seek treatment, even if they are advised to do so. Likewise, dropping out of therapy is a well-known problem (Stallard, 2006). Possible barriers to seeking or accepting mental health treatment are low perceived need and a desire to handle the problems on one's own (Andrade et al., 2014). Perceived stigma, time commitment or costs may also play a role in some families (Smith et al., 2018). Possible reasons for drop-out are perceived ineffectiveness of treatment and negative experiences with treatment providers (Andrade et al., 2014). With regard to injured children, the NICE guideline suggests that injured children who are still undergoing medical treatment, or who have to cope with permanent physical disability, probably judge these problems as more important than the need for treatment for psychological problems (NICE, 2005). Moreover, since avoidance is one of the symptoms of PTSD, it is likely that seeking and completing treatment will have to be promoted actively. Healthcare professionals can actively follow up children with PTSD who miss scheduled appointments (NICE, 2005). Furthermore, we will have to find effective ways to emphasize the importance of treatment, perhaps by exploring the use of peers and social media.

Strengths and limitations

A few limitations in this study need to be considered. First, since the follow-up assessment was not scheduled in the design of the initial study, the time between the first and the follow-up assessment ranged from 2 to 4 years. Therefore, although we conducted a long-term follow-up study, the findings may not be generalizable to other samples due to the resulting variability in children's development and possible transitions in life. Second, follow-up participants reported fewer posttraumatic stress symptoms at T1 than non-participants did. If the loss to follow-up in the group with more symptoms would have been lower, it is likely that the prevalence of PTSD could have been higher. Third, in an ideal situation, we would have used logistic regression

analysis to examine the association between multiple variables and PTSD and PTSS, and we would have accounted for the variance in the time between T1 and T2, which ranged between 2 and 4 years. However, the number of children with PTSD or PTSS in our sample was too low to perform this analysis (Peduzzi et al., 1996). Fourth, due to the range in ages of children, we used two different PTSS self-report measures, CRIES and IES-R. However, algorithms to transform raw scores into standardized scores are not available. Hence, we could not combine continuous data from these instruments and perform multivariate linear regression. Fifth, due to the acute situation after an accident, a retrospective pain rating was used. This increases the chance of unreliable pain ratings (Lewandowski, Palermo, Kirchner, & Drotar, 2009; van Meijel et al., 2019). Sixth, since the T1 information was available to the interviewers, they were not blinded to diagnoses and scores. To account for the possible implications of this aspect of the study, the interpretation of the results was performed in cooperation with an independent clinical statistician.

The most important strength of this study is the much longer-term follow-up than in prior studies and the possibility to compare the results with short-term findings. Second, in addition to psychological aspects, we included acute pain and physical condition in our study. Third, we used parent and child-informed interviews as well as validated child questionnaires, thus increasing completeness and reliability of the information. Finally, although the sample size is relatively small, a 61% response for a long-term follow-up study is good. The results of our study can, therefore, make a valuable contribution to the overall knowledge of long-term consequences of accidental injury.

Conclusions and clinical implications

Our findings show that the long-term prevalence of PTSD in children and adolescents following accidents is comparable to the short-term prevalence. Over the long term, PTSD was related to a new traumatic event or to the initial accident. In our study, a small number of children completed trauma-focused psychotherapy after the accident. At follow-up they were still free of posttraumatic stress symptoms, in contrast to those who did not complete psychotherapy. A substantial number of the participating children reported permanent physical impairment, ongoing

physical problems and negative consequences on their education, social life and future plans. Our results revealed a substantial difference between children with and without PTSD regarding permanent physical impairment, indicating an association between the presence of PTSD and permanent physical impairment. Adolescence in combination with permanent impairment may have an influence on later PTSD as this can be a sensitive period in which this age group is modeling future plans. The consequence may be that adolescents are more at risk for long-term negative psychological outcome when permanent physical impairment negatively influences their future plans. Further research, preferably in a larger sample, is needed to test this hypothesis and other possible explanations regarding an association between permanent physical impairment and PTSD.

Our results have implications for clinical practice. To prevent long-term negative consequences of accidents, we recommend systematic monitoring—including screening—of injured children and their parents. The introduction of trauma-informed care can facilitate this process. Children with permanent physical impairment or ongoing physical problems may need special attention. For those who need it, we recommend active promotion of timely and appropriate evidence-based trauma-focused psychotherapy. Healthcare professionals should be aware of the importance of children completing their trauma-focused psychotherapy and should find ways to prevent drop-out.

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CHAPTER 5

Short and long-term parental posttraumatic stress after a child's accident: prevalence and associated factors

"The horror of that moment, the realization that my child could be dead, came back thousands of times a day after the accident. I was almost literally stuck in that moment."

A mother who witnessed her child's accident

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Abstract

Studies on the long-term prevalence of parental posttraumatic stress symptoms (PTSS) following child accidental injury are scarce, and findings on risk factors vary. In this follow-up study (T2, n=69) we determined the prevalence of parental PTSS 2–4 years after accidental injury of their child, compared with 3 months after the accident (T1, n=135). Additionally, we examined the association between parental and child factors and PTSS severity. Children were 8-18 years old at the time of the accident. Parent and child PTSS was assessed by self-report. Other data were retrieved from medical records and a telephone interview. Parental PTSS was 9.6% at T1 and 5.8% at T2. Acute parental stress as measured within two weeks of the child's accident was significantly associated with parental PTSS severity (T1 and T2), as was the child's hospitalization of more than 1 day at T1 and the child's permanent physical impairment at T2. To prevent adverse long-term psychological consequences we recommend identifying and monitoring parents at risk and offering them timely treatment.

Introduction

Accidental injury in children also affects the parents and puts them at risk for developing substantial posttraumatic stress symptoms (PTSS) (Kassam-Adams et al., 2009; Le Brocque et al., 2010). The prevalence of PTSS in parents 3-6 months after their child's accidental trauma is 10%–15%. In a preceding study, self-reported PTSS was measured in 135 parents, 3 months after their child's accidental injury. Symptoms at a clinically significant level were reported by nearly 10% of the parents (van Meijel et al., 2015). Kassam-Adams and colleagues assessed self-reported PTSD in 251 parents of children with traffic-related injuries (Kassam-Adams et al., 2009). They found partial or full posttraumatic stress disorder (PTSD) in 15% of the parents approximately 6 months post-injury. A systematic review on pediatric medical traumatic stress (PMTS) reported a prevalence of parental PMTS ranging from 0% to 18% at ten months or more post-injury (Price et al., 2016). PMTS was defined as 'a set of psychological and physiological responses of children and their families to pain, injury, serious illness, medical procedures, and invasive or frightening treatment experiences', often including posttraumatic stress reactions (Price et al., 2016). While data are supportive for long-term PTSS and related impairment in parents (Kazak et al., 2006), there is a lack of long-term follow-up studies. We only found one study with a 1 and 11 years follow-up period (Bakker et al., 2010) in 48 mothers of children with burns. PTSS was assessed by self-report. At 1 year and 11 years after their child's burn event, 17% of the mothers reported clinically significant symptoms.

In general, parents' well-being has an effect on the child's functioning (Alisic et al., 2011). PTSS in parents, short and long-term, affects children in various ways. It is longitudinally related to poorer recovery of PTSS in the child (Landolt et al., 2012). Parental PTSS increases the risk of child PTSD (Kolaitis et al., 2011) and parents' early symptoms are a risk factor for persistent posttraumatic stress in injured children (Kassam-Adams et al., 2013). A meta-analysis reported significant effect sizes for the relationship between parent and child PTSS, suggesting that parental PTSS, especially maternal, may be a risk factor for child PTSS (Morris et al., 2012). Authors of the Integrative Trajectory Model of Pediatric Medical Traumatic Stress (Price et al., 2016) also stressed the role of parents following their child's injury. The Integrative Trajectory Model of Pediatric Medical Stress provides a conceptual framework for traumatic stress responses across pediatric injuries and illnesses (Kazak et al., 2006; Price et al.,

2016). The model is based on six assumptions. One of these is specifically relevant for understanding the role of parents: 'a social ecological or contextual approach is optimal for intervention'. Their findings with that model suggest that parental PTSS increases risk for and maintenance of child PTSS. Parental PTSS not only affects the daily functioning of the parents themselves, but can also impact parenting practices and readiness to meet the demands of medical care for children (Price et al., 2016). The results of a qualitative study in parents following injury (Alisic, Boeije, Jongmans, & Kleber, 2012) suggest that a responsive parenting style supports child recovery. Parents report that their own distress interferes with the use of this parenting style (Alisic et al., 2012; Price et al., 2016).

Given the probable adverse consequences for the parents as well as the children, it is important to identify parents at risk for high levels of posttraumatic stress as soon as possible after their child's accident. Screening instruments such as the Screening Tool for Early Predictors of PTSD (STEPP) are suitable for this purpose (van Meijel et al., 2015; Winston et al., 2003). However, if the setting does not allow for the use of a screening instrument or if no screening method is available, other methods to identify parents at risk can be advisable. Therefore, insight into factors possibly associated with parental PTSS is necessary. Risk factors for adult PTSS or PTSD after their own trauma are well studied, but less is known about factors associated with parental posttraumatic stress reactions following child accidental trauma or injury (Hiller et al., 2016). Furthermore, studies on risk factors for parental PTSD usually involve mixed populations of ill and injured children, and risk factors across these groups appear to vary (Price et al., 2016). Factors associated with parental posttraumatic stress can be parent-related or child-related. Prior trauma history is a consistent predictor of PTSD in adults following a subsequent trauma (Delahanty & Nugent, 2006) and is a predictor of PTSD severity in parents of children with traffic-related injuries (Kassam-Adams et al., 2009). Acute stress responses in parents of children treated in the pediatric intensive care unit were found to be related to parental PTSD (Bronner et al., 2010), and peritraumatic distress was found to be a predictor of PTSD in mothers of victims of motor vehicle accidents (Allenou et al., 2010). Witnessing the event was associated with parental PTSD (de Vries et al., 1999), but parents can be at risk for PTSD even if they are not directly involved in their child's accident (Kassam-Adams et al., 2013). The number of initial days in hospital significantly predicted PTSS (short and long-term) in parents of a mixed population of accidentally injured children and children with diabetes and

cancer (Landolt et al., 2012). However, Bronner and colleagues found no predictive value for the length of hospital stay in parents of children that received unexpected intensive care treatment (Bronner et al., 2010). To date, severe pain in children and permanent physical impairment of injured children have not been studied in relation to parental PTSS. Obviously, parents also experience stress watching their child having severe pain. Furthermore, permanent physical impairment of children is likely to have impact on the parents, possibly comparable to the impact of extensive permanent scarring on parents of children with burns (Bakker et al., 2010).

Regarding prevention of chronic posttraumatic stress, trauma-focused psychotherapy has been shown to be effective and is highly recommended by the NICE (2005). However, de Vries and colleagues stated that only 20% of the parents with PTSS seek help for themselves (de Vries et al., 1999). Given the adverse effect of parental PTSS and the positive effect of trauma-focused psychotherapy, it would be useful to know more about the choices of parents regarding psychotherapy. This information could be of help in providing support, psycho-education or interventions to parents following their child's accidental injury and could potentially clarify the relationship of psychotherapy with long-term posttraumatic stress.

The overarching aim of this study was to contribute to the knowledge of short and long-term parental posttraumatic stress following child accidental injury. In our study we therefore aimed to: 1) determine the long-term prevalence of PTSS in parents, 2–4 years after accidental injury of their child, compared with 3 months after the accident; 2) describe the association between parent prior trauma history, acute parental stress, witnessing the child's accident, new traumatic events, child's hospitalization, child's severe pain and permanent physical impairment, and the severity of parental PTSS; 3) survey the choices of parents regarding trauma-focused psychotherapy.

Methods

Procedure

From 2008 to 2010, we conducted a study in which we evaluated the Screening Tool for Early Predictors of PTSD (STEPP), a screening instrument to determine the risk of PTSD in children aged 8-18 who had been injured due to accidental trauma and in

their parents (van Meijel et al., 2015). This study was concluded with the assessment of posttraumatic stress in the children and in one of each child's parents 3 months after the child's accident (T1). The design of that study did not include a follow-up assessment. However, in 2012-2013, we had the opportunity to conduct a follow-up assessment in a limited period of time. Despite resulting variability due to the range of 2 to 4 years in follow-up, we decided to perform this follow-up study. We contacted the families (the children and one of their parents) who had participated in the first study and we assessed PTSS in children and parents at 2 to 4 years after the accident (T2). The families first received a letter in which the follow-up study was announced and its purpose was explained. Subsequently, we contacted the families by telephone and invited them to participate in a telephone interview and to complete a questionnaire sent by email. Consent was given either in writing (by email) or during the initial telephone conversation (in which case this part of the conversation was audiotaped). The results of the child follow-up assessments are reported elsewhere (van Meijel et al., 2019). Both studies were approved by the Medical Ethical Committees of the Academic Medical Center and VU University medical center, Amsterdam, the Netherlands.

Participants

To answer the research questions in the present study, we used the data from both the STEPP study and the follow-up study as mentioned above. We excluded cases for which only child data, but no parental data, were available. From the STEPP study, data of 135 parents and children were available: 103 mothers (76.3%), 32 fathers (23.7%), 58 girls (43%) and 77 boys (57%). Of the 135 families participating in the STEPP study, 69 families (51.1%) participated in the follow-up study. Of the initial group, 29 families could not be reached (2 telephone numbers were no longer in use and 27 did not answer our calls) and 37 declined to participate. Reasons for declining participation were serious medical and/or psychological problems of the child (2 families) and lack of time or no interest (35 families).

Measures

Factors associated with parental PTSS

The multiple points of data collection are summarized in Figure 5.1. Within two weeks after the accident the parents were asked the following closed questions (yes/no) on trauma history and acute stress: 'Before the accident, did you ever experience anything frightening or horrible yourself?' (Trauma history); 'Have you felt very stressed or irritable since your child was injured or since your child has been in the hospital?' (Acute stress); 'If you now think about your injured child, do you perspire, shake or does your heart beat faster?' (Acute stress). These questions were used in cooperation with the authors of the STEPP (Winston et al., 2003). From the STEPP assessment we used the question: 'Did you see the accident in which your child got hurt?' Within two weeks after the accident we also asked children to rate the worst pain since the accident (van Meijel et al., 2019). For this purpose, we used the Visual Analogue Scale (VAS), a small ruler with a 10-centimeter line, marked with "no pain" on the left, and "the worst possible pain" on the right. The children used a sliding gauge to mark the location corresponding to the amount of pain they had experienced. The reverse side of the instrument shows the corresponding values from 0 to 100 mm. This instrument was used according to internal hospital guidelines (Baas & Kramer, 2008). Scores can be rounded to the nearest integer and categorized as *no or mild pain* (0-3), *moderate pain* (4-7) and *severe pain* (8-10). We used the category *children with severe pain* to examine the association with severity of posttraumatic stress of parents. Data on child hospitalization were derived from the medical records and checked with the parents at the 3-month assessment (T1). We divided the variable "length of hospitalization" into two categories: hospitalization 1 day or less and hospitalization more than 1 day.

The follow-up interviews (T2) started with the following open-ended questions, first regarding the child, and then regarding the parent him or herself: 'How are things going?' and 'What has happened since we last met?' With this initial part of the interview we aimed to become informed about the parents' perception of the course of posttraumatic stress over time and about any other relevant health or mental health related information. Details on long-term consequences of the injury, specifically permanent physical impairment of children, were obtained from children and/or parents in this part of the follow-up assessment. In our study, permanent physical impairment was defined as loss or abnormality of parts of the body, resulting in

restrictions or lack of ability to perform activities that were considered normal before the accident and are normal for children of that age. According to this definition, answers were coded dichotomously: the presence of permanent physical impairment 'yes' or 'no'. Examples of permanent physical impairment are chronic or frequent pain, walking with a limp, partial deafness and chronic fatigue. Furthermore, a specific question was included regarding new traumatic events: 'Since the accident, did other stressful things happen to you?' DSM-IV-TR criteria for a traumatic event (APA, 2000) were decisive for a positive or negative score on this item. Non-traumatic events were classified as life events. If the parent reported one or more new traumatic events, we asked how the parent felt about the consequences of the event and, if applicable, if help in any form was needed. Parents that reported PTSS at T1 or between T1 and T2, and parents that reported new traumatic or life events between T1 and T2, were asked if they had had any form of psychotherapy and if yes, we asked for more details about the therapy and the result of it.

