

Final Project Report

ODPS – EMS/Trauma research Grant 47414 C0067

“Traumatic Injury Patients and Their Families”

Introduction

Prior investigations of pediatric injury patients have reported rates of posttraumatic stress disorder (PTSD) ranging from 12.5% to 23%. Childhood PTSD is associated with significant social impairments, cognitive deficits, poor academic performance, and a variety of comorbid behavioral and emotional disorders. Even subsyndromal symptom levels are associated with clinically significant impairment in functioning, underscoring the importance of early identification and appropriate intervention to reduce these symptoms in child trauma victims. However, as the majority of children exposed to trauma do not develop PTSD, efforts to intervene prior to symptom development are hampered by an inability to reliably predict children who are likely to develop Acute Stress Disorder (ASD)/PTSD and comorbid disorders. Further, with the release of the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) in 2013, the diagnostic criteria for ASD and PTSD changed. Although changes to the diagnostic criteria were not anticipated to dramatically shift incidence rates, research into the prevalence of ASD and PTSD (both with respect to DSM-IV and DSM-5 criteria) in child traumatic injury patients and their families is needed to determine the impact that post-traumatic distress has on injury victims.

Recent preliminary findings have identified peritraumatic and initial post-traumatic factors associated with increased risk for the development of PTSD symptoms (PTSS) in traumatic injury victims. Parents of child trauma victims are equally likely as the child, if not more so, to develop PTSD in response to their child’s trauma, and parent reactions and family environment can impact the child’s symptoms. However, the extent to which family environment and parent and child reactions to the child’s trauma dynamically interact over time to buffer or exacerbate post-traumatic distress has not been examined. Identification of these interactions and how they differ depending on age/gender/pubertal status of the child will aid in the design and targeting of appropriate and developmentally-tailored interventions.

In the present study we systematically examined the development of post-traumatic distress in child trauma victims over time. Early responses to traumatic injury (assessed in-hospital and 2-weeks after the event) were measured to determine initial risk and resilience factors for longer-term distress and psychopathology (PTSD and comorbid disorders). The influence of pre- (e.g., prior traumatic stress experiences, developmental and demographic factors) and post-traumatic (e.g., the interaction between parent and child reactions to the trauma, parent-child conflict) factors on the child’s risk for developing psychopathology was also examined.

Specific objectives of the present study were:

1. To determine prevalence rates of Acute Stress Disorder (ASD) and Posttraumatic Stress Disorder (PTSD) in child traumatic injury victims who were transported to the hospital via Emergency Medical Service (EMS) transport and their parent(s).
2. To examine the relationship between a child victim’s response to a traumatic event and family factors within the home environment. Parent (both mother and father, when applicable) and child responses to the child’s trauma were assessed at all time points to allow for examination of the development of child symptoms over time as well as the determination of mechanisms through which parent PTSS and parent-child conflict interacted with child PTSS to increase risk for persistent symptomatology.
3. To examine the extent to which sociodemographic and trauma-related differences among

trauma victims interacted with child's initial responses to either increase or decrease risk of post-traumatic symptoms. Specifically, we examined the impact of gender, prior trauma history, type of injury, age, pubertal status and whether or not caregivers were present at the time of the injury.

TABLE OF CONTENTS

EXECUTIVE SUMMARY4

INFORMATION/QUALIFICATIONS OF PI AND CO-Is.....5

A REVIEW OF THE LITERATURE RELATED TO THE PROJECT TOPIC5

HISTORICAL PERSPECTIVE ON THE PROJECT TOPIC8

A BRIEF REVIEW OF THE CURRENT STATUS OF THE TOPIC IN OHIO.....9

EDUCATION AND TRAINING ISSUES AND CONSIDERATIONS9

DATA AND INFORMATION ISSUES AND CONSIDERATIONS10

AN ANALYSIS OF THE RESEARCHER’S FINDINGS12

CONCLUSIONS.....16

RECOMMENDATIONS17

REFERENCES.....18

Executive Summary

The present research was designed to determine whether changes to the Posttraumatic Stress Disorder (PTSD) and Acute Stress Disorder (ASD) diagnostic criteria in the DSM-5 will impact previously observed prevalence rates for these disorders in child traumatic injury victims and their parents/guardians. "Trauma" in this context refers not to the medical trauma (injury), but rather to psychological trauma and prolonged stress symptoms that families may experience even after the imminent risk of the injury has passed. In addition, family factors (parental PTSD symptoms and parent-child conflict) can increase or buffer risk afforded by initial responses to the traumatic event and can increase risk for PTSD symptoms (PTSS) in children who are not at risk. Pilot research with small sample sizes have precluded the ability to examine the extent to which family factors impact child ASD and PTSD symptom risk while including typically-observed covariates. The present study was a prospective examination of the development of ASD/PTSD in a sample of child traumatic injury victims and their parents. 145 children transported to Akron Children's Hospital and their parents were recruited in-hospital and completed assessments in-hospital and 2-weeks, and 3- and 6-months later.

Results highlighted the prevalence of ASD and PTSD symptoms in child traumatic injury patients and their families. Regardless of scoring metric or use of DSM-IV versus DSM-5 criteria, rates of PTSD in children and their parents were relatively consistent. 15-20% of child traumatic injury patients met likely PTSD diagnostic criteria up to 6-months post-injury that impacted many domains of daily functioning. The changes to DSM-5 ASD criteria resulted in significantly higher prevalence rates of ASD versus using DSM-IV criteria; however, neither diagnostic criteria were particularly good at predicting PTSS in respondents. Only in female caregivers was ASD associated significantly with subsequent PTSD, and the strength of the relationship did not differ by DSM-IV versus 5 criteria. Results did suggest that using DSM-5 ASD criteria may obscure relationships between maternal ASD and child PTSS, as inclusion of the negative alterations in mood and cognition criterion eliminated the significant predictive power of maternal ASD.

