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Posttraumatic Stress in Youth Experiencing Illnesses and Injuries: An Exploratory Meta-Analysis

Shoshana Y. Kahana, Norah C. Feeny,
Eric A. Youngstrom, and Dennis Drotar

To date there is no quantitative review of predictors of posttraumatic stress disorder (PTSD) symptoms in youth experiencing illnesses or injuries. This article presents a meta-analysis of variables associated with the development of PTSD among those youth. Twenty-six studies were included: 18 involving children experiencing injuries and 8 with pediatric illnesses. Among injured youth, socioeconomic status and social impairment were small to moderate correlates of PTSD, whereas depressive and anxious symptoms, dissociation, acute stress disorder, and the appraisal of trauma severity and life threat displayed large effect sizes with PTSD severity. Among ill

youth, social support and the appraisal of illness severity and life threat emerged as small to moderate predictors of posttraumatic symptoms. The current findings are exploratory in nature, as a primary limitation of the current study includes the limited number of independent studies that have evaluated these predictors. Current findings further our understanding of PTSD through exploration of possible indicators of at-risk youth who have experienced illness and injury.

Keywords: PTSD; youth; injuries; medical illness; predictors

The incidence of injuries and illnesses (e.g., cancer and organ transplantation) among youth is high. Injuries have been the largest cause of morbidity and mortality among children in the United States for many years (Guyer et al., 1999). Close to 20 million children suffer unintentional injuries annually, and motor vehicle accidents (MVs) and fires are among the leading causes of unintentional injuries in youth through the ages of 19 (Public Health Policy Advisory Board, 1999). With respect to medical illnesses, recent epidemiological data suggest that the incidence of certain childhood cancers has steadily increased since 1990, including acute lymphoblastic leukemia, central nervous system

tumors, and non-Hodgkin's lymphoma (Woodruff et al., 2004). More than 11,000 children are diagnosed with new cancers each year in the United States, and there are currently an estimated 250,000 pediatric cancer survivors. Furthermore, from 1988 to present, between 7% and 9.5% of all organ transplants conducted annually in the United States were performed with pediatric populations (Transplant DataSource, 2001).

Despite the high prevalence rates of both injuries and illnesses among youth, little is understood about the psychological sequelae that are related to both conditions. Recently, researchers have posited that posttraumatic stress disorder (PTSD) may be a useful construct to conceptualize some of the psychological distress and loss of functioning that is present in a significant subset of individuals following illnesses or injuries. Consistent with the *Diagnostic and Statistical Manual, Fourth Edition (DSM-IV;* American Psychiatric Association, 2001), a serious or life-threatening illness or injury usually contains several traumatic elements, including a "real or

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threatened death or a threat to the physical integrity of self and others." In addition to the injury or illness itself, life-threatening conditions and their treatments typically involve a series of potential traumas, such as the life threat inherent in some of the "high-tech" procedures involved in treatment, the repeated intrusions of the procedures, and the experienced pain (Stuber, Nader, Houskamp, & Pynoos, 1996). Moreover, both injuries and illnesses frequently evoke intense feelings of fear, uncertainty, and helplessness about future outcomes and functioning.

Although many individuals exposed to trauma do not develop PTSD, a substantial minority do. Indeed, researchers have reported significant rates of PTSD as well as posttraumatic stress symptoms (PTSSs) in children experiencing various illness-related traumas, such as cancer (Kazak et al., 2004) and liver transplants (Shemesh et al., 2000), or injuries, such as MVAs (Bryant, Mayou, Wiggs, Ehlers, & Stores, 2004), traumatic brain injury (TBI; Levi, Drotar, Yeates, & Taylor, 1999), and burns (Saxe, Stoddard, & Sheridan, 1998). Pelcovitz et al. (1998) reported that 35% of adolescents with cancer were diagnosed with PTSD, whereas 34.5% of youth involved in MVAs met criteria for PTSD (Stallard, Velleman, & Baldwin, 1998).

It is important to note that the clinical significance of subthreshold or partial PTSD (i.e., exhibiting some but not all PTSD symptoms) also has begun to be addressed in the literature. For example, research has noted that among youth who had experienced acute physical injury, many suffered with subthreshold levels of PTSD, which was associated with internalizing symptoms, such as depression and anxiety (Aaron, Zaglul, & Emery, 1999). In addition, Marshall et al. (2001) reported that the presence of subthreshold PTSSs significantly increased the risk for suicidal ideation, comorbidity, and overall greater impairment. Thus, the clinical relevance of subthreshold PTSD is an important construct to consider among individuals exposed to various traumas.

Because of the relatively high incidence of PTSD among youth experiencing injuries and illnesses, it is crucial to identify children at high risk for the development of PTSD after these traumas. If left untreated, PTSD may affect many domains, including social functioning (Berman, Kurtines, Silverman, & Serafini, 1996; Stallard, Velleman, Langsford, & Baldwin, 2001), physical recovery from illnesses or injuries (Stallard et al., 2001), and academic functioning (Reinherz, Giaconia, Lefkowitz, Pakiz, & Frost,

1993). The identification of potential predictors of PTSD among youth experiencing illness- or injury-related traumas may also facilitate efforts to effectively address emergent psychiatric symptoms.