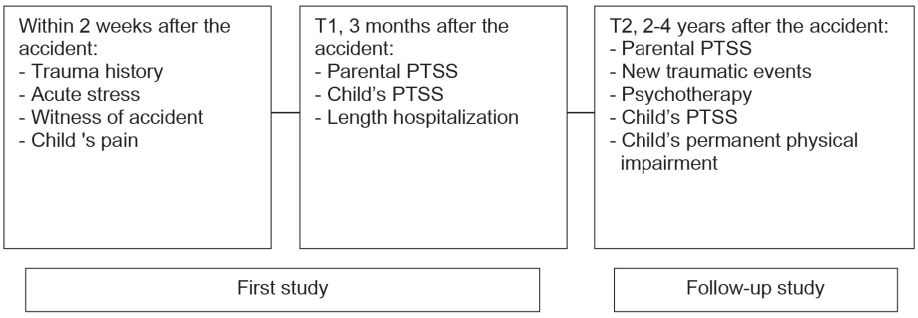
Parental posttraumatic stress symptoms (PTSS)

The parents completed a self-report instrument, the Dutch version of the Impact of Event Scale-Revised (IES-R; Horowitz et al., 1979; Weiss, 2007). The IES-R consists of 22 questions and contains the subscales re-experiencing, avoidance and hyperarousal (APA, 2000). An example of an item is: "I found myself acting or feeling like I was back at that time." Scoring is on a 5-point scale. Items are rated according to the frequency of their occurrence during the past week (Not at all=0, A little bit=1, Moderately=2, Quite a bit=3, Extremely=4; range 0-88). The focus is on the child's accident. A total score of 23 or above indicates the likely presence of PTSD according to DSM-IV-TR criteria (APA, 2000; Mouthaan et al., 2014); in our study this was reported as PTSS, clinically significant posttraumatic stress. We used the total IES-R score to compare means between parents with and without PTSS and to test for associations with parental PTSS severity. A higher score indicates higher severity (Mouthaan et al., 2014). The Dutch IES-R showed adequate similarity with the total score of the Clinician-administered PTSD scale (CAPS; $r = 0.75$, $p < .001$) (Hovens et al., 1994; Mouthaan et al., 2014; Weathers et al., 2001). The internal consistency reliability (Cronbach's alpha) of the current sample was 0.93.

Children's posttraumatic stress

At T1, the children completed the Dutch version of the Child Revised Impact of Event Scale (CRIES; Children and War Foundation, 1998; Olff, 2005; Verlinden et al., 2014). This self-report measure is based on the definition of PTSD according to DSM-IV-TR criteria and gives a good indication of the presence of PTSD (APA, 2000; Verlinden et al., 2014). It consists of 13 questions in the subscales re-experiencing, avoidance and hyperarousal, with answers on a 4-point scale. An example of an item is: "Do you have waves of strong feelings about it?" We asked the children to focus on their accident when answering the questions. Items are rated according to the frequency of their occurrence during the past week (*Not at all*=0, *Rarely*=1, *Sometimes*=3 and *Often*=5). The Dutch CRIES is an effective and valid tool for screening of PTSD and shows moderate to good reliability: Cronbach's alpha for the total score is 0.89 and for the subscales of re-experiencing, avoidance and hyperarousal 0.82, 0.77 and 0.74, respectively (Verlinden et al., 2014). The total score can range from 0 to 65. The cut-off score for a positive test is 30. The outcome correlates highly with the PTSD diagnosis according to the Anxiety Disorders Interview Schedule for DSM-IV, Child and Parent Version (ADIS C/P) (Verlinden et al., 2014). For the current sample Cronbach's alpha was 0.87 (van Meijel et al., 2015). In the current study we used a dichotomous variable: yes or no PTSS. PTSS is considered if symptoms are at a clinically significant level (a score of 30 or more) (Verlinden et al., 2014). At T2, we used two self-report measures: the CRIES for children under 18 and the IES-R (see 'Parental posttraumatic stress symptoms' above) for children 18 years and older.

Figure 5.1 Summary of data collection



Data analysis

We described parental and child characteristics using counts, percentages, means and standard deviations. Differences between follow-up participants and non-participants were analyzed with Mann-Whitney U tests for the continuous variable posttraumatic stress at the time of the first assessment, and a Fisher's exact test for the categorical variable sex. In these tests, an alpha level of .05 was considered statistically significant.

We described the association between the level of parental PTSS and the level of child PTSS using Spearman's correlation coefficient. We used univariable linear regression analysis to describe associations between the independent variables prior trauma history, acute parental stress, witnessing the accident, hospitalization of more than 1 day and severe pain, and the dependent variable parental PTSS severity as measured with the IES-R. We also added the independent variable permanent physical impairment of the child to the analyses of T2. We performed multivariable linear regression analysis using the independent variables with $p < .10$ in the univariable analysis. We then performed a backwards selection procedure until all independent variables had $p < .05$. Due to the skewed distribution of the PTSS data, we performed the linear regression analysis on log10 transformed data. To avoid taking the log10 of values of zero, we added one point to each parent's score on the IES-R before performing the log10 transformation. To aid interpretation of the results, we back transformed the regression parameter estimates and corresponding upper and lower limits of confidence intervals. All analyses were performed using SPSS 24 (IBM Statistical Product and Service Solutions, Chicago, Ill).

Results

Participants

In the follow-up study we included 69 families, 58 mothers (84.1%), 11 fathers (15.9%), 28 girls (40.6%) and 41 boys (59.4%). The children had been exposed to various types of accidents: 43 (62.3%) had been involved in a traffic accident, 14 (20.3%) in a sports accident and 12 (17.4%) in other types of accidents, including falls.

There was no significant difference between follow-up participants and non-participants with regard to posttraumatic stress 3 months after the accident ($U = 2082$,

Z = -.864, $p = 0.39$). There was a significant difference with regard to sex: fewer fathers than mothers completed follow-up ($\chi^2 = 0.03$, $p = 0.04$).

Parental PTSS at T1 and T2

At T1, 122 parents reported no PTSS (90.4%; 92 mothers and 30 fathers) and 13 parents (9.6%; 11 mothers and 2 fathers) reported PTSS. Of these 13 parents, 9 were lost for follow-up: 5 of them declined participation due to lack of time or no interest, and 4 could not be reached. The mean IES-R score of parents with PTSS was 45.2 (SD 15.5, min-max 25-68); for parents without PTSS this was 5.6 (SD 5.4, min-max 0-21).

At T2, 65 parents reported no PTSS (94.2%; 54 mothers and 11 fathers) and 4 parents (5.8%; all mothers) reported PTSS. Of these 4 parents, 1 parent reported PTSS at T1 and 3 parents developed PTSS due to the accident between T1 and T2. The mean IES-R score of parents with PTSS was 34.3 (SD 10.6, min-max 24-49; for parents without PTSS this was 4.2 (SD 5.3, min-max 0-20). See also Figure 5.2 for an overview.

We found a significant association between parental and child PTSS at T1 (Spearman's $\rho = 0.25$, $p < .001$) but not at T2.

Factors associated with parental PTSS

The univariable and multivariable associations between the parental and child factors of interest and the severity of parental PTSS are presented in Table 5.1 (T1) and Table 5.2 (T2). In both the univariable and the multivariable model, parental acute stress and hospitalization of more than 1 day of the child were significantly associated with severity of parental posttraumatic stress at T1. Parental acute stress and permanent physical impairment of the child were associated with parental PTSS severity at T2 in both the univariable model and the multivariable model.

Two of the parents reported new traumatic events between T1 and T2: a life-threatening illness of a child and being involved in a car accident as a passenger. None of the two parents reported PTSS at T2. Due to the small number of parents that experienced a new traumatic event, this factor could not be included in the regression analysis. Of the remaining parents, 25 (37.3%) reported one or more life events but no

traumatic events. Parents mentioned life events such as death or serious illness of a loved one, mostly one of their parents, concern about the mental or physical health of loved ones or of their own health, and becoming unemployed. Of the 3 parents who developed PTSS between T1 and T2, 1 parent reported a preceding stressful period (not specified) and 1 parent reported grief because of the death of her husband who died a few years before the child's accident. Although parental PTSS was reported as a consequence of the accident, it could also have been influenced by grief or by a period of stress.

Figure 5.2 Parents with and without PTSS at T1 and T2

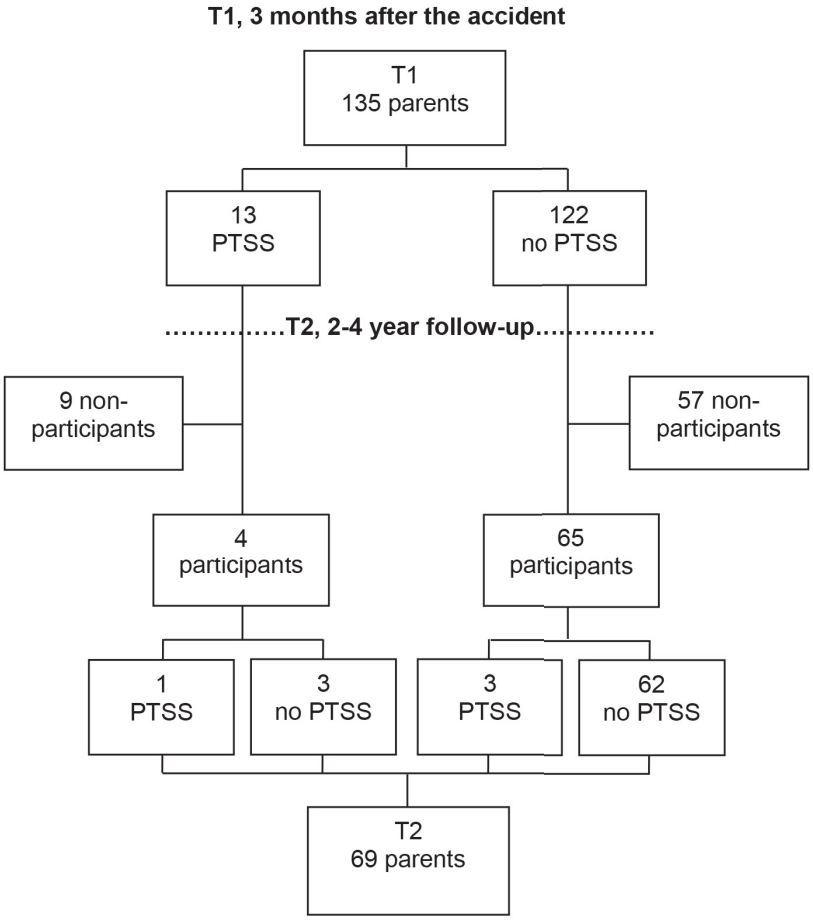


Table 5.1 The univariable and multivariable associations between parent and child factors and the severity of parental PTSS (IES-R scores) at T1 (n = 135)

	Univariable model			**Multivariable model**		
	Beta[a]	95% confidence interval	*p*-value	Beta[a]	95% confidence interval	*p*-value
Parent characteristics						
Prior trauma history	1.35	0.91 - 2.00	0.13	-	-	-
Acute stress, irritable	2.07	1.44 - 2.98	0.000	1.60	1.11 - 2.29	0.01
Acute stress, physical	2.26	1.52 - 3.35	0.000	2.10	1.40 - 3.06	0.000
Witnessing accident	0.62	0.34 - 1.15	0.13	-	-	-
Child characteristics						
Hospital > 1 day	1.69	1.16 - 2.48	0.007	1.67	1.17 - 2.38	0.005
Severe pain	0.99	0.66 - 1.47	0.94	-	-	-

T1 = 3 months after the accident. PTSS = clinically significant posttraumatic stress symptoms. IES-R = Impact of Event Scale Revised. [a] Due to the skewed distribution of the parental PTSS data, we performed linear regression analysis on log10 transformed data. To aid interpretation of the results, we present back transformed regression parameter estimates and corresponding upper and lower limits of confidence intervals.

Table 5.2 The univariable and multivariable associations between parent and child factors and the severity of parental PTSS (IES-R scores) at T2 (n = 69)

	Univariable model			**Multivariable model**		
	Beta[a]	95% confidence interval	*p*-value	Beta[a]	95% confidence interval	*p*-value
Parent characteristics						
Prior trauma history	0.93	0.54 - 1.61	0.80	-	-	-
Acute stress, irritable	1.78	1.05 - 3.01	0.03	1.68	1.00 - 2.81	0.048
Acute stress, physical[b]	1.71	0.95 - 3.07	0.07	-	-	-
Witnessing accident	0.59	0.28 - 1.27	0.17	-	-	-
Child characteristics						
Hospital > 1 day	1.49	0.86 - 2.57	0.15	-	-	-
Severe pain	0.77	0.45 - 1.34	0.36	-	-	-
Permanent physical impairment	2.51	1.44 - 4.40	0.002	2.16	1.23 - 3.81	0.008

T2 = 2–4 years after the accident. PTSS = clinically significant posttraumatic stress symptoms. IES-R = Impact of Event Scale Revised. [a] Due to the skewed distribution of the parental PTSS data, we performed linear regression analysis on log10 transformed data. To aid interpretation of the results, we present back transformed regression parameter estimates and corresponding upper and lower limits of confidence intervals. [b] Did not positively contribute to the multivariable level and was therefore left out.

Psychotherapy

Of the total group of 13 parents with PTSS at T1, 9 did not participate at T2. Of the remaining 4 parents with PTSS at T1, 1 parent still reported PTSS at T2 and 3 did not. The parent with PTSS at both T1 and T2 did not want any type of psychotherapy. She believed the symptoms would disappear over time. Of the 3 parents that no longer reported PTSS at T2, 1 still reported symptoms and distress but at a lower level. This parent started Eye Movement Desensitization and Reprocessing (EMDR) but did not finish it due to a mismatch with the therapist. The parent was willing to start EMDR again. The second parent successfully finished EMDR. The third parent did not want to be interviewed and only filled out the parent questionnaire, so it is unknown whether this parent received psychotherapy or not. The 3 parents that developed PTSS between T1 and T2 reported no need for psychotherapy. The first of these parents said that she didn't need help and she would rather wait for recovery. If necessary, she would contact us at a later stage. The second parent said that she didn't need trauma-focused therapy because she was already receiving general support from a social worker. The third parent stated that she didn't need therapy because she only felt sad when talking about the accident.

Discussion

The long-term prevalence of parental PTSS (5.8%) that we found in our study differs from the findings of previous studies on parental posttraumatic stress. Bronner and colleagues studied parental PTSD in parents 9 months after unexpected pediatric intensive care unit (PICU) treatment of their child (Bronner et al., 2010). The prevalence of clinical PTSD in their study was 10.5%. This percentage did not change over time, and posttraumatic stress responses at 3 months predicted subclinical and clinical PTSD at follow-up. Bakker et al. (2010) studied maternal PTSS in children 1 and 11 years after a burn event of their child. Although mean total stress scores decreased significantly over time, 17% of the mothers reported clinically significant stress at both 1 year and 11 years after the burn event. There are several possible explanations for the discrepancy in findings with our study, such as the use of different questionnaires (Bronner et al., 2010), different follow-up periods and different study populations. Furthermore, the majority of parents with PTSS at 3 months after the accident (9 out of 13) did not participate in the follow-up. If all 13 parents had participated in the

follow-up assessment, it is likely that the prevalence at follow-up would have been higher and in agreement with assumptions based on previous studies (Bakker et al., 2010; Bronner et al., 2010; Kazak et al., 2006).

In our study, parental and child posttraumatic stress were significantly associated 3 months after the accident, which is in line with the outcomes of other studies included in the meta-analysis of Morris et al. (2012). The association between child and parental PTSS, and the adverse effect of parental stress on the child's PTSS and recovery, illustrate the important role of parental posttraumatic stress and the importance of adequate psychotherapy. In our sample, although it was very small, the majority of the parents reported no need for therapy. Our findings on the association between child and parent PTSS and the effects on children can be supportive in developing strategies to convince parents to accept adequate treatment.