Our findings regarding the interplay of parental and child PTSS symptoms over time highlighted the impact of family environment on child psychosocial recovery following an injury that necessitated EMS transport. Our findings underscored that maternal and paternal reactions to the child's trauma often differentially impacted risk for persistent distress in child trauma victims. More specifically, while maternal reactions to the trauma were relatively consistent in predicting child distress, over time paternal influences grew. We found that maternal symptoms were relatively strong predictors of child distress at 3-months, but that paternal symptoms had a greater impact over time and were usually larger in relation to the child's 6-month symptoms.

Our results highlight the importance of regular screening, referral and appropriate trauma-focused treatment of at-risk families who have experienced a traumatic injury. Medical school curricula should include appropriate coverage of the incidence and impact of psychological trauma to ensure that the next generation of physicians is sufficiently skilled in the identification and appropriate referral of and intervention with at-risk children and their families. A greater understanding of the prevalence rates of ASD/PTSD and factors associated with increased risk for the disorders will aid in appropriate identification of those at-risk and appropriate allocation of limited resources to those children/families in greatest need of services.

Information/Qualifications – Principal and all Co-investigators

Dr. Douglas L. Delahanty (Principle Investigator) is a Professor of Psychology at Kent State University and Director of the Kent State Initiative for Clinical and Translational Research (ICTR). Dr. Delahanty is an expert in the area of early biopsychological predictors of PTSD and has extensive experience assessing traumatic experiences and PTSD symptoms in adults and children. His basic research in adults and children has identified numerous risk factors and consequences of trauma exposure, and his applied translational projects have focused on developing early interventions to reduce/prevent PTSD and comorbid disorders.

Dr. Norman C. Christopher (Co-Investigator) is the Noah Miller Chairman of the Department of Pediatrics at Children's Hospital Medical Center of Akron. For the last decade, he has collaborated with Dr. Douglas Delahanty on a series of studies examining biopsychological predictors of PTSD in child trauma patients. Together Drs. Delahanty and Christopher have improved methods of identifying child trauma victims and their family members who are most at risk for experiencing persistent distress. They have further translated these basic research findings into novel pharmacologic and psychological interventions to prevent the development of post-traumatic stress in families who have experienced the serious injury of a child.

Dr. Sarah Ostrowski (Co-Investigator) is the Research Program Director of the NeuroDevelopmental Science Center (NDSC) at Children's Hospital and Medical Center of Akron (CHMCA). She has an extensive history of collaborating with the research team in applying a developmental framework to the study of child traumatic stress from a family systems perspective. She currently serves as the Principal Investigator of a SAMHSA funded National Child Traumatic Stress Network (NCTSN) grant focused on enhancing our ability to identify and treat children exposed to traumatic and adverse events. Dr. Ostrowski has expertise in the assessment and treatment of traumatized children and managing large-scale prospective studies of children and their families recruited from trauma units and emergency department settings. Dr. Ostrowski has extensive experience in data management and statistical analyses of large-scale, longitudinal datasets.

A Review of the Literature Related to the Project Topic

PTSD in child trauma victims

Over 4 million children in the U.S. are exposed to traumatic events yearly¹, and roughly 36% of children exposed to trauma develop PTSD². Worldwide, injury is a leading cause of death, morbidity, and acquired disability among children³. Twenty million children in the US each year suffer unintentional injuries, resulting in 8.7 million emergency room visits; 241,000 children annually are injured seriously enough to be hospitalized⁴. According to the 2010 Ohio Trauma Registry (OTR) report⁵, the incidence of injury in children and adolescents (ages 0-20) ranged from 1.38-2.10 injuries for every 1000 people at risk. Blunt injuries accounted for the vast majority of injuries reported to the OTR in 2010 (90.5%), and the vast majority of the injuries were unintentional (89.4%). Common mechanisms of injury included injury due to fall (52.9%) or motor vehicle collision (15.3%).

Research with injured children has suggested that between 6-32% of children develop PTSD, and an additional number of these children (up to 20%) develop sub-syndromal PTSD⁶⁻¹¹. A recent meta-analysis of 26 studies of child PTSS associated with medical events¹² found average prevalence rates of significant PTSS to be 20% after injury. Subsyndromal levels of symptoms are also associated with clinically significant impairment in functioning. Prior research has demonstrated that those with subthreshold PTSD often endorse similar levels of impairment

as those meeting full PTSD criteria¹³⁻¹⁵. Moreover, functional impairment, number of comorbid disorders, rates of comorbid major depressive disorder, and current suicidal ideation increase linearly and significantly with each increase in number of PTSD symptoms (PTSS), supporting the importance of understanding predictors of PTSS even in populations with relatively low rates of full PTSD¹⁴⁻¹⁷.

According to the DSM-IV, a diagnosis of PTSD requires that an individual experiences one or more traumatic events and reports symptoms from three symptom clusters: (a) intrusive re-experiencing of the trauma(s); (b) avoidance of stimuli associated with the trauma(s) and general numbing; and (c) heightened physiological arousal¹⁸. According to DSM-IV criteria, a potentially traumatic event involves a person: (a) experiencing, witnessing, or being confronted with an event that involves actual or threatened death or serious injury, or a threat to the physical integrity of self or others; and (b) responds with intense fear, helplessness, or horror (or in children, disorganized or agitated behavior). Symptoms must be present for at least one month to meet diagnostic criteria. A diagnosis of Acute Stress Disorder (ASD) was developed to allow identification of individuals suffering high levels of post-traumatic distress, but who would not meet the one month duration criterion¹⁸.

The previously reviewed incidence rates were all computed using DSM-IV criteria; however, a number of changes to the diagnostic criteria were included in the DSM-5 (released in May, 2013). The largest changes involved eliminating the requirement that a victim must subjectively respond with fear, helplessness, or horror (commonly called A2), and the division of the three symptom clusters into four clusters (intrusion symptoms, avoidance symptoms, arousal/reactivity symptoms, and negative mood and cognitions). Changes to ASD criteria are potentially larger, involving the collapsing of symptom clusters and requirement of eight or more new (since the time of the event) symptoms for a diagnosis of ASD to be considered¹⁹. Although the changes to the PTSD and ASD criteria are not anticipated to result in large differences in prevalence rates, empirical evidence is necessary to determine the prevalence rates of DSM-5 diagnostic levels of PTSD and ASD symptoms in traumatically injured children and their families (**Addressed in Specific Aim 1**). A greater understanding of the prevalence rates of ASD/PTSD and factors associated with increased risk for the disorders will aid in appropriate identification of those at-risk and appropriate allocation of limited resources to those children/families in greatest need of services.