Currently, we know a good deal about predictors for the development of PTSD in adults, but we know substantially less about predictors for youth exposed to illness- or injury-related traumas. Some early research (La Greca, Silverman, Vernberg, & Prinstein, 1996; Vernberg, Silverman, La Greca, & Prinstein, 1996) has been influential in introducing a classification model for the predictors of PTSD in traumatized youth, which includes the child's characteristics (i.e., gender, age), characteristics of the stressor (i.e., amount of time exposed to stressor, life threat involved), characteristics of the environment (i.e., access to social support, family psychiatric history), and cognitive processing (i.e., coping) of the traumatic event. Although some qualitative work has described various predictors of PTSD among youth with illnesses and injuries (e.g., Stuber, Shemesh, & Saxe, 2003), no research to date has derived quantitative estimates for these predictors. Similarly, meaningful descriptive data across various studies, such as the aggregation of the number and types of PTSSs, has not been reported for youth experiencing illnesses and injuries.

Finally, although illnesses and injuries clearly share some significant commonalities (e.g., can involve life threat, affect family functioning) and have often been treated as the same construct, the literature has not addressed differences that may exist between these two traumas. In fact, it is likely that individuals who experience illness as compared to injury are exposed to different traumatic events. Furthermore, it is the exposure to these events that *defines* the traumatic experience of illnesses and injuries. For example, among youth exposed to more acute traumas, typically involving injuries, the aftermath may include additional traumatic stressors, such as aspects of the emergency medical setting and/or the deaths of other individuals involved in the traumatic event. Conversely, for youth with illnesses, there are the uncertainties of second malignancies (cancer) or organ rejection (transplantees) as well as the painfulness of certain treatments (e.g., chemotherapy). In short, combining injuries and illnesses into the same construct may obscure some of the subtle yet important nuances that are inherent to each.

The aim of this study is twofold. The authors synthesize descriptive information along with PTSD

prevalence rates and symptoms among youth who were exposed to illnesses or injuries. In addition, the authors conduct a meta-analysis to identify consistent variables associated with the development of PTSD among youth experiencing illnesses or injuries. To address what we perceive to be the gap in the literature, the phenomenology of PTSD among youth experiencing illnesses and injuries will be investigated separately and, when possible, will be directly compared to each other.

Method

Literature Search

The authors conducted comprehensive literature searches using various medical and psychological bibliographic databases, such as PsycINFO and MEDLINE, to find articles that reported the prevalence rates as well as data on the predictors for PTSD (as defined by *DSM-III*, *DSM-III-R*, and *DSM-IV*) in youth between the ages of 6 and 19. Search terms such as *trauma*, *posttraumatic stress disorder*, *posttraumatic stress symptoms*, *PTSD*, *PTSS*, *stress*, *child*, *adolescent*, *youth*, *medical*, *traffic accidents*, *motor vehicle accidents*, *injury*, *cancer*, *burns*, *transplant*, *predictor(s)*, *prevalence*, and *epidemiology* were utilized in the search for articles. In addition, the reference sections of all of these identified articles were examined to glean additional articles. Finally, several researchers noted for their work in pediatric traumatic stress were contacted to access data that were included in manuscripts in press.

Criteria for Inclusion and Exclusion

The studies included for the current review used quantitative methods to examine the prevalence rates of PTSD, as well as the potential predictors of PTSD, in youth experiencing illnesses or injuries. In accordance with the current classifications of numerous government, medical, and public policy organizations (e.g., National Center for Injury Prevention and Control), ill youth were defined as those experiencing relatively acute medical illnesses, such as cancer or liver transplants, whereas injury-related traumas were defined as those involving MVAs, burns, or brain injury. Injuries that were the result of violent physical interpersonal traumas, such as assaults and muggings, were not included in this study. A predictor was defined as any variable

that contributed to variability in PTSD diagnostic status or symptom severity. The authors opted for the use of terms such as *predictors* and *correlates*, as compared to *risk factors*, owing to the developing and emergent state of the current medical trauma literature.

Several additional inclusionary and exclusionary criteria were applied to the current study. Only English-language articles published in peer-reviewed journals (from 1980 onward) were included, as the diagnosis of PTSD as applied to children only emerged in the 1980s. The use of only published studies has received some recent support from research suggesting that a publication bias does not necessarily exist among certain medical and social science journals (Olson et al., 2002). Finally, this review included studies that assessed for a DSM diagnosis of PTSD or PTSD symptom severity.

Articles were excluded on the following grounds: (a) they did not utilize a diagnostic instrument or measure that could assess all relevant PTSSs, (b) they were based on case studies, (c) they were based on a sample that was primarily composed of individuals older than 19 years of age, and (d) they did not include sufficient statistical data to compute meaningful analyses. As such, 26 empirical studies were included in this review—18 of which described injured youth, whereas 8 involved youth with various illnesses (see Table 1 for a description of studies).