In the univariable models, both acute stress items were significantly associated with the severity of parental PTSS at T1 and T2. In the multivariable models, this was the case at T1 but not at T2. At T2, one of the acute stress items did not contribute to the multivariable model. The differences between the multivariable models at T1 and T2 may result from the small sample size at T2 (n = 69). Our results show that acute parental stress is significantly associated with parental PTSS severity at 3 months and at 2–4 years post-injury. These results are in line with those of other studies (Allenou et al., 2010; Bronner et al., 2010). Furthermore, our results show that hospitalization longer than one day is associated with short and long-term parental PTSS severity. These findings are in line with those of Landolt et al. (2012) but differ from those of Bronner et al. (2010). Our results also show that long-term permanent impairment of the child is associated with parental PTSS severity at follow-up. In future research, it might be useful to examine whether the length of hospitalization and later permanent impairment are related to the characteristics of the injury. If so, it might be possible to determine, at an early stage, what type of injury and/or what injury severity will probably lead to permanent impairment. Although injury severity itself is not a predictor for PTSS, research in children with burns indicates that there is an indirect relationship between burn extent and parental PTSS, through factors such as anxiety or guilt (Bakker et al., 2010; Hall et al., 2006).

This study had several limitations. First, almost half of the parents were lost to follow-up. Among those, 9 of 13 reported PTSS at 3 months. This precludes generalization and conclusions about the change of parental PTSS over time, as the estimated prevalence of PTSS at long-term follow-up may be biased. Second, the time between the first and follow-up assessment ranged from 2 to 4 years, resulting in variability in children's development and transitions in life (van Meijel et al., 2019). This could preclude generalization of the findings to other populations, specifically on the association between parental and child PTSS. Third, posttraumatic stress was assessed by questionnaire and not by clinical interview. Therefore, the prevalence of parental PTSS should be interpreted with caution. Fourth, acute stress (irritability), acute stress (physical), and trauma history were measured with only one question. Due to a lack of comprehensiveness, acute stress and trauma history may not have been adequately measured.

The present study adds to the knowledge of parental PTSS. The identification of factors associated with severity of later parental PTSS can support decisions about assessments and interventions in the various medical phases. In the peritrauma and acute phase, special attention is required for the stress experienced by the parents, whether or not this is visible to the medical staff. Circumstances surrounding acute treatment of accidentally injured children are often unclear and therefore stressful for many parents. Medical staff should be trained to increase their awareness of acute parental stress, to prevent parental stress as much as possible, to ask about it systematically, to inform parents about it, and, if necessary, refer parents to a psychologist for intervention. To prevent interaction with the child's response, parents can be helped in dealing with the circumstances and coping with their stress. Supporting parents to adequately address the child's needs would facilitate child adjustment and recovery. Furthermore, to avoid persistent posttraumatic stress, we recommend timely screening for risk. Later on, systematic monitoring of parents of injured children is indicated, including screening for traumatic stress and treatment of significant traumatic stress. Overall, our results illustrate the importance of attention for parental posttraumatic stress to prevent adverse long-term psychological consequences for the parent and indirectly for the child. Further research is necessary to determine the prevalence of long-term PTSS in parents after accidental injury of their child and to confirm the role of factors associated with parental PTSS severity and their possible interaction.

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CHAPTER 6

Comparing three diagnostic algorithms of posttraumatic stress in young children exposed to accidental trauma: an exploratory study

PTSD can occur at any age, beginning after the first year of life
DSM-5

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Slightly adapted for consistency

Abstract

Both the DSM-5 algorithm for posttraumatic stress disorder (PTSD) in children 6 years and younger and Scheeringa's alternative PTSD algorithm (PTSD-AA) aim to be more developmentally sensitive for young children than the DSM-IV PTSD algorithm. However, very few studies compared the three algorithms simultaneously. The current study explores diagnostic outcomes of the three algorithms in young child survivors of accidental trauma. Parents of 98 young children (0-7 years) involved in an accident between 2006 and 2012 participated in a semi-structured telephone interview. Child posttraumatic stress symptoms (PTSS) were measured with the Anxiety Disorders Interview Schedule for DSM-IV - Child Version (ADIS-C/P), complemented with items from the Diagnostic Infant and Preschool Assessment (DIPA). Descriptive statistics were used to analyze the characteristics of the children, accident related information and PTS symptoms. We compared the three PTSD algorithms in order to explore the diagnostic outcomes. A total of 9 of the children (9.2%) showed substantial PTSS. Of these children 2 met the criteria of all three algorithms, 7 met both the DSM-5 subtype for children 6 years and younger and the PTSD-AA algorithm, and 2 did not fully meet any of the algorithms (subsyndromal PTSD). For young children, the DSM-5 subtype for children 6 years and younger and the PTSD-AA algorithm appear to be better suited than the previous DSM-IV algorithm. It remains important that clinicians pay attention to children with subsyndromal PTSD.

Background

The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; APA, 2013) includes a subtype for posttraumatic stress disorder (PTSD) in children 6 years and younger. Before the release of the DSM-5, several studies had shown that more developmentally sensitive PTSD criteria for young children were needed (De Young, Kenardy, & Cobham, 2011b; Postert, Averbeck-Holocher, Beyer, Muller, & Furniss, 2009; Scheeringa, Zeanah, Drell, & Larrieu, 1995). The PTSD criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR; APA, 2000) were based on research among adults and older children (Postert et al., 2009; Scheeringa, Myers, Putnam, & Zeanah, 2012). Therefore, some of the symptoms were not suitable for young children, because they required skills that young children have not yet developed, such as verbal expression, memory or abstract thought (Postert et al., 2009; Scheeringa, Zeanah, Myers, & Putnam, 2003). As a consequence, not all young children with substantial levels of posttraumatic stress symptoms (PTSS) did fully meet the required DSM-IV criteria for PTSD, although these children can experience impairment and need trauma-focused treatment (Scheeringa, Zeanah, Myers, & Putnam, 2005).

In order to improve the identification of PTSD in young children, Scheeringa and colleagues proposed alternative PTSD criteria for young children (Scheeringa et al., 1995). This alternative algorithm (PTSD-AA) focused on behavioral symptoms instead of thoughts and feelings, and included the following changes to the DSM-IV criteria. First, criterion A2 (response of fear, helplessness or horror) was removed because young children are less able to report their response to the traumatic event and witnesses are not always present. Second, the wording of some symptoms was adapted to make them more applicable for young children. Finally, the threshold to meet the avoidance/numbing criterion was lowered from 3 to 1 symptom (Scheeringa et al., 2012). These changes have been incorporated in the DSM-5 subtype for children 6 years and younger, in addition to the following (unrelated to the PTSD-AA proposal): First, criterion C avoidance/numbing has been split into *"Persistent avoidance of stimuli"* and *"Negative alterations in cognitions"*. Second, symptom C3 - "*Inability to recall an important aspect of the trauma"* and symptom C7 - *"Sense of a foreshortened future"* have been removed. Third, symptom C3 - *"Increased frequency of negative emotional states"* has been added to criterion C (APA, 2013; Friedman, 2013). In accordance with

the PTSD-AA algorithm, criterion A2 was left out from the DSM-5. This criterion was considered redundant for the development of PTSD, because research showed that this criterion is common after experiencing a traumatic event and has little influence on the number of people who qualify for PTSD following a traumatic event (Breslau & Kessler, 2001). In addition, other studies showed that people can develop PTSD without meeting criterion A2. For example, many professionals like military personnel or police officers do not have an emotional response to a traumatic event because of their professional training, but can still develop PTSD (Friedman, Resick, Bryant, & Brewin, 2011). Table 6.1 presents an overview of the PTS symptoms and criteria of the DSM-IV, PTSD-AA algorithm and DSM-5 subtype for children 6 years and younger.

It is important to compare the three algorithms and to explore the diagnostic outcomes of the algorithms among young children (Alisic et al., 2011). However, research in this area is scarce. A study on PTSD in young children with burn injuries demonstrated a prevalence rate of 4.6% with DSM-IV, 25.4% with DSM-5 and 24.6% with PTSD-AA at 1 month after the injury (De Young, Kenardy, & Cobham, 2011a). Meiser-Stedman and colleagues found a PTSD prevalence rate of 1.7% with the DSM-IV algorithm and 10% with the PTSD-AA algorithm in young children who were involved in a motor vehicle accident (Meiser-Stedman, Smith, Glucksman, Yule, & Dalgleish, 2008). Scheeringa and colleagues compared PTSD diagnoses according to the DSM-IV, PTSD-AA, DSM-5 and DSM-5-under consideration (DSM-5-UC) algorithm in children aged 3 to 6 years exposed to diverse types of trauma (Scheeringa et al., 2012). They found that the percentage of children who qualified for a PTSD diagnosis was significantly lower when using the DSM-IV algorithm (13%) compared to the PTSD-AA algorithm (45%), DSM-5 algorithm (44%) or DSM-5-UC algorithm (49%). In order to understand PTSD in young children and prevent underdiagnosis, a broad research base is needed, including research in various countries and after various types of trauma exposure.

In the present study we compared the three main PTSD algorithms for young children age 0 to 7 years in an accidental injury sample involving various types of exposure (e.g., road traffic accidents, near drowning, falls).

Table 6.1 Symptoms and Criteria of the Three Diagnostic Algorithms for PTSD

DSM-IV [5]	**PTSD-AA [6]**	**DSM-5, subtype for children 6 years and younger [1]**
Criterion A1	Criterion A1	Criterion A1
Criterion A2: Response to event involves intense fear, helplessness or horror	Criterion A2 not required	Criterion A2 not required
B. Intrusion (1 required)	B. Intrusion (1 required)	B. Intrusion (1 required)
1. Recurrent and intrusive distressing recollections	1. Recurrent and intrusive recollections, not required to be distressing	1. Recurrent and intrusive recollections, not required to be distressing
2. Recurrent distressing dreams of the event	2. Recurrent distressing dreams of the event	2. Recurrent distressing dreams of the event
3. Dissociation (e.g., flashbacks)	3. Dissociation (e.g. flashbacks)	3. Dissociation (e.g., flashbacks)
4. Intense psychological distress at reminders	4. Intense psychological distress at reminders	4. Intense psychological distress at reminders
5. Physiological reactivity at reminders	5. Physiological reactivity at reminders	5. Physiological reactivity at reminders
C. Avoidance/numbing (3 required)	C. Avoidance/numbing (1 required)	C. Avoidance/negative alterations in cognitions and mood (1 required)
1. Efforts to avoid thoughts, feelings or conversations	1. Efforts to avoid thoughts, feelings or conversations	1. Efforts to avoid activities, places or physical reminders
2. Efforts to avoid activities, places or people	2. Efforts to avoid activities, places or people	2. Efforts to avoid people, conversations or interpersonal situations
3. Inability to recall an important aspect of the trauma	3. Inability to recall an important aspect of the trauma	3. Increased frequency of negative emotional states
4. Diminished interests in significant activities	4. Diminished interests, emphasize play constriction	4. Diminished interests, including play constriction
5.Feelings of detachment from others	5. Socially withdrawn behavior	5. Socially withdrawn behavior
6. Restricted range of affect	6. Restricted range of affect	6. Reduction in expression of positive emotions
7.Sense of foreshortened future	7. Sense of foreshortened future	
D. Hyperarousal (2 required)	D. Hyperarousal (2 required)	D. Hyperarousal (2 required)
1. Difficulty falling or staying asleep	1. Difficulty falling or staying asleep	1. Difficulty falling or staying asleep
2. Irritability, angry outbursts	2. Irritability, includes excessive temper	2. Irritability, angry outbursts, includes extreme temper tantrums
3. Difficulty concentrating	3. Difficulty concentrating	3. Difficulty concentrating
4. Hypervigilance	4. Hypervigilance	4. Hypervigilance
5. Exaggerated startle response	5. Exaggerated startle response	5. Exaggerated startle response

Method

Participants and procedure

The current study was part of a larger retrospective exploratory study and was conducted in the Academic Medical Center (AMC) and the VU medical center (VUmc), both academic hospitals in Amsterdam, the Netherlands, with a level 1 trauma center. The study was approved by the Medical Ethics Committees of both hospitals.

All children age 0 to 7 years who had been involved in an accident, transported to the hospital by ambulance, and treated in the trauma (resuscitation) room between January 2006 and August 2011 were eligible for inclusion. Although the DSM-5 PTSD subtype for children 6 years and younger and the PTSD-AA algorithm are studied in children up to 6 years of age, we included 7-year-old children as well. In the clinical practice in the Netherlands, the distinction between age categories of children is often made as follows: young children are referred to as children aged 0-7 years and older children are referred to as children aged 8-17 years. In addition, many measures for PTSD use the same age categories. In order to stay close to the clinical practice and not to "forget" children aged 7 years, we decided to include 7-year-old children as well.

One child per family was included. Exclusion criteria were: living abroad, unknown place of residence and telephone number, permanent neurological injury and injured due to child abuse. Children who were injured due to child abuse were excluded because of hospital's policy for this group of children. The policy implied that we could not contact these children for our study. In order to identify eligible children for the study we used the trauma registration system(s) of the Emergency Department.

First we performed a pilot study in order to test the procedures and measures. Thereafter, parents of the selected children received a letter in November 2011 containing information about the study. From December 2011 to February 2012, we contacted parents via telephone and invited them to participate. Informed consent was obtained from all participating parents. After informed consent, the first (MRG) and second author (EPMM) conducted a telephone interview with the parents.

Measures

We constructed a semi-structured interview for parents whose child had been involved in an accident (Meynen, van Meijel, Gigengack, & Lindauer, 2011) based on an existing protocol (Beer, Verlinden, Boer, & Lindauer, 2011). This protocol for health-care professionals contains examples of questions on children's and parents' acute and posttraumatic stress reactions to a traumatic event and can be used as a screening tool for PTSS in children and parents. The semi-structured interview consists of 12 open-ended questions on the following areas: the accident and the injuries, other traumatic experiences, medical/psychological history, peri- and posttraumatic reactions of the child and the parent, and coping. We constructed the interview in consultation with a child and adolescent psychiatrist (the fourth author; RJLL) and a clinical psychologist/psychotherapist, both experienced clinicians in the field of trauma.

During the semi-structured interview parents were asked about PTS symptoms of their child in the past. The questions consist of an open-ended question (*'Did you notice any changes in your child's behavior in the period following the accident?')* followed by close-ended questions concerning examples of PTS symptoms (e.g., '*Did your child have trouble sleeping since the accident?'* and *'Did your child have nightmares or bad dreams about the accident?'*). These questions serve as a skip-out criterion. If parents reported one or more PTS symptoms for their child, we further assessed child PTSS with the PTSD module of the Dutch version of the Anxiety Disorders Interview Schedule for DSM-IV - Child Version (ADIS-C/P; Siebelink & Treffers, 2001; Silverman & Albano, 1996). The ADIS-C/P is a semi-structured interview to assess anxiety disorders and comorbidity in children. Test-retest reliability and interrater reliability of the ADIS-C/P range from good to excellent (Lyneham et al., 2007; Silverman et al., 2001). The 17 ADIS-C/P questions are based on the 17 PTS symptoms of the DSM-IV and formed the basis of our PTSD interview. However, these questions did not fully cover the PTS symptoms according to the PTSD-AA algorithm and the DSM-5 subtype for children 6 years and younger. In order to measure PTS symptoms according to all three algorithms, we complemented the ADIS-C/P questions with a number of PTSD questions (questions 37, 41, 42, 44, 47, 51, 52, 54, 55) from the 2009 version of the Diagnostic Infant and Preschool Assessment (DIPA; Scheeringa, 2009). The DIPA is a semi-structured interview to assess symptoms of 12 DSM-IV disorders in children from late in their first year to 6 years of age (Scheeringa & Haslett, 2010). Preliminary data on the reliability and the criterion validity show that the DIPA appears to be

a reliable and valid measure (Scheeringa & Haslett, 2010). The DIPA-questions were translated into Dutch by the first (MRG) and second author (EPMM) in consultation with a clinical psychologist/psychotherapist and a child and adolescent psychiatrist (the fourth author; RJLL).