Childhood PTSD is a debilitating disorder

Childhood PTSD is associated with significant social impairments²⁰; cognitive deficits²¹; poor academic performance²²; and a variety of comorbid disorders². Comorbid anxiety, depression, and alcohol and drug dependence are common in pediatric patients with PTSD²³⁻²⁵. Moreover, chronic PTSD in children has been associated with persistent hormonal and neuroanatomical abnormalities and has been identified as a risk factor for the development of psychopathology in individuals who experience a subsequent trauma in adulthood^{e.g., 26-29}. Given the chronic, debilitating course of pediatric PTSD³⁰, close monitoring of trauma victims at increased risk for PTSD may facilitate efforts to address emergent psychiatric symptoms before they develop into a chronic syndrome and undermine a child's health and development. Elucidation of risk factors may facilitate effective screening and guide the design of early interventions to prevent or buffer the development of ASD, PTSD, and comorbid disorders.

Family functioning in response to a child's trauma: A conceptual framework

Parental responses to a child's trauma can impact the child's recovery following a traumatic event, and have been found to moderate early risk factors. In this study, we focused on two key theoretically and empirically informed family processes that are particularly relevant to a child's recovery following trauma: parental PTSS and parent-child conflict.

PTSD in parents of child trauma victims

One family factor that must be taken into account when examining the development of PTSS in children is parental response to the traumatic event. Higher levels of general distress may result in a parent being less available to their child during the early post-traumatic period⁴⁰. However, parental PTSS stemming from the child's trauma have been more strongly related to the development of PTSD in children than general parental distress^{31,32}, suggesting specific risk afforded by parental PTSS and underscoring the importance of examining parental PTSS as a contributing factor to the development and persistence of PTSS in child trauma victims.

Parents of children hospitalized with moderate to severe traumatic injuries report high rates of PTSS and other psychosocial consequences. Diagnostic levels of PTSD are found in approximately 15% of parents^{33,34}, while subsyndromal levels of PTSD are more common, with approximately 33% of parents meeting at least partial PTSD criteria³³⁻³⁵. Landolt et al.³⁴ found that mothers of children injured in motor vehicle accidents (MVAs) had higher rates of PTSD than did the children themselves (20.0% versus 14.6%, respectively). Despite the relatively high incidence of PTSD in both child victims and their parents, a 10-year review of the pediatric trauma literature revealed that psychiatric consequences of trauma are largely neglected³⁶. The authors underscored the necessity of early identification of children at risk for post-injury psychiatric sequelae³⁶.

Associations between Child and Parental PTSS. Studies including multiple assessment points suggest that initial PTSS in the child can impact subsequent symptoms in the parent³⁷, and that acute symptoms of distress in the parent predict subsequent PTSD in the child³⁸. Few studies have examined PTSD in fathers of child trauma victims, and the majority of these studies have examined samples consisting of families in which a child is diagnosed with a chronic disease. These studies have typically found higher PTSD incidence in mothers versus fathers^{39,40}, but have not examined the impact of paternal PTSS on child PTSS. Failure to consider the impact of paternal post-traumatic responding is a major limitation of prior literature, as fathers have been found to be important contributors to child adjustment and socialization^{41,42}.

Although prior research has predominantly examined the impact of parental PTSS as a whole on child overall symptomatology, specific parent symptoms may influence the persistence of PTSS in the child more than others. The most common symptoms experienced by both parents and children following a child's trauma are re-experiencing (intrusion) symptoms^{8,34,40,43}. Parental re-experiencing symptoms may make it difficult for the parent to contain their own and their child's anxieties, which may intensify the child's own intrusions. Parental hyperarousal symptoms may be particularly associated with increased child distress. The direct conveyance of a parent's anxiety to the child may increase the child's vulnerability to post-traumatic distress³⁸. Parental hypervigilance following a child's traumatic event has also been found to be associated with increased child PTSS⁸. The extent to which various PTSD symptom clusters in the father and mother may differentially impact the child and the extent to which these relationships may differ by child gender and age have not been examined. The proposed research will include the assessment of PTSS and PTSD symptom clusters in both the child victim as well as both caregivers (when available: usually the parents) who are currently living with the child.

Given the interrelationships between parent and child PTSS, and recognizing that these relationships may differ over time, the present study was designed to prospectively examine the dynamic interplay between parent (both father and mother) and child responses to the child's injuries both in the acute and more chronic phases of recovery (**Addressed in Specific Aim 2**).

Parent-Child Conflict

Although there are many dimensions of parent-child relationships that have been identified as important to child adjustment, parent-child conflict is the single best family predictor of childhood behavior problems⁴⁴. Parent-child conflict has been associated with depression,

withdrawal, poor social competence, poor academic performance and conduct-related difficulties in children and adolescents⁴⁴⁻⁴⁶. Parent-child conflict may be particularly challenging for child trauma victims as they may be more psychologically vulnerable than other children. Increased strain in the parent-child relationship may add significant burden to these already compromised children, putting them at greater risk for persistent PTSS. Parent-child conflict has been found to mediate the relationship between exposure to community violence and child PTSD⁴⁷ and to be associated with increased risk for PTSD in parents of child burn victims⁴⁸.