The ADIS-C/P questions were complemented with DIPA questions in order to measure all symptoms of the PTSD-AA algorithm and DSM-5 subtype for young children. No DIPA questions were added to the *intrusion* cluster of the ADIS-C/P. In the cluster *avoidance/negative alterations in cognitions and mood* a number of DIPA questions were added. First, the ADIS-C/P question regarding symptom C1 - '*Recurrent and intrusive distressing recollections*' - was expanded with the following DIPA question '*Does s/he try to avoid conversations that might remind him/her of the trauma?*' - '*Does s/he try to avoid private thoughts or feelings that might remind him/her of the trauma?* ' (question 37). Furthermore, the following DIPA question was added: '*Since the trauma has s/he become more distant from family members and friends? I mean, s/he doesn't want to show affection or maybe even be around people?*' (question 44). This question measures the adjusted symptom C5 - *'Socially withdrawn behavior'* - of the PTSD-AA and DSM-5 subtype for young children. In order to measure symptom C6 - *'Reduction in expression of positive emotions*' - of the DSM-5 subtype for young children, the DIPA question '*Since the trauma, s/he doesn't show as many happy emotions - like smiles or laughs - on his/her face, or doesn't show them as strongly as s/he used to?*' was added (question 41). PTSD interviews were administered before the release of the DSM-5. The ADIS-C/P and the DIPA did not yet contain the new DSM-5 symptom C3 of the subtype for young children - '*Substantially increased frequency of negative emotional states (e.g., fear, guilt, sadness, shame, confusion)'*. This symptom was measured with the following question derived from the DIPA *'Is your child more sad, angry or upset since the accident?'* (question 42). In the PTSD-AA algorithm and the DSM-5 subtype for children 6 years and younger the hyperarousal symptom '*Irritability, outbursts of anger*' includes extreme temper tantrums. Therefore, the following part of DIPA question 47 was added to the hyperarousal cluster of the ADIS-C/P: '*Has s/he developed extreme temper tantrums since the trauma?*'.

PTS symptoms were scored present or absent based on the frequency. Symptoms were scored present if they occurred a couple of times a month. Intensity of the symptoms was based on the reported impairment. If parents reported no impairment, then

children did not fulfill the criteria for substantial PTSS. Impairment was measured with DIPA questions about impairment in the following domains: parental relationships, sibling relationships, daycare provider/teacher relationships, relationships with peers, ability to act appropriately outside home or daycare/school and measure of child's distress (questions 56 to 61).

If parents reported child PTSS in the past, they were also asked if the symptoms were still present (results are not presented and are available on request). If parents reported other experienced traumatic events besides the accident, the PTS questions were administered separately for each of the events.

Data analysis

We used IBM Statistical Product and Service Solutions (SPSS) 19 for all analyses. Descriptive statistics were used to analyze the characteristics of the children, accident related information and PTS symptoms. Differences between participants and non-participants were analyzed using the chi-square test and Mann-Whitney U tests. We compared the DSM-IV PTSD algorithm, the DSM-5 PTSD subtype for children 6 years and younger and the PTSD-AA algorithm in order to explore the diagnostic outcomes of the algorithms.

We defined substantial PTSS as 1) the child met the criteria of all PTSD clusters of any of the three algorithms and the parent reported impairment (threshold PTSD) or 2) the child did not fully meet the criteria of all PTSD clusters of any of the three algorithms, but met two of the clusters in any of the three algorithms and the parent reported impairment (subthreshold PTSD). Subthreshold PTSD is clinically significant, because people with subthreshold PTSD can experience impairment and may require treatment (McLaughlin et al., 2015). Our definition of subthreshold PTSD is supported by a study on definitions of subthreshold PTSD according to the DSM-5 PTSD algorithm (McLaughlin et al., 2015). The results of this study show that full symptoms in two or three of the PTSD clusters is the best fit for subthreshold PTSD. The authors recommend that future studies should use this definition of subthreshold PTSD (McLaughlin et al., 2015).

Results

Sample characteristics

A total of 270 children and their parents were eligible to participate in the study. Of these families, 140 could not be contacted (telephone number was out of service or the telephone was not answered), 24 parents refused to participate and the interview with 8 parents could not be scheduled during the study period.

We included 98 parents (75 mothers and 23 fathers) of 98 children. Demographic characteristics of the children and accident related information are shown in Table 6.2. There were no significant differences between participants and non-participants in terms of gender ($\chi^2 = 0.87$, $p = .35$), age (U = 951.5, Z = -1.46, $p = .14$) and duration of admission (U = 678.0, Z = -0.54, $p = .59$).

Table 6.2 Demographic Child Characteristics and Accident Related Information (n = 98)

	N (%)	Median	Mean (SD)	Min-Max
Gender				
Male	67 (68.4)	--	--	--
Female	31 (31.6)	--	--	--
Child age during accident	--	3	3.1 (2.2)	0-7
Child age during interview	--	6	6.2 (2.7)	1-13
Time between accident and interview (in months)	--	35	36.3 (20.6)	4-69
Trauma type				
Road traffic accident	28 (29.6)	--	--	--
Fall	49 (50.0)	--	--	--
Other, including burns and near drowning	21 (21.4)	--	--	--
Total days in hospital including (P)ICU[a]	81 (81.0)	1	4.7 (9.5)	1-57
Total days on (P)ICU[a]	27 (27.0)	1	3.6 (4.3)	1-14

Note. -- = not applicable.
[a] (P)ICU: (Pediatric) Intensive Care Unit.

Posttraumatic stress symptoms

A total of 14 parents reported one or more PTS symptoms in their child in the past following the accident and completed the ADIS-C/P and DIPA questions. Of this group, 9 children (9.2% of the total study population) showed substantial PTSS and impairment. These 9 children consisted of 7 boys and 2 girls. The age of the children with substantial PTSS ranged from 1 to 7 years at the time of the accident (median 6 years, mean 5.0 years, SD=2.2), and was distributed as follows: 1 year (1 child), 2 years (1 child), 4 years (1 child), 6 years (4 children) and 7 years (2 children).

PTSD criterion and diagnosis frequencies measured with the three PTSD algorithms are presented in Table 6.3. Two of the 9 children with substantial PTSS met all three algorithms. Using the DSM-5 subtype for children 6 years and younger and the PTSD-AA algorithm 7 children with substantial PTSS were identified; 2 of these children met all three algorithms and 5 children met the DSM-5 subtype for children 6 years and younger and the PTSD-AA algorithm but did not meet the DSM-IV algorithm. The DSM-5 subtype for children 6 years and younger and PTSD-AA algorithm identified the same children. The 2 children who showed substantial PTSS and impairment but did not fully meet any of the algorithms, met the criteria of two PTSD clusters but lacked one or more symptoms in the third cluster. One of these children lacked symptoms in the cluster intrusion and one child lacked one symptom in the cluster hyperarousal.

Table 6.3 PTSD Criterion and Diagnosis Frequencies in Young Children with Substantial PTSS

PTSD criterion or diagnosis	N (n=9)	% (n=9)	Prevalence rate % (n=98)
Intrusion	8	88	--
Avoidance/numbing (DSM-IV; 3 symptoms)	2	22	--
Avoidance/numbing (PTSD-AA; 1 symptom)	9	100	--
Avoidance/negative alterations cognitions and mood (DSM-5; 1 symptom)	9	100	--
Hyperarousal	8	88	--
DSM-IV diagnosis	2	22	2.0
PTSD-AA diagnosis	7	77	7.1
DSM-5 diagnosis	7	77	7.1
Substantial symptoms but no diagnosis[a]	2	22	2.0

Note. -- = not applicable.

[a] Children met at least two clusters of symptoms of PTSD according to any of the algorithms

Discussion

This is one of the first studies comparing the three most prominent diagnostic algorithms for PTSD simultaneously in a substantial sample of young children exposed to accidental trauma. We found that 9.2% of the young children developed substantial PTSS following an accident. This finding is in line with a previous study on the PTSD-AA algorithm following a motor vehicle accident (10%) (Meiser-Stedman et al., 2008).

Our findings indicate that both the DSM-5 subtype for children 6 years and younger and the PTSD-AA algorithm appear to be more sensitive for young children than the DSM-IV algorithm. Using these two algorithms most of the children with substantial PTSS were identified (7 out of 9). In contrast, a minority of the children with substantial PTSS met the criteria of the DSM-IV algorithm (2 out of 9). The improved sensitivity of the PTSD criteria for young children seems a step forward, now that more young children suffering from substantial PTSS can be identified and thereby offered treatment. We believe it is important to maximize the sensitivity and to identify as many young children with substantial symptoms and impairment as possible, instead of not identifying young children who do have substantial PTSS and might need treatment.

Intrusion and hyperarousal symptoms were common, however, in accordance with other studies (De Young et al., 2011a; Scheeringa, Wright, Hunt, & Zeanah, 2006), most of the children (7 out of 9) did not meet the DSM-IV threshold of the avoidance cluster (3 symptoms). With the lower threshold from the PTSD-AA and DSM-5 subtype for children 6 years and younger (1 avoidance symptom required instead of 3) all children met the criterion. Besides the lower threshold, the following adaptation of avoidance symptoms in the DSM-5 subtype for young children might have made this cluster better suited for young children: the wording of some symptoms has been made more appropriate for young children, 2 symptoms which were not applicable for young children have been removed, and 1 symptom better suited for young children has been added (APA, 2013; Friedman, 2013).

Our findings indicate that the DSM-5 subtype for children 6 years and younger and the PTSD-AA algorithm identify the same children with substantial PTSS. On the one hand, this seems evident because the algorithms are mainly similar and incorporated roughly

similar changes to the DSM-IV criteria. For example, in both algorithms the wording of some symptoms was adapted to make them more applicable for young children and the threshold to meet the avoidance criterion was lowered from 3 to 1 symptom (Scheeringa et al., 2012). On the other hand, the algorithms are not completely similar, because the DSM-5 subtype for children 6 years and younger was slightly more adapted by removing 2 avoidance symptoms and adding 1 new symptom to the avoidance cluster (APA, 2013; Friedman, 2013). Scheeringa and colleagues found that these adaptations had a limited effect on the prevalence of the avoidance criterion (Scheeringa et al., 2012). The prevalence of the PTSD-AA avoidance criterion and the prevalence of this criterion according to the DSM-5 subtype for young children was almost equal (Scheeringa et al., 2012). This might explain why both algorithms identify the same children, despite a number of dissimilar avoidance symptoms.

The prevalence rate of PTSD more than tripled when the PTSD-AA algorithm or the DSM-5 subtype for children 6 years and younger algorithm (7.0%) was used instead of the DSM-IV algorithm (2.0%), although still 2 of the 9 children who experienced substantial PTSS and impairment did not fully meet the criteria of one of the three algorithms (2.0%). Scheeringa and colleagues measured PTSD in young traumatized children at three time points and also found that, in particular at the last time point, more children were impaired but not diagnosed with PTSD (Scheeringa et al., 2005). Angold and colleagues suggest to classify impaired but undiagnosed children into a *not otherwise specified* category of a disorder, in order to improve the identification of these children (Angold, Costello, Farmer, Burns, & Erkanli, 1999). We suggest to pay attention to this group of children. Clinicians should be aware that children with substantial PTSS who do not fully meet the criteria of any of the PTSD algorithms, can be very impaired and might need treatment.

Limitations and strengths

This is an exploratory and retrospective study with a number of limitations. We interviewed parents 4 months to 5 years after the accident of their child. Parents' recollections of the accident and their child's posttraumatic stress symptoms may have become biased over time. For example, parents and children with physical or psychological symptoms and a long rehabilitation period, may have had more

negative recollections than parents and children who recovered quickly. In addition, we administered the interviews via telephone. Telephone interviews are considered less valid than face-to-face interviews, because people would be less likely to disclose during telephone interviews due to the lack of face-to-face interaction (Aziz & Kenford, 2004). This might have lead to an underreport of PTSS in our sample. On the contrary, studies in which telephone interviews are compared to face-to-face interviews showed that telephone interviews lead to similar results as face-to-face interviews. Both are valid methods to measure several psychiatric disorders, including PTSD (Aziz & Kenford, 2004; Rohde, Lewinsohn, & Seeley, 1997).

ADIS-C/P and DIPA questions were administered if parents reported one or more PTS symptoms on the initial questions of the semi-structured interview. Due to this method, it is possible that some children may have suffered from substantial PTSS but their parents failed to mention symptoms. As a consequence, the ADIS-C/P and DIPA questions would not have been administered in these parents. Nevertheless, this does not seem likely because the initial questions contained examples of PTS symptoms from all PTSD clusters. We expected parents of children with substantial PTSS to recognize a number of these examples.

The validation study of the DIPA has not yet been finished in the Netherlands. Hence, apart from the pilot study, the Dutch DIPA-questions have not been extensively validated. Besides, the study was conducted before the release of the DSM-5. For this reason the ADIS-C/P and the DIPA were not yet adjusted to the DSM-5 changes.

Our sample size and the number of children who qualify for a PTSD diagnosis are limited. As a consequence, a relatively small difference exists between the number of children who qualify for a DSM-IV diagnosis and the number of children who qualify for a diagnosis with the PTSD-AA algorithm and the DSM-5 subtype for children 6 years and younger. Nevertheless, especially from a clinical point of view, we believe that this difference is important, because all of the children who qualify for a diagnosis are impaired and might need treatment. Furthermore, because our sample consists of young children exposed to accidental trauma, caution should be taken in generalizing the results to children involved in other types of traumatic events. Our study should be replicated with a larger sample size and with children exposed to various types of traumatic events.

Strengths of the study are the focus of the under-researched population of (very) young children and the use of a combination of clinical interviews to measure (several variations of) PTSD diagnoses. Furthermore, research on the comparison of three diagnostic PTSD algorithms for young children is scarce. With this study we aimed to contribute to the knowledge on this topic and to expand the research base.

Conclusions

Our results suggest that the DSM-5 subtype for PTSD in children 6 years and younger is an important improvement in identifying young children with PTSD compared to the DSM-IV algorithm. Nevertheless, clinicians should still be aware that some children with subsyndromal PTSD who may need trauma-focused treatment can stay unidentified.

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CHAPTER 7

General discussion

Don't be afraid to care
From *Breathe*, Pink Floyd

Table 7.1 Main findings of the studies on posttraumatic stress in accidentally injured children and their parents

Chapter 2 The Screening Tool for Early Predictors of Posttraumatic Stress Disorder (**STEPP**) was evaluated in 147 children 8-18 years old, and 135 parents. Three months after the accident, PTSD was diagnosed in 11.6% of the children; 9.6% of their parents had clinically significant PTSS. At the originally recommended cut-off, the sensitivity in our sample was too low. With adjusted cut-off scores, 82% of the children and 92% of the parents with a subsequent positive diagnosis were identified correctly. The results show that the STEPP is a valid and useful instrument that can be used in the Netherlands as a first screening method in stepped psychotrauma care following accidents. Special attention in the procedure is required due to a high rate of false positives.
Chapter 3 The association between **acute pain and PTSD** 3 months later was examined in 135 children, 8-18 years old. The amount of pain was negatively associated with injury severity in girls and positively associated with the presence of an extremity fracture in boys. In children who reported severe pain, this pain was significantly associated with PTSS and may account for around 10% of the variance in the severity of posttraumatic stress symptoms. Although the experience of pain is subjective, our study indicates that severe pain is associated with the severity of later posttraumatic stress symptoms.
Chapter 4 In the **follow-up study in children** that we performed 2–4 years after the accident (n=90; 11-22 years old), we found a prevalence of PTSD of 11.4%. At 3 months this was 11.6%. PTSD was associated with a new traumatic event or with the initial accident. Children who completed trauma-focused psychotherapy reported no symptoms or low levels of symptoms at follow-up, in contrast to those who did not complete psychotherapy. Of the participants, 31% reported permanent physical impairment and ongoing physical problems; a majority of this subgroup reported that these problems had negative consequences on their education, social life and future plans. There was a substantial difference between children with and without PTSD regarding permanent physical impairment, indicating an association between the presence of PTSD and permanent physical impairment.
Chapter 5 In the **follow-up study in 69 parents** 2–4 years after the accident (T2) we found a prevalence of PTSD of 5.8% compared to 9.6% in 135 parents after 3 months (T1). If all parents with PTSS had participated in the follow-up study, it is likely that the prevalence at follow-up would have been higher. Acute parental stress was significantly associated with parental PTSS severity at T1 and T2, as was child's hospitalization of more than 1 day at T1 and the child's permanent physical impairment at T2. Parental and child posttraumatic stress were significantly associated at T1. Given the adverse effect of parental stress on the child's PTSS and recovery, adequate psychotherapy for parents is advisable. In our sample, although it was very small, the majority of the parents reported no need for therapy.
Chapter 6 In an exploratory study we examined algorithms for posttraumatic stress reactions in parents of 98 accidentally injured **children up to 8 years old**. Substantial PTSS was found in 9.2% of the children. The DSM-5 subtype for children 6 years and younger and the PTSD-AA algorithm appeared to be better suited for PTSD diagnostics than the previous DSM-IV algorithm. Our results suggest that the DSM-5 subtype for PTSD in children 6 years and younger is an important improvement in identifying young children with PTSD compared to the DSM-IV algorithm.