Given the theoretical importance of both parental post-traumatic responses to the child's trauma and parent-child conflict as family dimensions of direct relevance to child trauma victims, we examined the dynamic interplay of these family factors with child PTSS over time. Sociodemographic, developmental, and trauma-related factors may also impact the relationship between family factors and child PTSS. Therefore, the extent to which the abovementioned established risk factors impacted the relationship between family factors and child PTSS was also examined. For instance, we have previously found that maternal PTSS and depression differentially impacted boy versus girl trauma victims, and others have suggested differing impact of family conflict dependent on the gender of the parent-child dyad (i.e., mother-daughter, mother-son, father-daughter, father-son^{49,50}). Further, mixed results have been reported with respect to direction of the relationship between age/pubertal status of the child and parent-child conflict⁵¹. However, evidence on differences between distinct family dyads is minimal.

Sociodemographic, developmental, and trauma-related variables may moderate risk afforded by initial responses to trauma

Prior research has identified many variables that may confound the anticipated relationships between initial reactions and persistent child PTSS. PTSS appear to be influenced by a complex constellation of environmental and person-specific factors. For instance, perceived trauma severity, age, gender, ethnicity, and prior trauma experiences⁵² have all been found to relate to child PTSS. Child gender may exert the most notable impact on child PTSS and initial reactions to the trauma. It is also likely that age/pubertal status will interact with gender to impact the relationship between initial responses to trauma and subsequent PTSS.

It is unclear how these additional risk factors operate individually or interact to impact the relationship between the child's initial response to trauma and more persistent symptoms. Therefore, the extent to which established risk factors impact the relationship between initial responses to the trauma and subsequent PTSS was also examined (**Addressed in Specific Aim #3**).

Historical Perspectives on the Topic of this Report

The diagnosis of PTSD was initially developed to address conditions faced by combat veterans experiencing a range of psychological sequelae after exposure to extreme distress during military campaigns. While it is readily acknowledged that PTSD can develop following exposure to a number of traumatic events involving threat of death or serious injury, emergency medical personnel remain less aware of the potential psychological consequences of traumatic injury and may not receive adequate training regarding the identification or treatment of traumatic stress. As mentioned in the review of the literature, a 10-year review of the pediatric trauma literature revealed that psychiatric consequences of trauma are largely neglected³⁶. We and others have demonstrated that PTSD occurs in a minority, albeit a significant minority, of child traumatic injury victims and their parents. The majority of this literature has focused on mother-child dyads, as mothers are typically the most available caregiver. The present study filled a critical void in our understanding of risk for post-traumatic stress in child injury patients by involving strong efforts to recruit and retain male caregivers and to understand the impact that child trauma victims and their parents have on each other's recovery. An in-depth

understanding of early risk factors that can be measured soon after trauma (and preferably during standard medical time points, thus not requiring subsequent interaction with patients once they return to their daily routines) will inform the design of family-focused interventions to prevent the development of debilitating symptoms in at-risk children and their families.

A Brief Review of the Current Status of the Topic in Ohio

Recently, the Ohio Departments of Mental Health and Addiction Services and Developmental Disabilities launched a statewide Trauma-Informed Care (TIC) Initiative. The purpose of this initiative is: 1. To increase awareness of trauma's impact on the emotional and physical well-being of Ohioans; 2. Provide appropriate training, skill development, and support for practitioners, facilities and agencies; and 3. Enhance community based capacity to deliver trauma-informed, evidence-based practices. As a result of this initiative, Ohio was divided into 4 regions to assist in developing systems of care that are knowledgeable and informed about trauma practices. Akron Children's Hospital is a member of 2 of these regions (upper northeast and lower northeast). Akron Children's Hospital participated in the TIC Summit and strives to serve as a resource in TIC. For example, as part of the NCTSN grant, Akron Children's is hosting a Learning Collaborative to train area providers on an evidence-based intervention for traumatized children and their families (TF-CBT). Thus, these efforts combined with the research infrastructure provided via the present study and the education efforts of the concurrent National Child Traumatic Stress Network (NCTSN) grant awarded to Dr. Ostrowski have catalyzed awareness at Akron Children's Hospital and Northeast Ohio of the impact and consequences of post-traumatic distress. These efforts are serving as a stepping stone to bring trauma-informed care to all child patients and their families and to facilitate screening and treatment efforts.

Education and Training Issues and Considerations

The fact that the present grant was funded at the same time that Dr. Ostrowski received funding from the NCTSN to broaden education, training, and referral of children seen at Akron Children's Hospital who had experienced adverse life events (ACES) served to create an ideal environment at Akron Children's Hospital for implementing and expanding research, education, and training regarding traumatic stress. Our study served as a concrete example of the impact of traumatic injury and the incidence of persistent distress in children and their families and "made traumatic stress real" for medical personnel. In concert with the NCTSN proposal, we facilitated the following educational steps regarding trauma and traumatic stress:

1. Resulting from the present study, all child traumatic injury patients and their families are now being screened for PTSD risk. We are collaborating with colleagues at Case Western Reserve University to test the efficacy of an early 4-session family-focused intervention that can be administered via Skype at reducing persistent distress in those screening at high-risk. Further, standardized screening ensures that those at risk receive appropriate early referrals to trauma treatment specialists.

2. Training modules were developed for medical students, residents, and fellows on adverse childhood events and trauma informed practices.

3. This training is being expanded to Akron Children's Hospital-affiliated primary care physicians throughout northeast Ohio enabling the creation of a trauma-focused network of care that will improve access to treatment.

Future goals are to incorporate training regarding adverse child events, trauma, traumatic stress, and secondary traumatic stress into standard curricula for medical students. Trainees and fellows have, anecdotally, been the most responsive to the trainings, and early education regarding psychological trauma will ensure that the next generation of physicians is sufficiently skilled in the identification and appropriate referral of and intervention with at-risk children and their families.

Data and information issues and Considerations

1. Study design

We used a longitudinal design to assess the relationship between initial family factors and child psychological reactions to a traumatic injury and persistent PTSS in the child. Four measurement points were chosen to examine immediate, acute and longer-term responding to the trauma. The initial assessment was performed in the hospital within an average of 24 hours post-trauma. Subsequent assessments occurred 2-weeks, and 3-, and 6-months post-trauma.

2. Procedure

Recruitment

Over time, our recruitment efforts changed: initially it was planned that families would be approached by a trauma research nurse. However, due to environmental and clinical changes to the ED staff, recruitment via Akron Children's medical staff became unfeasible. We thus developed a pool of undergraduate students from Kent State University and the University of Akron (students who were motivated to gain research experience to be more competitive for graduate or medical school) who recruited families, obtained informed consent/assent, and completed in-hospital assessments. We made a concerted effort to recruit fathers/male caregivers; if the father/male caregiver was not present during initial recruitment, the RA inquired as to whether he/she would be able to talk to the father during the child's stay. If yes, then the father was consented and received the initial questionnaires in-hospital. If either the father or mother was not reachable in-hospital during the child's stay, a packet of questionnaires were provided along with a copy of the consent form and a self-addressed postage-paid envelope for returning the questionnaires.

Assessments

In-hospital assessment. This first session (T1) involved the administration of various self-report measures. Parents were asked to complete the Center for Epidemiological Studies- Depression (CES-D⁵³) to assess depressive symptoms, and the Impact of Event Scale-Revised (IES-R⁵⁴) and PTSD Symptom Scale to measure PTSS. Updated measures were used that assessed the new DSM-5 diagnostic criteria. Parents also completed the Strengths and Difficulties Questionnaire for Parents (SDQ-P⁵⁵) with reference to their child's behavior prior to hospitalization.

Child trauma victims were asked to complete the Center for Epidemiological Studies- Depression for Children (CES-DC⁵⁶) to assess symptoms of depression and the Child PTSD Symptom Scale to assess PTSD symptoms. Again, measures updated to reflect DSM-5 criteria were used. The child and their parent(s)/caregiver(s) completed forms separately so that their responses did not influence each other. The initial in-hospital assessment also included gathering self-report information pertaining to the accident and demographic information, such as the child's grade in school, date of birth, gender, ethnicity, and contact information (e.g., phone number(s),

addresses, emails). Parents were also asked to sign a medical release and HIPAA release form to provide access to the child's medical chart.

Follow-up assessments. At 2-weeks post-trauma, the primary caregiver(s) were contacted to arrange for a follow-up assessment via telephone (T2). At this time, the caregiver(s) and child were separately administered a structured interview to measure ASD diagnostic criteria⁵⁷. We used a modified version of the ASDI¹⁹ which can be scored to reflect both DSM-IV and DSM-5 criteria. Participants also completed the SASS which provides a continuous measure of acute stress symptom severity.

The general procedures for times 3 (3-months) and 4 (6-months) were similar. Families were sent separate packets for each member (parent(s)/caregiver(s), child) to complete. Mailings were accompanied by phone calls to ensure the packets were received and to talk participants through the directions for the questionnaires. Each family member was instructed to complete their forms in private so that their answers did not influence each other. Children again completed the Child PTSD Symptom Scale and the CES-DC. Further, children completed the Petersen Pubertal Development Scale (PDS⁵⁸) as a measure of pubertal development. Parents/guardians completed a questionnaire concerning demographic information (e.g., familial income, education level of parents and child, number of siblings, birth order of child), as well as the PTSD Symptom Scaler and CES-D. Both parents/guardians and the child also completed an assessment of perceptions of family conflict (Issues Checklist⁵⁹).

3. Study Participants

Study participants were child trauma victims aged 8 to 18 who were transported via EMS transport (either ambulance or helicopter) to Akron Children's Hospital for non-abuse related injuries and their parents/guardians. Participants were not restricted due to type of injury (beyond excluding cases of suspected abuse) as this would decrease generalizability and utility of our findings in the acute care setting; however, we have never found type of trauma or injury to systematically impact our findings in our prior studies of PTSD in children.

Participants were excluded if they scored lower than a 14 on the Glasgow Coma Scale (GCS⁶⁰) or if they were in a coma or were unconscious for more than one hour before or during emergency room admission. Further, participants must have been able to communicate fluently in English. Consecutive, non-referred participants were approached to eliminate any effects of referral bias and to increase generalizability of the results.

Given patient demographics at CHMCA, we had anticipated that the final sample would consist of approximately 30% female and 17% minority participants. We exceeded these estimates, as, in child participants, 37% of participants were female and 35% were from racial/ethnic minority groups (21% were African American and 8.9% endorsed biracial/other).

4. Data analysis plan

Data collection and follow-up assessments are ongoing. Once complete, the dataset will allow for more sophisticated analyses using a combination of autoregressive and latent curve models⁶¹ within a latent variable modeling framework. At this point, we are excited by the current significant findings despite the smaller sample size.

Preliminary Analyses

Prior to the main analyses, the psychometric properties of all measures were tested. The internal consistency of scales was examined for the entire sample. Data were checked for outliers and univariate normality.

Study hypotheses

1. To determine prevalence rates of DSM-5 ASD and PTSD in child traumatic injury patients and their parent(s)/guardian(s).
2. Parent and child responses to the child's traumatic injury will interact over time to increase risk for persistent PTSD in the child. More specifically, it was hypothesized that, independent of child risk, increased parent PTSS would convey additional risk for persistent PTSS and comorbid disorders in the child.
3. Family factors (parent PTSS, parent-child conflict) would interact with initial child symptoms to increase or buffer risk for persistent PTSS in the child.
4. The interaction of parent and child responses would persist after controlling for sociodemographic, developmental, and trauma-related differences in trauma victims.

Statistical Analyses for Specific Hypotheses.

Hypothesis 1. Hypothesis 1 was tested primarily with descriptive statistics, providing estimates of the percent of child trauma victims and their parent(s)/guardian(s) who met ASD and PTSD criteria according to the differential diagnostic criteria of the DSM-IV and DSM-5.

Hypothesis 2. It was hypothesized that (a) parental PTSS would affect child PTSS at later time-points, and (b) that change in parental PTSS would be associated with change in child PTSS. To test these hypotheses, linear regression analyses were conducted. The proposed variables related to parental PTSS were included in the models as independent variables and child acute stress symptoms, PTSS, and depression symptoms were included as dependent variables. These analyses examined the impact of early parental symptoms and reactions on later child symptom levels.