Introduction

This thesis presents the results of our research on posttraumatic stress following accidental injury in children aged 8-18 years and their parents.

The aims of this research project were (1) to evaluate the utility in the Netherlands of the STEPP, a screening instrument to identify children and parents at risk for PTSD following child accidental injury, and (2) to examine short and long-term posttraumatic stress in children and parents following child accidental injury, including possible associated factors such as acute pain, permanent physical impairment and choices regarding trauma-focused psychotherapy.

In the final part of this thesis, we reflect on the main themes and issues that emerged from our findings. The current chapter also includes clinical implications of the findings, a reflection on the limitations of the studies, and suggestions for future research.

Reflections on the main findings of the studies

Evaluation of the utility of the STEPP in the Netherlands

In addition to the first validation of the STEPP (Winston et al., 2003), we tested the tool not only in traffic-related injury, but also in a mixed sample of accidentally injured children. We considered this sample to be more representative of clinical practice. The performance of the original STEPP (Winston et al., 2003) was not replicated in our study; at the original cut-off scores, the STEPP performed only moderately in the prediction of PTSD three months later. In Chapter 2 of this thesis, we discuss possible explanations for this lack of performance. However, the negative predictive value was high; the STEPP performed very well in screening out those who are not at risk for PTSD. With adjusted cut-off scores, both the predictive power and the negative predictive power of the STEPP were improved. Knowing who is not at risk is important in targeting follow-up efforts. The high rate of false positives requires special attention in the screening procedure. However, if the STEPP is used by trained professionals in a careful stepped care procedure (see below), it is a useful instrument for Dutch clinical practice.

The risk of PTSD following accidental injury

Accidents are a major cause of injury to children and can be traumatic. Initial posttraumatic stress is a normal reaction to a potentially traumatic experience; most children and parents recover in the first weeks following the accident. However, a significant proportion of children and parents are likely to continue to experience persistent posttraumatic stress symptoms or PTSD over the long-term if they do not receive treatment (J. Kenardy, Cobham, Nixon, McDermott, & March, 2010). Timely and effective trauma-focused treatment of PTSD can only be offered if PTSD is recognized. The purpose of screening for risk is to identify persons at high risk of developing PTSD at a later stage, who will perhaps require closer monitoring (NICE, 2005). The most important reason to screen for risk is that clinicians are not able to predict who will develop PTSD. Two decades ago, researchers had already noted that if clinicians use severity of injury as a guideline for referral to psychological follow-up services, then many children at risk for PTSD may be overlooked (de Vries et al., 1999). This referred to children with—on closer inspection—minor injuries, often sent home after the medical screening. However, just like severely injured children, these children had been exposed to potentially traumatic events. They experienced a serious accident and had a medical screening and treatment in the trauma room of the Emergency Department. A valid and user-friendly instrument to screen for risk helps clinicians to ensure that no children and parents will be missed for active monitoring. With the Dutch STEPP, a valid instrument has been made available for clinical practice in the Netherlands.

Screening for risk may also have negative side-effects. Specific questions can generate distress, concerns and expectations (NICE, 2005). However, research on participation in clinical research showed very low risk of distress from questions about one's traumatic experience (Kassam-Adams & Newman, 2005). Furthermore, if the screening procedure is implemented within a broad and professional program of stepped care, the risk of negative effects can be largely prevented.

A stepped care approach includes not only identification of those at risk, but also further evaluation of those with a positive test result, including screening for PTSD, further assessment and evidence based early interventions if necessary (Kassam-Adams et al., 2011). The disadvantages of false positives in screening can be addressed by using a brief questionnaire to assess the probability of PTSD. Only those who

have a positive screen would be referred for further assessment (van Meijel et al., 2015). Stepped models that link a positive screening result to systematic follow-up are recommended as best practice for prevention of persistent posttraumatic stress symptoms or PTSD after a potentially traumatic event (NICE, 2005; Ward-Begnoche et al., 2006).

Reproduction of research findings

In our study on the evaluation of the STEPP (van Meijel et al., 2015), we aimed to reproduce research results on the performance of the STEPP (Winston et al., 2003), thus aiding scientific progress in general, and specifically on the international utility of screening instruments. Despite our study, there is still a lack of replication studies for instruments screening for risk after injury (Kassam-Adams, Marsac, Garcia-Espana, & Winston, 2015). Our study also added to the knowledge on the prevalence of PTSD following accidental injury, in the Netherlands and other countries. When we started the study, knowledge on the prevalence of PTSD in specific populations was scarce. The assumption was that up to 37.5% of the children developed PTSD following unintentional or accidental injury. In the last decade, research results—such as those from our study —have shown that this prevalence is probably lower: 8.4 to 13.3% (Alisic et al., 2014; van Meijel et al., 2015). These new figures enable better allocation of mental health resources and improvements in the design of new research projects, especially a more accurate calculation of the power and the sample size of future studies (Alisic et al., 2014). This can benefit studies such as the STEPP study (van Meijel et al., 2015), in which the prevalence of PTSD was lower than expected.

Our findings in the light of the model of Pediatric Medical Traumatic Stress (PMTS)

The findings of our studies on pain, long-term PTSD and parental PTSS (Chapters 3 to 5) highlight various factors associated with posttraumatic stress following accidental injury. The model of PMTS as introduced in Chapter 1 may help to explain the role of these factors within a broader context.

In our study on factors associated with PTSD (Chapter 3), we found that severe acute pain is associated with later PTSD (van Meijel et al., 2019). The PMTS model illustrates that pain can occur during all three phases: from peritrauma to many years after discharge from care. This can be important in understanding the development and

continuation of PTSD. The model also suggests that the child's pain can negatively affect the parents and other members of the family (Price et al., 2016). Our findings on long-term PTSD in children, and the association with permanent physical impairment (van Meijel et al., 2019) fit into phase III of the model and emphasize the need for long-term monitoring and support after accidental injury. One of the assumptions of the model of PMTS is that a contextual approach to child posttraumatic stress is essential to effective interventions (Price et al., 2016). As parent and child PTSS are related (Kolaitis et al., 2011), parents play an important role in this context. In our study on parental posttraumatic stress (see chapter 5), acute parental stress was significantly associated with short and long-term severity of parental PTSS. Therefore, parents should be supported and assisted from the acute phase after their child's accident. Our findings also stress the importance of systematically screening and monitoring the parents of accidentally injured children. (See also 'Clinical implications'.)

Implications of the introduction of DSM-5, new criteria for PTSD

Shortly after finishing the inclusion of data for this study, criteria for PTSD were revised and a new version of the DSM was launched in 2013 (APA, 2013). Although symptoms are generally comparable between DSM-IV and DSM-5, the following changes need to be mentioned (National Center for PTSD, 2019). As a consequence of a new qualification of traumatic events (criterion A1), the unexpected death of family or close friends is no longer included. Criterion A2 of DSM-IV, a response of intense fear, hopelessness or horror to a traumatic event, was removed from DSM-5. The avoidance and numbing criterion C in DSM-IV was separated into criterion C, avoidance, and criterion D, negative alterations in cognitions and mood. Newly added symptoms were: overly negative thoughts and assumptions about oneself or the world, negative affect and risky or destructive behavior.

In a study by Kilpatrick and colleagues, it was suggested that criterion A2 did not improve diagnostic accuracy but research in Dutch children and adolescents indicated that the subjective reaction during a traumatic event is of great importance to the assessment of PTSD (Kilpatrick et al., 2013; Verlinden et al., 2013). The specific implications of these results for accidentally injured children are unknown. However,

a previous study showed that children and parents who perceive a high risk of life threat in medical events are at great risk of PMTS (Price et al., 2016). The STEPP also contains several questions that refer to the subjective reaction during or right after the event. Examples of such items are: "When your child was hurt (or when you first heard it had happened), did you feel really helpless, like you wanted to make it stop happening, but you couldn't?" and "When you got hurt, or right afterwards, did you feel really afraid? Since the STEPP does not include posttraumatic stress symptoms, there is probably no need to adapt the questionnaire to DSM-5 criteria (see also our recommendations for future research).

Due to the changes in the diagnostic criteria in DSM-5, a drop in prevalence by about 1% was expected (Kilpatrick et al., 2013). Although research that compares the prevalence rates of DSM-IV and DSM-5 in children and adolescents is scarce, the results have shown comparable prevalence rates for both diagnostic systems. In adolescents and young adults who survived the shooting at Utoya Island in Norway, a prevalence of 11.1% was found using DSM-IV criteria and 11.7% using DSM-5 criteria (Hafstad, Dyb, Jensen, Steinberg, & Pynoos, 2014). In a non-clinical sample of earthquake survivors, the authors found an overall high consistency (87.1%) between DSM-IV-TR and DSM-5 diagnoses and prevalence rates of 37.5% and 39.8%, respectively (Carmassi et al., 2013). However, both studies reported methodological limitations such as the use of a self-report instrument (Carmassi et al., 2013) and the lack of assessment of functional impairment (both studies), which precludes generalization to other samples.

Clinical implications

This research project evaluated several subjects and themes that are important to accidentally injured children and their parents. Since accidents are widespread, the general and specific findings of this thesis justify systematic clinical attention for the psychological consequences of accidents for children and their parents.

Challenges for improvement in medical care

Acute pain is an example of a modifiable factor in medical care associated with the development of traumatic stress. The identification of potentially modifiable factors makes it possible to intervene and to address these factors beginning with the acute

phase of medical treatment. In Chapter 3 of this thesis, the role of severe acute pain in the development of later PTSD was confirmed. The findings emphasize the importance of the use of pain protocols for children. Measuring pain and intervening according to the pain protocol during the acute phase after an accident can make the difference for children in pain. Besides pain, factors such as severe anxiety, feeling out of control and physical arousal are also well known. The introduction of a child-friendly environment, patient-oriented communication and the availability of interpersonal social support are other examples of factors that can be addressed in medical care (Alisic et al., 2011; Cox, Kenardy, & Hendrikz, 2008; Hildenbrand et al., 2016; Kahana et al., 2006; Kassam-Adams & Butler, 2017). The National Child Traumatic Stress Network developed material and tools for acute stress management by health care professionals (Stuber, Schneider, Kassam-Adams, Kazak, & Saxe, 2006). After considering the medical parameters A-B-C (Airway-Breathing-Circulation), the D-E-Fs (Distress-Emotional support-Family) should have the professional's attention. Each of the three components contains practical guidelines. Examples are: "Actively assess and treat pain", "Give a reassuring explanation about normal stress responses" (Distress); "Encourage expression of emotion, but do not force to talk" (Emotional support); "Promote to seek social support" (Family). The material is modified in a checklist "How to help: D-E-F" for the Dutch practice (Bronner, 2009) and is currently in use in the pediatric intensive care unit in the University Medical Centers location AMC in Amsterdam.

The introduction of Trauma-Informed Care (TIC; *traumasensitieve zorg* in Dutch) offers a way to target medical care related risk factors. TIC is a multidisciplinary approach to reduce the risk of persistent posttraumatic stress and PTSD after injury (Marsac et al., 2016; Weiss et al., 2017), and can be used in all phases of the PMTS model. TIC uses psychotrauma related knowledge in medical practice. Knowledge of pediatric medical traumatic stress and TIC is necessary to understand the potential iatrogenic psychological consequences of medical care for children, and also how to mitigate these consequences (Kassam-Adams & Butler, 2017). Findings of a recent study on TIC in practice on hospital staff and patients (Moss et al., 2019) can be used to prepare implementation of TIC. The practice examples described in this study can be incorporated in staff training programs. International research among health care professionals such as ambulance staff and emergency department staff suggests that there is much variation in knowledge and practice of TIC. Almost all responding staff stated that they want to improve their knowledge and receive training on child

traumatic stress and psychosocial care (Alisic et al., 2011; Alisic et al., 2016). The extent to which aspects of trauma-informed care are currently being used in medical care in the Netherlands is unknown. However, at least two hospitals in the Netherlands (OLVG in Amsterdam and Maastricht UMC), actively promote and implement a trauma-informed approach for children. With this approach, the initiators are aiming to reduce stress, fear and pain, and to improve confidence. They have started to disseminate their approach by training colleagues. The results of our research project support their vision and will hopefully help them in continuing the development of their approach.

Screening, monitoring and intervention

Trauma-informed care can facilitate a hospital monitoring system after injury, including screening for risk, monitoring and timely interventions if needed. Our research project has yielded the STEPP screening tool to identify children and parents at risk for PTSD after accidental injury. The STEPP can serve as a first step in systematic monitoring of accidentally injured children and their parents. It is advisable to screen all children and their parents, regardless of injury severity, hospitalization or other presumed decisive factors. Since posttraumatic stress symptoms can also develop or worsen later on, long-term monitoring is appropriate, which is in accordance with best practice guidelines following acute trauma (NICE, 2005). The emergency department is the only department where the personal data of all accidentally injured persons are available. Consequently, it is the logical starting point for screening and psychological care following accidents. In a pilot project involving six Dutch hospitals, we tested the possibilities for implementing screening for risk of PTSD. Despite very positive reactions, implementation was successful in only one of these hospitals. Evaluation of the project revealed the following main reasons and points of interest. First, extra work such as screening for risk requires re-allocation of financial resources and staff (or deploying additional staff). Second, not all hospital boards, departmental managers or staff feel responsible for preventing mental health problems in their patients. Many of them support the idea of screening, monitoring and prevention. However, when it comes to practical implementation, they suggest that this should be done by others, for example by the general practitioner. Third, partly as a consequence of the preceding points, the emergency department has no infrastructure for psychological or mental health issues, except for patients in an acute psychiatric crisis. At the only hospital where we were able to implement the STEPP, the procedure was integrated into the existing care system following sexual abuse. Fourth, as we stated in our introduction,

the psychological consequences of accidents and injury entail considerable costs for society at large. However, because these costs are not acutely visible, reducing them is not a priority. Our findings suggest that risk screening, monitoring and referral should be integrated into a broader system of hospital care. Furthermore, work needs to be done to illustrate the importance of prevention of mental health problems (see also our recommendations for future research). The results of a recent study on implementation of a standardized screening program for risk of PTSD in injured youth (Price et al., 2019) can give further insight into barriers and facilitators of such a screening program. In this study, the STEPP was integrated into standard care following treatment in a Level I pediatric trauma center. The findings suggest that standardized screening is feasible and that such a program improves the application of TIC. Finally, within a system of screening and monitoring, children and parents with substantial posttraumatic stress symptoms need referral for further diagnostics. Children and parents with PTSD or clinically significant symptoms should then be referred to a registered psychotrauma therapist. In the Netherlands, these professionals can be found via https://www.traumaexperts.nl/verwijzen-naar-een-geregistreerde-professional

Reflections on the limitations of the studies

There are several limitations in the studies that deserve attention because they may influence conclusions and generalizability of our findings. These limitations concern the prevalence of PTSD, drop-out for follow-up and the use of questionnaires.

The prevalence of child PTSD in our studies was lower than expected. This resulted in methodological restrictions: we were not able to determine causal relationships between possible associated factors and PTSD or PTSS, or correct for factors such as variance in time and interaction effects. These restrictions can preclude generalization of our findings. There was a substantial drop-out for the follow-up studies and specifically in the group with PTSD or PTSS at 3 months. This loss to follow-up precludes generalization and conclusions about the change over time. Parental posttraumatic stress was only assessed by questionnaire and not by a clinical interview. Although the questionnaire has a good agreement with the PTSS interview, the outcome is an indication of PTSD but is not a diagnosis. The prevalence of parental PTSS should therefore be interpreted carefully.