Hypothesis 3. This hypothesis was examined using hierarchical regression analyses. All significant regression models from hypothesis 2 were re-examined with demographic variables (e.g., age, pubertal status, etc.) included as secondary predictors (covariates) in the models. We investigated whether including covariates significantly improved model fit as indicated by improvement in overall model fit indices.

Hypothesis 4. Additional hierarchical regressions were conducted to examine the extent to which interactions between parent-child conflict and parent PTSS and initial child symptoms affected child PTSS across time.

An Analysis of the Researcher's Findings

To date, we have enrolled 145 children who were transported to Akron Children's Hospital via EMS transport (either ambulance or helicopter) due to an acute physical injury. In addition we have recruited 137 female parents/guardians and 88 male parents/guardians. On average, child participants were 12.3 years old (range=8-18 years). 65% of participants were Caucasian, 21% were African-American, and 9% reported biracial or other race/ethnicity. Findings are grouped with respect to study Aims. With respect to Aim 1 (determination of incidence rates of acute stress disorder [ASD] and posttraumatic stress disorder [PTSD]), approximately 4% of child participants, no mothers/female caregivers, and 2.4% of fathers/male caregivers met DSM-IV diagnostic criteria for ASD. Using DSM-5 criteria, rates were significantly higher: 17% for children, 9% for mothers/female caregivers, and 5% for fathers/male caregivers. The Severity of Acute Stress Symptoms (SASS) questionnaire was used to provide estimates of symptom severity (0=None, 1= Mild, 2= Moderate, 3=Severe, 4= Extreme). In line with higher ASD estimates using DSM-5 criteria, the percent of participants reporting moderate or above symptoms was 18% for children, 9% for mothers/female caregivers, and 2% for fathers/male caregivers.

PTSD assessment instruments have different cutoff scores that have been identified to determine diagnostic levels of PTSD. Children completed the Child PTSD Symptom Scale. According to Foa et al., (2001), a cutoff score of 11 yielded 95% sensitivity and 96% specificity for identifying PTSD. However, clinical experiences have suggested a more conservative cutoff of 15. Consistent with DSM-IV criteria, a diagnosis should be considered when a trauma victim endorses 1 re-experiencing, 3 avoidance, and 2 hyperarousal symptoms. The CPSS adapted for the DSM-5 has the same cutoff score suggestions, although to meet DSM-5 criteria the new scoring rule is 1 intrusive, 1 avoidance, 2 negative alterations in mood and cognition, and 2 hyperarousal symptoms. Rates of DSM-IV and DSM-5 PTSD at 3-months post-trauma, according to the different scoring metrics, are presented in Table 1. Rates at 6-months post-trauma are provided in Table 2. A further index of post-traumatic distress involves an assessment of functional impairment in a variety of domains (e.g., work, home, school, etc). 35% of children, 16% of mothers/female caregivers, and 6% of fathers/male caregivers endorsed functional impairment in at least one domain at the 3-month time-point, while 24% of children, 9% of mothers/female caregivers, and 4% of fathers/male caregivers endorsed functional impairment in at least one domain at the 6-month timepoint.

Table 1. DSM-IV prevalence rates for PTSD at 3-months post-trauma using different cutoffs/scoring schemes. DSM-5 rates are shown in parentheses.

	Using a score of 11 as a cutoff	Using a score of 15 as a cutoff	Using the 1,3,2 (DSM-IV) or 1,1,2,2 (DSM-5) diagnostic rules
Children	21% (23%)	15% (17%)	17% (23%)
Female parent/guardian		7% (9%)	5% (12%)
Male parent/guardian		0% (0%)	3% (3%)

Table 2. DSM-IV prevalence rates for PTSD at 6-months post-trauma using different cutoffs/scoring schemes. DSM-5 rates are shown in parentheses.

	Using a score of 11 as a cutoff	Using a score of 15 as a cutoff	Using the 1,3,2 (DSM-IV) or 1,1,2,2 (DSM-5) diagnostic rules
Children	19% (19%)	16% (16%)	19% (19%)
Female parent/guardian		3% (3%)	3% (3%)
Male parent/guardian		7% (7%)	11% (11%)

As can be seen, regardless of scoring metric used, there was not a substantial difference in PTSD rates determined by DSM-IV versus DSM-5 criteria. However, more children and mothers were likely to meet criteria according to DSM-5 versus DSM-IV criteria at the 3-month time point. Perhaps the greater variability in scores more proximal to the index trauma contributed to the differential observed rates, as rates at 6-months post-trauma were identical. In contrast, rates of ASD as determined via DSM-IV versus DSM-5 were quite

different: rates according to DSM-5 criteria were approximately five times higher than rates according to DSM-IV criteria. The ASD diagnosis was created in order to identify individuals who were displaying high levels of post-traumatic distress, but who did not meet the 4 week symptom duration necessary for a diagnosis of PTSD. Thus, the utility of the ASD diagnosis hinges upon its ability to reliably predict subsequent PTSD. We examined whether DSM-IV diagnosed versus DSM-5 diagnosed ASD was better at identifying individuals who were likely to meet PTSD criteria. As there were relatively few individuals meeting ASD diagnostic criteria, we used continuous symptom scores for these analyses. Prior research has consistently criticized the DSM-IV ASD diagnosis for its unreliability in predicting PTSD; thus, we hypothesized that DSM-5 criteria would better predict subsequent PTSS. However, findings did not support this hypothesis: neither DSM-IV nor DSM-5 ASD symptoms correlated with PTSS at any time point in children or male caregivers. In contrast, in female caregivers, ASD scores were significantly related to female caregiver PTSS at 6-months post-trauma. Surprisingly, the correlations were virtually identical ($p=.040$, $r=.384$; $p=.046$, $r=.374$, for DSM-IV and 5, respectively). Thus, despite differences in incidence rates of ASD, the changes to DSM-5 did not result in increased ability to predict subsequent PTSS.

Aim 2 focused on examining the impact of parental PTSD symptoms and parent-child conflict on the child's PTSD symptoms over time. A number of interesting findings differing by parent gender supported our assertion of the importance of including both male and female caregivers in analyses of symptom development in children. For ease of explanation, from this point on paternal will refer to male parents/guardians while maternal will refer to female parents/guardians.

Predicting Child PTSD symptoms at 3-months. As predicted, the child's history of prior traumatic events was significantly related to PTSS risk 3-month post-trauma ($p=.052$, $\beta= 7.773$). Examination of the relationships between maternal and paternal traumatic stress symptoms and child PTSS revealed a number of differences by parental gender. Longitudinally, female caregiver ASD symptoms significantly predicted child 3-month PTSD symptoms ($p= .002$, $\beta= 8.735$), but male caregiver ASD symptoms did not ($p= .191$, $\beta= -.090$). In contrast, cross-sectionally, at 3-months post-trauma, paternal PTSS was significantly related to child PTSS ($p=.010$, $\beta= 1.703$), but the relationship between maternal and child PTSS was not near significant ($p=.690$). Looking at each symptom cluster separately, the significant relationship between paternal and child symptoms appeared to be due to significant relationships involving paternal intrusions and hyperarousal ($p=.004$, $\beta= 5.191$; $p=.007$, $\beta= 5.739$, respectively) but not avoidance symptoms ($p= .323$). It appears that the lack of a significant cross-sectional relationship between maternal and child PTSS may be due to the DSM-5 addition of Cluster D (Negative alterations in mood and cognition); the remaining maternal clusters (i.e., the traditional DSM-IV clusters of intrusions, avoidance and hyperarousal) were significantly related to child PTSS ($p= .006$, $\beta= 1.628$; $p=.001$, $\beta= 4.095$; $p=.001$, $\beta= 1.937$, respectively). Finally parent-child conflict was not cross-sectionally related to child PTSS.

Predicting Child Depression symptoms at 3-months. The child's history of prior traumatic events was also significantly related to child depression symptoms at 3-months ($p=.014$, $\beta= 3.428$). However, parental ASD symptoms did not predict child depression. Cross-sectionally, paternal ($p=.021$, $\beta= 1.531$) but not maternal ($p=.385$) PTSS at 3-months were related to 3-month child depression. Paternal intrusions and hyperarousal symptoms were related to child depression symptoms ($p=.010$, $\beta= 4.619$; $p=.043$, $\beta= 4.360$, respectively) while maternal avoidance and hyperarousal were related to 3-month child depression symptoms ($p=.011$, $\beta= 3.261$; $p=.006$, $\beta=1.607$, respectively). Parent-child conflict was also not cross-sectionally related to child depression.

Predicting Child PTSD symptoms at 6-months. Whereas only maternal ASD predicted child PTSS at 3-months, both maternal and paternal ASD symptoms predicted child PTSS at 6-months, although in male caregivers there was a negative relationship ($p=.024$, $\beta= 5.851$; $p=.019$, $\beta=-.142$, respectively). Thus, while higher maternal ASD was related to higher child PTSS at 6-months, lower paternal ASD was related to higher child PTSS at 6-months. Neither maternal nor paternal PTSS at 3-months predicted child PTSS at 6-months, underscoring the utility of parental ASD symptoms as a risk factor evident soon after trauma exposure. In addition, maternal, but not paternal, reports of parent-child conflict at 3-months also significantly predicted child PTSS at 6-months ($p= .036$, $\beta= -.062$; $p=.155$, $\beta= -.037$). However, the negative beta weight indicates that lower perception of parent-child conflict by mothers at 3-months was associated with higher PTSS in children 6-months post-trauma.

Predicting Child Depression symptoms at 6-months. Whereas parental ASD symptoms did not predict child depression at 3-months, paternal ($p=.048$, $\beta= -.146$) but not maternal ($p=.360$) ASD symptoms predicted child depression at 6-months. However, similar to the 6-month PTSD symptoms, again this relationship was negative, suggesting that lower paternal ASD scores were related to higher child depression 6-months post-trauma. Maternal ($p=.036$, $\beta=.617$), but not paternal ($p=.776$) depression symptoms at 3-months predicted child 6-month depression. Finally, parent-child conflict at 3-months was not related to child PTSS at 6-months.

We also ran the above analyses separately for male and female children. Rather than restate all the above findings separately for boys and girls, we will highlight findings that are particularly interesting. For boys, the only significant predictor of 3-month PTSS was the child's report of parent-child conflict ($p=.000$, $\beta= -.119$), again, surprisingly in a negative direction. In addition, maternal, but not paternal, ASD symptoms were strong predictors of boys' PTSS 6-months post-trauma ($p=.006$, $\beta= 9.215$). Also interesting was that later paternal, but not maternal, responses predicted child depression at 6 months; paternal PTSS and depression scores significantly predicted child PTSS at 6-months ($ps<.05$) in boys.

With respect to girls, there were more parental influences on girl than boy post-traumatic symptomatology. Both paternal and maternal ASD symptoms predicted girl PTSS at 3-months ($p=.040$, $\beta= -.283$; $p=.027$, $\beta= 10.144$), but only paternal ASD symptoms continued to predict girl PTSS at 6-months ($p=.019$, $\beta= -.240$). Again, paternal ASD symptoms were negatively related to girl PTSS. Parental PTSS relationships reversed such that, cross-sectionally at 3-months, paternal ($p=.037$, $\beta= 2.222$) but not maternal ($p=.486$) PTSS was related to girl PTSS. Longitudinally, maternal ($p=.073$, $\beta= 1.651$) but not paternal ($p=.328$) PTSS at 3-months was marginally related to girl PTSS at 6-months. Parent-child conflict was not related to girl PTSS. Examination of girl depression symptoms revealed few consistencies, other than maternal depression at earlier time points consistently predicted girl depression ($ps<.05$), while paternal depression did not.