Despite these limitations, this thesis has provided new insights into posttraumatic stress following child accidental injury, specifically on prevalence and possibly related factors such as acute pain. Furthermore, a validated instrument for screening for risk of PTSD in the Netherlands is now available. A major strength of our studies is that we used a diagnostic semi-structured clinical interview for parents and children to assess child PTSD at 3 months and at long-term follow-up. Besides this interview, we used the child's self-report of posttraumatic stress symptoms. This is a time-consuming method, but it generates highly reliable results. In addition, our study of algorithms for young children has contributed to the understanding of PTSS in this age group and the development of age-appropriate assessment tools. Another important strength of our studies is the long-term follow-up period for children and parents. Although the follow-up sample was small, a 61% response rate is positive for a long-term study. The inclusion of physical recovery and choices regarding therapy in the longer term studies provided important new insights into the relationship between these factors and posttraumatic stress.

Future research

This thesis provided new insights into the psychological consequences of accidents and accidental injury in children and their parents. However, the individual studies also raised new questions and topics. First, the STEPP screening tool can be refined and further improved to decrease the percentage of false positives. The tool can be tested with DSM-5 criteria. New ways of screening, e.g., via telephone or apps, can be examined and can increase cost-effectiveness of screening. Second, further research on strategies to implement the STEPP can be useful. To implement screening for risk in hospital settings, it will probably be necessary to provide additional results from research and demonstrate the financial benefit of early identification of PTSD. Future research will then be needed before screening for risk becomes financially attractive to health insurance companies and hospital management. Third, the role of pain in the development of PTSD can be further specified in future research, including the interaction between pain and other factors, and the usefulness of acute pain in screening tools such as STEPP. With regard to long-term PTSD in children as well as in parents, research in a larger sample with a fixed follow-up period can further clarify the role of the various factors possibly associated with PTSD. Fourth, since diagnostic

instruments for young children are scarce, there is a need for future research to develop age-appropriate assessment tools for young children. Fifth, to recommend the selection and timing of early interventions, more research on the effectiveness of early interventions after accidental trauma is needed, preferably a randomized controlled trial. Finally, systematic evaluation of the effectiveness of trauma-informed care in reducing pediatric medical stress and prevention of PTSD can yield the information needed for systematic implementation.

Final conclusions

In this thesis, we focused on posttraumatic stress following accidental injury in children and their parents. PTSD after accidental injury is clearly a serious problem for children and their parents. The short and long-term prevalence revealed in this thesis supports an active approach to prevent PTSD and promote resilience. Findings on associated factors such as severe acute pain and permanent physical impairment provide an opportunity to improve the care for accidentally injured children and their parents. This can be brought into practice by implementing a stepped care approach and trauma-informed care. Ongoing efforts are needed to increase awareness for psychological consequences of accidents in all those concerned, from patients to government agencies. This awareness, together with knowledge of the consequences of PTSD, is a precondition for the successful implementation of screening for risk, trauma-informed care and changes in hospital policies and protocols.

CHAPTER 8

Summary

General introduction

Chapter 1 is an introductory chapter about posttraumatic stress after accidental injury in children and adolescents[4] and their parents and about the aims of this thesis. Accidents are a major cause of injury in children and can have great impact on the lives of children and their parents.

In the Netherlands, approximately 123,000 children (aged 8-18[5]; 43% girls, 57% boys) per year are injured in an accident and are subsequently treated in the emergency department of a hospital. In case of potentially life-threatening injury, children are treated in the trauma room of the emergency department, in which staff and equipment for treatment of severe traumatic injuries are available. The accident itself, being transported in the ambulance, the injury, the pain, medical procedures and hospitalization – all can be frightening and potentially traumatic.

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), the first criterion for PTSD is that the person was exposed to death, threatened death, actual or threatened serious injury, or actual or threatened sexual violence in one or more of the following ways: direct exposure, witnessing the trauma, learning that a relative or close friend was exposed to a trauma, or indirect exposure to aversive details of the trauma. PTSD includes symptoms of re-experiencing, avoidance, negative alterations in cognitions and mood and increased arousal. PTSD can be diagnosed if symptoms persist for longer than one month and cause substantial distress or impairment in functioning. Since the studies in this thesis were performed with DSM-IV-TR criteria, the most important differences between DSM-IV-TR and DSM-5 were summarized in this chapter.

PTSD negatively affects children's functioning and physical recovery from injury. Parental posttraumatic stress has an effect on their own functioning and increases the risk of child PTSD. Given the adverse consequences for the children and the parents, identifying persons at risk for PTSD is important. Moreover, it is important to gain insight in risk factors for PTSD, specifically because there are potential risk factors that can be addressed after an accident. An example of such a factor is acute pain. Research

4 For reasons of readability, both groups are generally referred to as 'children' in this thesis.
5 Since the main focus of this thesis is on children aged 8-18, only information on children in this age category is presented here.

on long-term posttraumatic stress and associated factors is scarce. Regarding long-term PTSD, potentially important factors include permanent physical impairment and choices regarding psychotherapy. Trauma-Focused Cognitive Behavior Therapy (TF-CBT) and Eye Movement Desensitization and Reprocessing (EMDR) are recommended in national guidelines in the Netherlands and other countries.

In the Netherlands, hospital care and aftercare with regard to physical consequences of accidental injury is integral to hospital policy and the financial compensation structures of health insurers. This is different for the psychological consequences of accidents. Despite the availability of evidence-based trauma-focused interventions, many children or parents do not receive any form of psychological treatment. An obvious reason is that avoidance is a frequent symptom of PTSD; it is likely that patients will not seek help. Another important reason is that health care practitioners don't recognize symptoms and therefore don't take action. Whether children and parents are offered help or not depends on the circumstances. In response to large accidents or disasters, psychological assistance is provided to many victims almost immediately. Victims are usually informed about normal psychological reactions and how to deal with them, and they are offered screening and adequate short-term and long-term care. For individual accidents, however, such systematic care is absent, even though the total of all victims of accidents, is the equivalent of a yearly disaster.

Best practice recommendations include 'watchful waiting', including screening to identify persons at risk for PTSD and monitoring those who are at risk. Screening for risk can be performed with instruments such as the Screening Tool for Early Predictors of PTSD (STEPP). The STEPP was developed in the USA and appeared to be effective in identifying children and parents at risk for PTSD. If the STEPP was also shown to be effective in the Netherlands, it could contribute to systematic psychological care for children and their parents after an accident.

The aims of this thesis were (1) to evaluate the utility – in the Netherlands – of the STEPP, a screening instrument to identify children and parents at risk for PTSD following child accidental injury, and (2) to examine short and long-term posttraumatic stress in children and parents following child accidental injury, including possibly associated factors such as acute pain, permanent physical impairment and choices regarding trauma-focused psychotherapy. The focus of this thesis is on children between 8 years

and 18 years of age but an exploratory study directed at children below the age of 8 is also included.

Screening for risk of PTSD after accidental injury

Chapter 2 described the results of the evaluation of the Screening Tool for Early Predictors of Posttraumatic Stress Disorder (STEPP) in a mixed-trauma sample in the Netherlands. Children aged 8-18 and one of their parents were recruited at two academic level I trauma centers: AMC and VUmc in Amsterdam, the Netherlands. The STEPP is a stand-alone screening tool. It was developed for use in the acute care setting and for assessment by trained professionals. It consists of 12 questions: 4 questions are asked of the child, 4 questions are asked of the parent and 4 items are obtained from the medical records. Including the items from the medical records, the total score for children is based on 8 items, and the total score for parents is based on 6 items. The items are answered dichotomously with "yes" (= 1) or "no" (= 0). The STEPP was assessed in 161 children (mean age 13.9 years) and 156 parents within one week of the accident. Three months later, clinical diagnoses and symptoms of PTSD were assessed in 147 children and 135 parents. Receiver Operating Characteristic analyses were performed to estimate the performance and to determine the optimal cut-off score in the sample. Since the purpose of screening is to identify children and parents who are at risk of PTSD, a high sensitivity is required, while those who are unlikely to develop PTSD should be screened out with a high negative predictive value. PTSD was diagnosed in 11.6% of the children; 9.6% of their parents scored above the cut-off point for PTSD. At the originally recommended cut-off scores (4 for children, 3 for parents), the sensitivity in our sample was 41% for children and 54% for parents. Negative predictive values were 92% for both groups. Adjusting the cut-off scores to 2 improved sensitivity to 82% for children and 92% for parents, with negative predictive values of 92% and 96%, respectively. With adjusted cut-off scores, the STEPP performed well: 82% of the children and 92% of the parents with a subsequent positive diagnosis were identified correctly. The study results show that the STEPP is a valid and useful instrument that can be used in the Netherlands as a first screening method in stepped psychotrauma care following accidents. Due to a high rate of false positives, however, special attention in the screening procedure is required.

Acute pain and later PTSD

In addition to factors included in the STEPP screening instrument, we examined to which extent acute pain contributes to later posttraumatic stress. **Chapter 3** provided the results of this prospective cohort study. Participants were 135 children, 8-18 years old. We examined the association between acute pain from accidental injury and PTSS in children, taking into account factors potentially related to pain or posttraumatic stress. Within two weeks of the accident we measured the worst experienced pain since the accident took place with a visual analogue scale. Three months after the accident, posttraumatic stress was assessed with a self-report measure. In the total group we found a positive association between acute pain and posttraumatic stress. The amount of pain was negatively associated with injury severity in girls and positively associated with the presence of an extremity fracture in boys. In children who reported severe pain, this pain was significantly associated with PTSS and may account for around 10% of the variance in the severity of posttraumatic stress symptoms. Although the experience of pain is subjective, our study indicates that severe pain is associated with the severity of later posttraumatic stress symptoms. Timely management of pain according to acute pain protocols in all phases and disciplines after accidental injury is therefore recommended. In addition to medication, psychological strategies can be of great help in pain relief. They can be used in accordance with the situation and the child's characteristics and preferences. Examples of psychological strategies are distraction, paying attention to the child's fear, explanation of medical routine, reassurance, and encouraging parents' involvement.

Long-term consequences of accidents in children: the follow-up study

Chapter 4 provided the results of the 2–4-year follow-up study. Although the long-term impact of traumatic events can be substantial, research on the long-term psychological consequences of accidental injury is scarce. We assessed diagnosed PTSD and clinically significant self-reported posttraumatic stress symptoms (PTSS) in 90 children (11-22 years of age, 60% boys and 40% girls) at 2–4 years after their accident. The outcome was compared to the first assessment 3 months after the accident in 147 children, 8-18 years of age. The prevalence of PTSD was 11.6% at first assessment and 11.4% at follow-up. Our results revealed a substantial difference between children with and without PTSD regarding permanent physical impairment, indicating an association between the presence of PTSD and permanent physical impairment. In this study we

also examined the association between acute pain, trauma history, new traumatic events and long-term posttraumatic stress but we found no association.

Our findings showed that the long-term prevalence of PTSD in children following accidents is comparable to the short-term prevalence. Over the long term, PTSD was related to a new traumatic event or to the initial accident. In our study, a small number of children completed trauma-focused psychotherapy after the accident. At follow-up they had still no symptoms or low levels of symptoms, in contrast to those who did not complete psychotherapy. A substantial number of the participating children reported permanent physical impairment, ongoing physical problems and negative consequences on their education, social life and future plans. Adolescence in combination with permanent impairment may have an influence on later PTSD, as this can be a sensitive period during which this age group is making future plans. The consequence may be that adolescents are more at risk for long-term negative psychological outcome when permanent physical impairment negatively influences their future plans. Further research, preferably in a larger sample, is needed to test this hypothesis and other possible explanations regarding an association between permanent physical impairment and PTSD.

Long-term parental posttraumatic stress after a child's accident

In **Chapter 5**, we presented the results of a study on parental posttraumatic stress. Accidental injury in children also affects the parents and puts them at risk for developing PTSS. Parents' PTSS can influence the adaptation of their children after an accident and can increase the risk of child PTSS.

We determined the prevalence of PTSS in 69 parents 2–4 years after accidental injury of their child (T2) and compared the results with PTSS in 135 parents 3 months after the accident (T1). Children were 8-18 years old at the time of the accident. Parental PTSS was 9.6% at T1 and 5.8% at T2. However, 9 out of 13 parents with PTSS at T1 were lost to follow-up. If all parents with PTSS at T1 had participated at T2, it is likely that the prevalence at T2 would have been higher. We also examined the association between parental and child factors and severity of parental PTSS. Acute parental stress was significantly associated with parental PTSS severity (T1 and T2), as was child's hospitalization of more than 1 day at T1 and the child's permanent physical

impairment at T2. To prevent adverse long-term psychological consequences we recommend identifying and monitoring parents at risk and offering them timely treatment. Special attention is required for parents with acute stress symptoms and parents with children at risk for permanent physical impairment. Further research is necessary to confirm the prevalence of long-term PTSS in parents, and to confirm the role of factors associated with PTSS severity and their possible interaction.

Posttraumatic stress in young children after an accident

Chapter 6 provided the results of an exploratory study to examine algorithms for posttraumatic stress reactions in accidentally injured children up to 8 years old. Both the DSM-5 algorithm for posttraumatic stress disorder (PTSD) in children 6 years and younger and Scheeringa's alternative PTSD algorithm (PTSD-AA) were intended to be more developmentally sensitive for young children than the DSM-IV PTSD algorithm. We compared the three algorithms simultaneously and explored diagnostic outcomes of the algorithms in young child survivors of accidental trauma. Parents of 98 young children (0-7 years) involved in an accident between 2006 and 2012 participated in a semi-structured telephone interview to assess child's posttraumatic stress symptoms. A total of 9 of the children (9.2%) showed substantial PTSS. Of these children, 2 met the criteria of all three algorithms, 7 met both the DSM-5 subtype for children 6 years and younger and the PTSD-AA algorithm, and 2 did not fully meet any of the algorithms (subsyndromal PTSD). For young children, the DSM-5 subtype for children 6 years and younger and the PTSD-AA algorithm appear to be better suited than the previous DSM-IV algorithm. Our results suggest that the DSM-5 subtype for PTSD in children 6 years and younger is an important improvement in identifying young children with PTSD compared to the DSM-IV algorithm. Nevertheless, clinicians should still be aware that some children with subsyndromal PTSD who may need trauma-focused treatment can stay unidentified.

General discussion

In **Chapter 7**, we reflected on the main themes and issues regarding posttraumatic stress following accidental injury in children and their parents that emerged from our findings. The rationale for screening for risk and its possible negative side effects

are outlined. We evaluated the utility of the STEPP with adjusted cut-off scores and recommended how to use this instrument to address possible negative side-effects.

We discussed our findings in the light of the model of Pediatric Medical Traumatic Stress (PMTS) to support understanding of individual risk factors and the importance of screening and monitoring, also in the long-term. The implications of the introduction of DSM-5 criteria for PTSD were discussed in the light of the utility of the STEPP and the prevalence of PTSD.

Clinical implications of our findings were discussed regarding two important themes: Challenges for improvement in medical care and Screening, monitoring and intervention. In the first section we described the benefits of identifying potentially modifiable factors such as acute pain and anxiety. Recognizing these factors provide the opportunity to intervene and address them, thus contributing to prevention of adverse psychological consequences. We discussed the introduction of Trauma-Informed Care (TIC) as a way to target medical care-related risk factors for PTSD. TIC is a multidisciplinary approach to reduce the risk of persisting posttraumatic stress and PTSD after injury. It uses psychotrauma-related knowledge in medical practice. In the second section we discussed the barriers and facilitators of introducing and implementing screening for risk and subsequent care in hospital settings. We argued that prevention of PTSD can save considerable costs for society. Limitations of the studies were discussed and recommendations for future research were made.

In the final conclusions we recommended implementing a stepped care approach including screening for risk and trauma-informed care. Ongoing efforts are needed to increase awareness for psychological consequences of accidents in all those concerned. Increased awareness and knowledge of psychological consequences of PTSD are preconditions for successful implementation of screening for risk and trauma-informed care and changes in hospital policies and protocols.

CHAPTER 9

Samenvatting (Summary in Dutch)

Algemene inleiding

Hoofdstuk 1 is een inleidend hoofdstuk over posttraumatische stress na ongevallen bij kinderen en adolescenten[6] en hun ouders, en het doel van dit proefschrift. Ongevallen zijn een belangrijke oorzaak van letsel bij kinderen en kunnen van grote invloed zijn op het leven van kinderen en hun ouders. In Nederland worden circa 123.000 kinderen per jaar tussen 8 en 18 jaar[7] (43% meisjes en 57% jongens) behandeld op de afdeling Spoedeisende Hulp (SEH) van een ziekenhuis nadat ze gewond zijn geraakt bij een ongeluk. Kinderen met potentieel levensbedreigend letsel worden behandeld in de traumakamer van de SEH waar men toegerust is voor de behandeling van patiënten met ernstig traumatisch letsel. Het ongeluk zelf, maar ook alle gebeurtenissen daarna kunnen beangstigend zijn en potentieel traumatisch.