Aim 3 examined possible factors that might impact the prior findings. Thus, we tested whether a variety of established risk-factors/moderating variables changed the above findings when we included them in analyses. As part of Aim 2, we already examined the impact of trauma history and child gender; however, for Aim 3 we further examined whether child pubertal status, age, trauma type or presence of male or female caregiver at the trauma site should be considered as covariates in analyses. We found that child age and pubertal status served as significant covariates in analyses of child PTSS at both 3- and 6-months, but there were no other factors that consistently moderated child PTSS or depression at either follow-up time point.

In addition to answering the specific research questions posed in the Aims, the present grant served to establish a trauma-focused research infrastructure at Akron Children's Hospital. As mentioned, physical and organizational changes at Akron Children's over the last 1.5 years necessitated that we create a mechanism for recruiting participants staffed by undergraduate

research assistants. Doing so required substantial time investment to 1. Identify mature students with the skillset necessary to recruit families in the immediate aftermath of having a child suffer a traumatic injury; 2. Train students in the study protocol and in necessary human subjects training; and 3. Follow all policies necessary to enable non Akron Children's employees to recruit participants from Akron Children's Hospital (e.g., background checks, receive necessary immunizations, etc). Now that we have effectively staffed this pool of undergraduate recruiters, our recruitment rates continue to increase. We are continuing to recruit families and have used the data collected to this point to support a grant proposal to NIH that was scored and is currently being revised for submission in October. The present award also resulted in a greater awareness of the potential for persistent distress in families treated through Akron Children's emergency department and led to a more trauma-focused environment and improved identification of individuals at risk for persistent distress. As mentioned in the education section, Akron Children's has implemented screening trauma admissions for post-traumatic distress as standard of care; thus, all traumatic injury victims now are being screened for PTSD risk. In conjunction with Dr. Ostrowski's efforts stemming from her NCTSN-funded grant, we have conducted workshops and in-services for medical personnel at Akron Children's Hospital regarding the importance of identifying and appropriately referring families at-risk for PTSD. Thus, this grant has resulted in policy changes that will improve patient care for families suffering from the traumatic injury of a child.

Conclusions

The data presented highlight the prevalence of ASD and PTSD symptoms in child traumatic injury patients and their families. Regardless of scoring metric or use of DSM-IV versus 5 criteria, rates of PTSD in children and their parents were relatively consistent. Further, results revealed that 15-20% of child traumatic injury patients met likely PTSD diagnostic criteria. In other words, one in five traumatic injury patients suffered persistent psychological distress that impacts many domains of daily functioning. The changes to DSM-5 ASD criteria resulted in significantly higher prevalence rates of ASD versus using DSM-IV criteria; however, neither diagnostic criteria were particularly good at predicting PTSS in respondents. Only in female caregivers was ASD associated significantly with subsequent PTSD, and the strength of the relationship did not differ by DSM-IV versus 5 criteria. Results did suggest that using DSM-5 ASD criteria may obscure relationships between maternal ASD and child PTSS, as inclusion of the negative alterations in mood and cognition criterion eliminated the significant predictive power of maternal ASD.

Our findings regarding the interplay of parental and child PTSS symptoms over time highlight the impact of family environment on child psychosocial recovery following an injury that necessitated EMS transport. Although the results are cumbersome our findings underscore that maternal and paternal reactions to the child's trauma often differentially impact risk for persistent distress in child trauma victims. More specifically, while maternal reactions to the trauma are relatively consistent in predicting child distress, over time paternal influences grow. We found that maternal symptoms were relatively strong predictors of child distress at 3-months, but that paternal symptoms had a greater impact over time and were usually larger in relation to the child's 6-month symptoms.

The present study addressed a large limitation in the traumatic stress literature by providing insight into the impact of paternal PTSS on child PTSS and depression. Interestingly, we found that some of the findings were in the opposite direction than we hypothesized. Specifically, paternal ASD symptoms were consistently associated with lower child PTSS over time. These findings are difficult to interpret; however, it could be that male caregivers who are less involved or distant with the child report fewer ASD symptoms and are less likely to aid in the child's recovery. We have previously found a similar surprising result in boy trauma victims;

maternal depression was negatively related to boys' PTSD symptoms. In other words, the more depressed the mother was, the less symptomatic the boy was. These findings, while surprising, highlight the importance of this line of research. With our larger sample size we will be able to examine the interaction of mother and father PTSS and how this may impact child post-traumatic recovery over time. Prior research has shown that fathers' mental health may serve a protective factor in the relationship between mothers' and children's depressive symptoms⁶². Oftentimes child trauma victims are considered as small adults, with research in adults influencing assessment and treatment decisions in children. These results and our other research consistently demonstrate that findings can't be generalized from adults to children or from boys to girls and underscore the importance of further examination of how different dyads differentially increase or decrease risk for persistent distress. Appropriate treatment of child trauma victims must consider age, gender and both parents' influences in order to best inform the content and order of presentation of intervention materials.

Recommendations

As mentioned, we will continue to recruit and collect follow-up assessments to build our existing dataset. Once completed, we will have the power to conduct more sophisticated modeling analyses that we anticipate will continue to emphasize the differing impact that male versus female caregivers may have on boy versus girl trauma victims. At that point, we will be more confident in improving upon existing screeners to identify families at risk for post-traumatic distress following the traumatic injury of a child. Currently, our results highlight the relatively high rates of persistent PTSS in child traumatic injury victims, and the necessity of including male caregivers. Inclusion of males is especially important as it appears that, over time, paternal symptoms may exert larger influences on a child's recovery. Our results highlight the importance of regular screening, referral and appropriate trauma-focused treatment of at-risk families who have experienced a traumatic injury. "Trauma" in this context refers not to the medical trauma (injury), but rather to the very real risk that families have of experiencing prolonged stress symptoms even after the imminent risk of the injury has passed. Finally, medical school curricula needs to include appropriate coverage of the incidence and impact of psychological trauma to ensure that the next generation of physicians is sufficiently skilled in the identification and appropriate referral of and intervention with at-risk children and their families. A greater understanding of the prevalence rates of ASD/PTSD and factors associated with increased risk for the disorders will aid in appropriate identification of those at-risk and appropriate allocation of limited resources to those children/families in greatest need of services.

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