Volgens DSM-5 is het eerste criterium voor posttraumatische stress stoornis (PTSD)[8] blootstelling aan een feitelijke of dreigende dood, ernstig letsel of seksueel geweld op een (of meer) van de volgende manieren: zelf ondergaan, getuige zijn, vernemen dat een naast familielid of goede vriend dit is overkomen, of indirecte blootstelling. PTSD omvat symptomen van herbeleving, vermijding, negatieve veranderingen in cognities en stemming en duidelijke veranderingen in arousal en reactiviteit. Als de duur van de symptomen langer is dan een maand en er is sprake van klinisch significante lijdensdruk of beperkingen dan kan de diagnose PTSD gesteld worden. Omdat voor de onderzoeken in dit proefschrift de criteria van DSM-IV-TR gebruikt zijn, zijn de belangrijkste verschillen tussen DSM-IV-TR en DSM-5 samengevat in dit hoofdstuk.

PTSD heeft een negatieve invloed op het functioneren en het beïnvloedt het lichamelijk herstel. Posttraumatische stress symptomen bij ouders hebben invloed op hun functioneren en verhoogt het risico van PTSD bij hun kind. Gezien de negatieve invloed voor kinderen en ouders is het belangrijk om degenen die risico lopen op PTSD snel te herkennen. Daarnaast is het van belang inzicht te krijgen in risicofactoren voor PTSD, zeker omdat er potentiële risicofactoren zijn waarop direct na een ongeluk actie ondernomen kan worden. Een voorbeeld hiervan is acute pijn. Over de lange termijn gevolgen van PTSD na een ongeluk en de factoren die

6 Voor de leesbaarheid wordt voor beide groepen de term 'kinderen' gebruikt in dit proefschrift.
7 Omdat het onderzoek in dit proefschrift voornamelijk gericht is op kinderen van 8 tot 18 jaar, wordt hier alleen informatie over deze leeftijdsgroep gegeven.
8 Om verwarring te voorkomen worden in de Nederlandse samenvatting dezelfde afkortingen gehanteerd als in het proefschrift en in de Engelse samenvatting.

daarmee samenhangen is nog weinig bekend. Potentieel belangrijke factoren voor de lange termijn zijn bijvoorbeeld blijvende lichamelijke beperkingen en de keuze met betrekking tot psychotraumabehandeling. De behandelingen die nationaal en internationaal worden aanbevolen zijn Trauma-Gerichte Cognitieve Gedrags Therapie (TF-CBT) of Eye Movement Desensitization and Reprocessing (EMDR).

In Nederland is de zorg vanwege de lichamelijke gevolgen van ongelukken vanzelfsprekend en ingebed in het beleid van de ziekenhuizen en de vergoedingenstructuur van de zorgverzekeringen. Voor de psychische gevolgen ligt dat anders. Ondanks de beschikbaarheid van effectieve behandelingen krijgen veel kinderen en ouders die niet. Een van de redenen is dat vermijding een veel voorkomend symptoom van PTSD is. Ondanks klachten zoekt men geen behandeling. Een andere belangrijke reden is dat veel medische professionals de symptomen niet herkennen en daarom geen actie ondernemen. Of kinderen en ouders hulp krijgen is zo afhankelijk van omstandigheden. Bij grote ongelukken en rampen met veel slachtoffers is er snel psychische ondersteuning. Slachtoffers worden geïnformeerd over normale psychologische reacties en hoe daarmee om te gaan en er wordt korte en lange termijn screening en psychische nazorg geboden. Hoe anders is dit bij individuele ongelukken, terwijl het wel elk jaar opnieuw een ramp is als alle individuele slachtoffers bij elkaar opgeteld worden.

De belangrijkste aanbeveling in richtlijnen is 'watchful waiting'. Dit houdt ook in risicoscreening en het volgen van degenen die risico lopen op PTSD. Risicoscreening kan met instrumenten zoals de Screening Tool for Early Predictors of PTSD (STEPP). De STEPP is in de VS ontwikkeld en daar effectief gebleken in het herkennen van kinderen en ouders met risico op PTSD. Als dit instrument in Nederland bruikbaar zou blijken, dan kan dit bijdragen aan systematische psychische zorg voor kinderen en ouders na een ongeluk.

De doelen van dit proefschrift waren (1) het evalueren van de bruikbaarheid van de STEPP in Nederland, en (2) het onderzoeken van korte en lange termijn posttraumatische stress bij kinderen en hun ouders na letsel bij het kind door een ongeval. Hierin zijn factoren inbegrepen die mogelijk samenhangen met PTSD zoals acute pijn, blijvende lichamelijke beperkingen en keuze met betrekking tot psychotraumabehandeling. De nadruk in dit proefschrift ligt op kinderen van 8 tot 18

jaar en hun ouders maar er is ook een exploratief onderzoek opgenomen dat gericht is op kinderen tot 8 jaar.

Screenen op risico van PTSD

In **Hoofdstuk 2** worden de resultaten beschreven van de evaluatie van de Screening Tool for Early Predictors of PTSD (STEPP) in een steekproef van slachtoffers van verschillende typen ongevallen in Nederland. Kinderen van 8 tot 18 jaar en een van hun ouders werden voor deelname geworven in twee academische ziekenhuizen, AMC en VUmc in Amsterdam. Beide ziekenhuizen zijn level I traumacentra, toegerust voor behandeling van patiënten met traumatisch letsel.

De STEPP is een screeninginstrument dat werd ontwikkeld voor gebruik door getrainde professionals in de acute zorg. De STEPP bestaat uit 12 vragen: 4 aan het kind, 4 aan de ouder, en 4 te beantwoorden uit het medisch dossier. De totale score voor kinderen is gebaseerd op 8 vragen die van ouders op 6 vragen. Beide scores zijn inclusief de vragen uit het medisch dossier. De antwoorden zijn dichotoom: "ja" (=1) of "nee" (=0). De STEPP is binnen een week na het ongeluk afgenomen bij 161 kinderen (gemiddelde leeftijd 13,9 jaar) en 156 ouders. Drie maanden later werd met een semigestructureerd interview bij 147 kinderen en met een vragenlijst bij 135 ouders gemeten of er een PTSD diagnose of klinisch significante PTSS vastgesteld kon worden. Met Receiver Operating Characteristics analyses werd de prestatie van de STEPP in de steekproef gemeten en het optimale afbreekpunt geschat. Omdat het doel van screening is de herkenning van kinderen en ouders met een risico op PTSD is een hoge sensitiviteit vereist. Daarnaast is een hoge negatieve predictieve waarde nodig om degenen te identificeren die geen PTSD zullen ontwikkelen. Van de kinderen kreeg 11,6% de diagnose PTSD en 9,6% van de ouders had een score boven het afbreekpunt voor PTSD op de vragenlijst. Met de oorspronkelijk aanbevolen afbreekpunten (4 voor kinderen, 3 voor ouders) was de sensitiviteit in onze steekproef 41% voor kinderen en 54% voor ouders. Voor beide groepen was de negatieve predictieve waarde 92%. Na aanpassing van de afbreekpunten naar 2 werd de sensitiviteit voor kinderen 82% en voor ouders 92%, met negatieve predictieve waardes van respectievelijk 92% en 96%. Met aangepaste afbreekpunten presteert de STEPP goed: 82% van de kinderen en 92% van de ouders werden juist herkend. De resultaten tonen aan dat de STEPP een valide en bruikbaar instrument is voor een eerste screening in psychische zorg na

ongelukken in Nederland. Vanwege het hoge percentage vals positieven is speciale aandacht hiervoor nodig in de screening procedure.

Acute pijn en latere PTSD

Aanvullend op de factoren in de STEPP hebben we onderzocht in welke mate acute pijn bijdraagt aan posttraumatische stress. In **Hoofdstuk 3** staan de resultaten van dit onderzoek. We hebben het verband onderzocht tussen acute pijn door het ongeluk en klinisch significante posttraumatische stress symptomen (PTSS) bij de kinderen, daarbij rekening houdend met factoren die verband zouden kunnen hebben met pijn of met PTSS. Binnen twee weken na het ongeluk werd met een visuele analoge schaal bepaald wat de ergste pijn was die kinderen sinds het ongeluk hadden ervaren. Drie maanden na het ongeluk vulden de kinderen een vragenlijst voor PTSS in. Er bleek een positief verband te zijn tussen acute pijn en posttraumatische stress in de totale groep. De mate van pijn had een negatief verband met de letselernst bij meisjes en een positief verband met een fractuur aan extremiteiten bij jongens. Bij de kinderen met ernstige acute pijn was er een significant verband tussen de pijn en PTSS; circa 10% van de variantie in de ernst van de symptomen was toe te schrijven aan pijn. Hoewel pijnervaring subjectief is wijzen de resultaten van ons onderzoek erop dat ernstige pijn verband houdt met de ernst van de latere posttraumatische stress symptomen. Tijdige pijnbestrijding volgens protocol in alle fasen na het ongeluk en door alle disciplines wordt daarom aanbevolen. Behalve medicatie kunnen ook psychologische methodes ingezet worden voor verlichting van de pijn. Deze methodes kunnen gebruikt worden naargelang de situatie en de kenmerken en voorkeuren van het kind. Voorbeelden van psychologische methodes zijn afleiding, aandacht besteden aan de angst, uitleg van de medische gang van zaken, geruststellen en het stimuleren van betrokkenheid van de ouders.

Lange termijn gevolgen van ongevallen bij kinderen: het follow-up onderzoek

Hoewel de lange termijn gevolgen van traumatische gebeurtenissen aanzienlijk kunnen zijn, is onderzoek ernaar schaars. De kinderen uit het STEPP-onderzoek zijn 2-4 jaar later opgevolgd. De resultaten van dit onderzoek worden beschreven in **Hoofdstuk 4**. PTSD en PTSS werd gemeten bij 90 kinderen (11-22 jaar, 60% jongens

en 40% meisjes) Het resultaat werd vergeleken met dat van 3 maanden na het ongeluk bij 147 kinderen (8-18 jaar). De prevalentie van PTSD was 11.6% na 3 maanden en 11.4% bij de follow-up. Uit de resultaten bleek een substantieel verschil tussen kinderen met en zonder PTSD in het voorkomen van blijvende lichamelijke beperkingen. Dit is een indicatie voor een verband tussen PTSD en blijvende lichamelijk beperkingen. In ons onderzoek werd geen verband gevonden tussen acute pijn, traumageschiedenis, nieuwe traumatische gebeurtenissen en lange termijn posttraumatische stress.

Onze resultaten toonden aan dat de prevalentie van PTSD op de lange termijn vergelijkbaar is met die op de korte termijn. De lange termijn PTSD was gerelateerd aan een nieuwe traumatische gebeurtenis of aan het ongeluk. Een klein aantal kinderen rondde na het ongeluk een psychotraumagerichte behandeling af. Bij het follow-up onderzoek hadden zij nog steeds geen of weinig klachten, in tegenstelling tot degenen die geen behandeling hadden gehad of met de behandeling gestopt waren. Een aanzienlijk aantal kinderen rapporteerde blijvende lichamelijke beperkingen, voortdurende lichamelijke problemen en negatieve gevolgen voor hun opleiding, sociale leven en toekomstplannen. De lange termijn PTSD kan te maken hebben met het feit dat de lichamelijke beperkingen ontstaan in de adolescentie, de periode waarin veelal toekomstplannen worden gemaakt. De consequentie kan zijn dat adolescenten met blijvende lichamelijke beperkingen meer risico lopen op PTSD. Er is vervolgonderzoek nodig, bij voorkeur in een grotere steekproef, om deze hypothese en andere mogelijke verklaringen voor het verband tussen blijvende lichamelijke beperkingen en PTSD te testen.

Lange termijn posttraumatische stress bij ouders na het ongeluk van hun kind

In **Hoofdstuk 5** worden de resultaten van een onderzoek naar posttraumatische stress bij de ouders beschreven. Letsel door een ongeval bij kinderen heeft ook gevolgen voor de ouders; zij lopen het risico op PTSS. PTSS bij de ouders kan van invloed zijn op de adaptie van het kind na het ongeluk en kan het risico op PTSS bij het kind vergroten. PTSS werd 2-4 jaar na het ongeluk gemeten bij 69 ouders (T2) en vergeleken met de meting van 3 maanden na het ongeluk bij 135 ouders (T1). De kinderen waren 8-18 jaar ten tijde van het ongeluk. Op T1 was de prevalentie van PTSS 9,6% en op T2 was het 5,8%. Van de 13 ouders met PTSS op T1 namen er 9 niet deel aan het

vervolgonderzoek op T2. Als zij wel hadden deelgenomen zou de prevalentie op T2 waarschijnlijk hoger zijn geweest. We onderzochten ook het verband tussen een aantal ouder- en kindfactoren en de ernst van de PTSS bij de ouders. Er bleek een significant verband te zijn tussen acute stress bij de ouders en PTSS bij de ouders op T1 en T2. Ook was er een significant verband tussen de opnameduur van het kind (meer dan 1 dag) en PTSS op T1 en tussen blijvende lichamelijke beperkingen bij het kind en PTSS op T2. Om de negatieve gevolgen voor ouders te voorkomen wordt aanbevolen om ouders die risico lopen op PTSS tijdig te identificeren, ze te volgen en ze behandeling aan te bieden zodra dat geïndiceerd is. Extra aandacht is nodig voor ouders met acute stress symptomen en ouders van kinderen met blijvende lichamelijke beperkingen. Er is meer onderzoek nodig ter bevestiging van de prevalentie van PTSS op de lange termijn, de rol van de factoren die verband houden met de ernst van PTSS en hun mogelijke interactie.

Posttraumatische stress bij jonge kinderen na een ongeluk

In **Hoofdstuk 6** worden de resultaten beschreven van een exploratief onderzoek naar de algoritmes voor posttraumatische stressreacties bij kinderen tot 8 jaar die gewond zijn geraakt bij een ongeluk. Het DSM-5 algoritme voor PTSD bij kinderen van 6 jaar en jonger en het alternatieve algoritme van Scheeringa (PTSD-AA) waren allebei bedoeld om posttraumatische stress ontwikkelingssensitiever te meten dan het DSM-IV algoritme. In dit onderzoek zijn de drie algoritmes gelijktijdig vergeleken en hebben we diagnostische uitkomsten ervan onderzocht in jonge kinderen die een ongeluk meegemaakt hadden. Bij ouders van 98 kinderen (0 t/m 7 jaar) die betrokken waren bij een ongeluk tussen 2006 en 2012 werd telefonisch een semigestructureerd interview afgenomen om de posttraumatische stress symptomen van de kinderen te bepalen. Bij 9 kinderen (9,2%) werden substantiële posttraumatische stress symptomen vastgesteld. Van deze 9 kinderen voldeden er 2 aan alle drie de algoritmes, 7 voldeden zowel aan het DSM-5 algoritme als aan het PTSD-AA algoritme en 2 voldeden aan geen van de subtypes volledig (subsyndromale PTSD). Voor jonge kinderen blijken het DSM-5 algoritme voor jonge kinderen en het PTSD-AA algoritme beter geschikt dan het DSM-IV algoritme. Desalniettemin zouden professionals zich er bewust van moeten blijven dat sommige kinderen met subsyndromale PTSD die behandeling nodig hebben, niet als zodanig herkend worden.

Algemene discussie

In **Hoofdstuk 7** worden de belangrijkste thema's en onderwerpen beschouwd met betrekking tot posttraumatische stress na een ongeluk bij kinderen en hun ouders die uit de onderzoeken naar voren kwamen. De rationale voor risicoscreening en de mogelijke negatieve neveneffecten worden beschreven. We evalueerden de bruikbaarheid van de STEPP met aangepaste afbreekscores en deden aanbevelingen om de mogelijke negatieve neveneffecten tegen te gaan.

De rol van de individuele risicofactoren en het belang van risicoscreening en monitoring zijn besproken in het kader van het Pediatrische Medische Traumatische Stress (PMTS) model. De implicaties van de invoering van DSM-5 criteria voor de bruikbaarheid van de STEPP en de prevalentie van PTSD zijn toegelicht.

De klinische implicaties van de bevindingen in dit proefschrift worden besproken in twee belangrijke thema's: 'Uitdagingen voor verbetering in de medische zorg' en 'Screening, volgen en interventie'. In het eerste deel worden de voordelen besproken van het identificeren van factoren die veranderd kunnen worden. Acute pijn en angst zijn hier voorbeelden van. Het identificeren van deze factoren heeft als voordeel dat er iets aan gedaan kan worden, wat bijdraagt aan het voorkomen van negatieve psychologische gevolgen. Het invoeren van traumasensitieve zorg (Trauma-Informed Care, TIC) is een manier om iets te doen aan medisch gerelateerde risicofactoren voor PTSD. Traumasensitieve zorg is een multidisciplinaire benadering om het risico op aanhoudende posttraumatische stress en PTSD na een ongeval en letsel te beperken. In deze benadering wordt gebruik gemaakt van kennis over psychotrauma in de medische praktijk. In het tweede deel van de klinische implicaties worden belemmerende en bevorderende factoren bij de introductie en het implementeren van risicoscreening en de daarop volgende zorg besproken. We betoogden dat preventie van PTSD een aanzienlijke kostenbesparing voor de samenleving kan betekenen.

Vervolgens worden de beperkingen van de onderzoeken belicht en worden suggesties gedaan voor vervolgonderzoek.

In de eindconclusie wordt aanbevolen stapsgewijze zorg na ongevallen, inclusief risicoscreening, en traumasensitieve zorg in te voeren. Voortdurende inspanning blijft

nodig om het bewustzijn over de psychologische gevolgen van ongelukken bij alle betrokkenen te vergroten. Voorwaarde voor het succesvol invoeren van risicoscreening en traumasensitieve zorg, en voor verandering in beleid en richtlijnen, is toename van het bewustzijn en de kennis over psychische gevolgen van ongelukken en PTSD.

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Contributors' statement

Predicting posttraumatic stress disorder in children and parents following accidental child injury: evaluation of the Screening Tool for Early Predictors of Posttraumatic Stress Disorder (STEPP)

Els van Meijel participated in the design and funding of the study, collected the data, performed the statistical analysis and drafted the manuscript; Maj Gigengack participated in the collection and interpretation of data and provided administrative and technical support; Eva Verlinden participated in the collection of data; Brent Opmeer participated in the design and funding of the study and advised on the interpretation of data and statistical analyses. Hugo Heij, Carel Goslings, Frank Bloemers and Jan Luitse participated in the design of the study and provided all necessary support for the collection of the data and the interpretation of the medical data. Frits Boer participated in the design and funding of the study and provided study supervision. Martha Grootenhuis participated in the interpretation of data and provided study supervision. Ramón Lindauer participated in the design and funding of the study and provided study supervision. All authors participated in critical revision of the manuscript.

The association between acute pain and posttraumatic stress symptoms in children and adolescents three months after accidental injury

Els van Meijel participated in the design and funding of the study, collected the data, performed the statistical analysis and drafted the manuscript; Maj Gigengack participated in the collection and interpretation of data and provided administrative and technical support; Eva Verlinden participated in the collection of data; Alida van der Steeg, Carel Goslings, Frank Bloemers and Jan Luitse provided all necessary support for the collection of the data and the interpretation of the medical data. Frits Boer participated in the design and funding of the study and provided study supervision. Martha Grootenhuis participated in the interpretation of data and provided study supervision. Ramón Lindauer participated in the design and funding of the study and provided study supervision. All authors participated in critical revision of the manuscript.

Long-term posttraumatic stress following accidental injury in children and adolescents: results of a 2–4-year follow-up study

Els van Meijel participated in the design and funding of the study, collected the data, performed the statistical analysis and drafted the manuscript; Maj Gigengack participated in the collection and interpretation of data and provided administrative and technical support; Eva Verlinden participated in the collection of data; Alida van der Steeg, Carel Goslings, Frank Bloemers and Jan Luitse provided all necessary support for the collection of the data and the interpretation of the medical data. Frits Boer participated in the design and funding of the study and provided study supervision. Martha Grootenhuis participated in the interpretation of data and provided study supervision. Ramón Lindauer participated in the design and funding of the study and provided study supervision. All authors participated in critical revision of the manuscript.

Short and long-term parental posttraumatic stress after a child's accident: prevalence and associated factors

Els van Meijel participated in the design and funding of the study, collected the data, performed the statistical analysis and drafted the manuscript; Maj Gigengack participated in the collection and interpretation of data and provided administrative and technical support; Eva Verlinden participated in the collection of data; Alida van der Steeg, Carel Goslings, Frank Bloemers and Jan Luitse provided all necessary support for the collection of the data and the interpretation of the medical data. Frits Boer participated in the design and funding of the study and provided study supervision. Martha Grootenhuis participated in the interpretation of data and provided study supervision. Ramón Lindauer participated in the design and funding of the study and provided study supervision. All authors participated in critical revision of the manuscript.

Comparing Three Diagnostic Algorithms of Posttraumatic Stress in Young Children Exposed to Accidental Trauma: an exploratory study

Maj Gigengack participated in the design of the study, collected the data, performed the statistical analysis and drafted the manuscript; Els van Meijel participated in the design of the study, collection and interpretation of data and the statistical analysis; Eva Alisic participated in the interpretation of data; Ramón Lindauer participated in the design of the study and provided study supervision. All authors participated in critical revision of the manuscript.

PhD portfolio

PhD period 2008-2013.

	Year	Workload (ECTS)
PhD training		
Courses AMC Graduate School		
Clinical Data Management	2009	0.6
Oral presentations in English	2009	0.8
Practical Biostatics	2010	1.1
Systematic Reviews	2010	0.7
Scientific Writing in English for Publication	2011	1.5
BROK (Good Clinical Practice)	2012	0.9
Other training and workshops		
Workshop Expertise child maltreatment, de Bascule, Amsterdam	2008	0.1
Workshop Pimp my poster, AMC, Amsterdam	2009	0.1
Workshop Acquiring external finance, University of Amsterdam	2009	0.1
Advanced conversation in English, Volksuniversiteit, Amsterdam	2009	0.7
Training PhD and Communication, University of Amsterdam	2010	0.4
Conferences, seminars and lectures		
World congress of the International Association for Child and Adolescent Psychiatry (IACAPAP), Istanbul, Turkey.	2008	1
Seminar Psychotrauma in Development, Utrecht	2008	0.2
Congress Nederlandstalige Vereniging voor Psychotrauma (NtVP), Zwolle.	2008	0.25
Seminar Long-term consequences of injury, Amsterdam	2008	0.1
Lecture Arieh Y. Shalev, Amsterdam	2008	0.1
European Conference on Traumatic Stress, Oslo, Norway.	2009	0.75
Seminar Trauma Focused Cognitive Behavioral Therapy, Amsterdam	2009	0.1
Jaap Christoffels Symposium, Amsterdam	2009	0.1
Conference Pediatric Medical Traumatic Stress, Emma Children's Hospital, Amsterdam	2009	0.2
Symposium Paediatric Psychology Network, Amsterdam	2009	0.2
ZonMw congress Youth in research, Nieuwegein	2010	0.2
Congress Trauma and attachment in children, Leiden	2010	0.25
World congress of the International Association for Child and Adolescent Psychiatry (IACAPAP), Beijing, China.	2010	1
Congress Nederlandstalige Vereniging voor Psychotrauma (NtVP), Amsterdam	2010	0.25
Seminar PTSD and DSM-5, Utrecht	2010	0.1
Symposium Globalization of knowledge, Amsterdam	2010	0.1
Congress Nederlandse Vereniging voor Psychiatrie (NVvP), Amsterdam	2011	0.25
Symposium Children and Trauma, Utrecht	2011	0.1
European Conference on Traumatic Stress, Vienna, Austria.	2011	1
Conference Paediatric Psychology Network, Nijmegen	2011	0.2
Symposium Stress, resilience and plasticy, Amsterdam	2011	0.1
Congress Nederlandstalige Vereniging voor Psychotrauma (NtVP), Amsterdam	2011	0.2

Symposium PTSD's; moving to a personalized approach, Ede	2012	0.25
Symposium Grief in children, Utrecht	2012	0.2
Anna Reynvaan lecture on Pain, Amsterdam	2012	0.1
Conference Paediatric Psychology Network, Oxford, UK	2012	0.5
World congress of the International Association for Child and Adolescent Psychiatry (IACAPAP), Paris, France.	2012	1
Symposium Trauma in children and adolescents, Utrecht	2012	0.1
European Conference on Traumatic Stress, Bologna, Italy	2013	1
Symposium Trauma treatment in complex situations, Amsterdam	2013	0.25
Symposium Traces of trauma and its treatment, Amsterdam	2013	0.1
Annual conference International Society of Traumatic Stress Studies (ISTSS), Philadelphia, USA	2013	0.75
Oral Presentations		
Posttraumatic stress reactions in children and adolescents after road traffic accidents. World Congress of IACAPAP, Istanbul, Turkey	2008	0.5
Dutch research experiences: The STEPP-project in the Netherlands. Conference Pediatric Medical Traumatic Stress, Emma Children's Hospital, Amsterdam	2009	0.5
The role of pain in pediatric posttraumatic stress following accidents. World Congress of IACAPAP, Beijing, China	2010	0.5
The role of pain in posttraumatic stress disorder in children following accidents. Congress NVvP, Amsterdam	2011	0.5
Pain as a factor in identifying children at risk after an accident. Conference Paediatric Psychology Network, Nijmegen	2011	0.5
Scientific research and clinical practice. Symposium Trauma treatment in complex situations, Amsterdam	2013	0.5
Screening for Risk of Posttraumatic Stress Disorder in Children and Parents following accidents. Annual conference ISTSS, Philadelphia USA	2013	0.5
Poster Presentations		
Early screening for risk of posttraumatic stress symptoms in children and parents after accidents. European Conference on Traumatic Stress, Oslo, Norway	2009	0.5
Posttraumatic Stress Symptoms in Children after Accidents: Two studies on prediction and treatment of PTSD, 2008-2012. Symposium Paediatric Psychology Network, Amsterdam	2009	0.5
Screening for risk of posttraumatic stress in children and parents after an accident. Congress NtVP, Amsterdam	2010	0.5
The role of parental stress in child's posttraumatic stress disorder following accidents. Conference Paediatric Psychology Network, Oxford, UK	2012	0.5
Can pain predict pediatric posttraumatic stress disorder following accidents? World Congress of IACAPAP, Paris, France	2012	0.5
PTSD, risk and resilience: results of a follow-up study in children and parents following accidental injury. Annual conference ISTSS, Philadelphia, USA	2013	0.5
Teaching		
Guest Lecturing		
Perspectives (JUCO), 2nd year medical students AMC	2008	0.2
Attitude/skills, 3rd year medical students AMC	2008	0.2
Child maltreatment, medical students AMC	2008	0.2

Psychological consequences of child accidental injury, children's ward staff AMC	2008	0.2
Psychological consequences of child accidental injury, emergency department staff AMC	2008	0.2
Psychological consequences of child accidental injury, trauma surgery staff AMC	2008	0.2
Attitude/skills, 3rd year medical students AMC	2009	0.3
Psychological consequences of child accidental injury, trauma surgery staff AMC	2009	0.1
Psychological consequences of child accidental injury, emergency department staff AMC	2009	0.1
Psychological consequences of child accidental injury, children's ward staff AMC	2009	0.1
Psychological consequences of child accidental injury, children's ward staff VUmc	2009	0.1
Attitude/skills, 3rd year medical students AMC	2010	0.2
Psychological consequences of child accidental injury, emergency department staff AMC	2010	0.1
Psychological consequences of child accidental injury, children's ward staff AMC	2010	0.1
Psychological consequences of child accidental injury, children's ward staff VUmc	2010	0.1
Attitude/skills, 3rd year medical students AMC	2011	0.2
Developmental Psychopathology 2nd year medical students AMC	2011	0.1
PTSD following accidents, emergency department medical specialists in training, VUmc	2012	0.1
Attitude/skills, 3rd year medical students AMC	2013	0.4
Supervising		
Medical student M. Meynen	2011	3
Parameters of esteem		
Grants		
ZonMw grant number 15700.1014	2007	
ZonMw grant number 15701.0005 (co-applicant)	2007	
ZonMw grant number 15700.0950.09	2014	
Publications		
Peer reviewed		

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Els
Arnhem, september 2019

Curriculum Vitae

Els was born on October 31, 1955, in Venray, the Netherlands. She grew up with her parents, four younger brothers and two younger sisters. She finished her pre-university education (VWO) at Boschveldcollege in Venray in 1974. In the following years she worked in various jobs, ending this period in a staff position in an insurance company. In 1991, Koos and Els had a daughter, Lotte. From 1992, Els combined a part-time job as a secretary with a part-time study psychology at the University of Amsterdam. In 2001 she graduated in the specialization Clinical Psychology. Her internship at the department of psychiatry of Academic Medical Center (AMC) in Amsterdam focused on psychotrauma. From 2000 to 2002 she worked in this department as a research assistant. In 2002 Els finished a post-HBO study career coaching and worked freelance as a trainer and career coach until 2006. Returning to the AMC, from 2006 to 2008 she worked as a research assistant in the newly started department of child and adolescent psychiatry of AMC/de Bascule. In 2008, while working at this department, she started her PhD project on posttraumatic stress following accidents in children and their parents. In 2013, after finishing a follow-up of the initial study, she assisted six months part-time with the start of the Amsterdam Sexual Abuse Case-study. Next, from the end of 2013, she worked part-time for two years as a senior researcher and consultant at VeiligheidNL in Amsterdam. In 2012-2013 she was a board member of the NtVP (the Netherlands association for psychotrauma). Since 2013, Els has worked part-time as a researcher at the department of Child and Adolescent Psychiatry of AMC/de Bascule. She works on grant applications and various projects such as a pilot project on implementation of screening for risk of PTSD in hospitals in the Netherlands (2014-2016) and the Dutch version of diagnostic interviews DIPA and CAPS-CA.

Els werd geboren op 31 oktober 1955 in Venray. Ze groeide op met haar ouders, vier jongere broers en twee jongere zussen. Haar VWO-opleiding aan het Boschveldcollege in Venray voltooide ze in 1974. In de daarop volgende jaren had ze verschillende banen, als laatste als lid van de ondersteunende staf bij een verzekeringsmaatschappij. In 1991 kregen Koos en Els een dochter, Lotte. Vanaf 1992 combineerde Els een deeltijd baan als secretaresse met de deeltijd studie psychologie aan de Universiteit van Amsterdam. In 2001 rondde ze deze studie af in de afstudeerrichting Klinische Psychologie. Haar stage bij de afdeling psychiatrie van het Academisch Medisch Centrum (AMC) was gericht op psychotrauma. Van 2000 tot 2002 werkte zij op deze afdeling als onderzoeksassistent. In 2002 voltooide Els een post-HBO opleiding loopbaanadvies en werkte als freelance trainer en coach tot 2006. Terug in het AMC, werkte zij van 2006 tot 2008 als onderzoeksassistent bij de nieuw opgerichte afdeling kinder- en jeugdpsychiatrie van AMC/de Bascule. In 2008 begon zij hier aan haar promotieonderzoek naar posttraumatische stress bij kinderen en hun ouders na een ongeluk. In 2013, na een follow-up van het initiële onderzoeksproject, assisteerde zij zes maanden part-time bij de start van het onderzoek naar de Amsterdamse Zedenzaak. Vanaf eind 2013 werkte Els twee jaar part-time als senior onderzoeker en adviseur bij VeiligheidNL in Amsterdam. In 2012-2013 was zij bestuurslid van de NtVP, de Nederlandstalige vereniging voor Psychotrauma. Sinds 2013 werkt Els part-time als onderzoeker bij de afdeling kinder- en jeugdpsychiatrie AMC/de Bascule. Zij werkt aan subsidie-aanvragen en verschillende projecten zoals een pilot-project naar implementatie van risicoscreening op PTSS in ziekenhuizen in Nederland (2014-2016), en de Nederlandse versie van de diagnostische interviews DIPA en CAPS-CA.