Methodological Considerations

The studies included in this meta-analysis utilized a wide range of research designs and effect size estimates. As such, the current authors employed various strategies to ensure methodological accuracy. For example, if the same sample was used in several studies, it was only included once in the meta-analysis, whereas multiple dependent variables based on the same sample were aggregated across studies. This was done to avoid a significant distortion of the standard error estimates that typically results when treating nonindependent studies as independent (Gleser & Olkin, 1994). In addition, when a study reported multiple effect size estimates for the same general construct, they were averaged to calculate an overall effect size.

To compute prevalence rates of PTSD, the authors decided that scores falling in the moderate and severe ranges of continuous assessment measures would qualify as roughly meeting PTSD diagnostic

Table 1. Description of Studies Included in the Meta-Analysis

| Author | Type of Sample | Sample Size of Traumatized Youth | Comparison Groups | Time Frame | Current or Lifetime | Informants | Diagnostic Instruments |
|--|---|----------------------------------|---|------------|----------------------|--|------------------------|
| Brown, Madan-Swain, & Lambert (2003) | Adolescent survivors of childhood cancer | 52 | Cancer survivors vs. healthy controls | R | Current and Lifetime | Child and Parent | PTSD-RI |
| Butler, Rizzi, & Handwerker (1996) | Pediatric cancer survivors | 72 | PTSD vs. non-PTSD | R | Unclear | Parent | PSS |
| Kazak et al. (1997) ^a | Childhood leukemia survivors | 130 | Cancer survivors vs. healthy controls | R | Current and Lifetime | Child and Parent | IES/PTSD-RI/TSC |
| Kazak et al. (2004) ^b | Adolescent survivors of childhood cancer | 150 | Survivors receiving psychosocial treatment vs. survivor wait-list controls | R and P | Current and Lifetime | Child and Parent | CPTSD-RI/IES-R/SCID |
| Pelcovitz et al. (1998) | Cancer | 23 | Physical injury; high-risk vs. low-risk | R | Current and Lifetime | Child and Parent | SCID/DIS |
| Shemesh et al. (2000) | Liver transplants | 19 | PTSD vs. non-PTSD | R | Current? | Child and Parent | UCLA-PTSD-RI |
| Stubber, Nader, Houskamp, & Pynoos (1996) ^c | Pediatric cancer (bone marrow transplants; BMT) | 30 | PTSD vs. non-PTSD | P | Unclear | Child | CPTSD-RI |
| Walker, Harris, Baker, Kelly, & Houghton (1999) | Liver transplants | 18 | Liver transplantees vs. youth with either chronic asthma or those undergoing ENT operations | R | Lifetime and Current | Child and Parent (only child for PTSD) | CPTS-RI |
| Aaron, Zaglul, & Emery (1999) | Physical injuries | 40 | PTSD vs. non-PTSD | P | Current | Child | PTSD-RI |
| Bryant, Mayou, Wiggs, Ehlers, & Stores (2004) ^d | MVA | 81 | PTSD vs. non-PTSD | P | Current | Child and Parent (only child for PTSD) | PTSD-RI/(IES) |

(continued)

Table 1 (continued)

| Author | Type of Sample | Sample Size of Traumatized Youth | Comparison Groups | Time Frame | Current or Lifetime | Informants | Diagnostic Instruments |
|---|-------------------------|----------------------------------|------------------------------------|------------|----------------------|------------------|------------------------|
| Davis et al. (2000) | Accidental injuries | 48 | PTSD vs. non-PTSD | P | Current | Child and Parent | CAPS-CA/ PCL-C/PR |
| de Vries et al. (1999) | MVA | 102 | PTSD vs. non-PTSD | P | Current | Parent | PCL |
| Di Gallo, Barton, & Parry-Jones (1997) ^c | MVA | 57 | PTSD vs. non-PTSD | P | Current? | Child and Parent | PTSD-RI/RIES |
| Dyb, Holen, Braenne, Indredavik, & Aarseth (2003) | MVA | 16 | PTSD vs. non-PTSD | P | Current | Child and Parent | CPTS-RI |
| Gerring et al. (2002) | Closed head injury | 95 | PTSD vs. non-PTSD | P | Current | Child and Parent | DICA |
| Kassam-Adams & Winston (2004) ^f | MVA | 177 | PTSD vs. non-PTSD | P | Current | Child | CAPS-CA |
| Keppel-Benson, Ollendick, & Benson (2002) | MVA | 50 | PTSD vs. non-PTSD | R | Current and Lifetime | Child and Parent | DICA-R-C; DICA-R-P |
| Levi, Drotar, Yeates, & Taylor (1999) | Severe and moderate TBI | ~71 | TBI vs. orthopedic injury | P | Current | Child and Parent | CPTSD-RI/PTSS |
| Max et al. (1998) | TBI | 44 | PTSD vs. non-PTSD | P | Current | Unclear | K-SADS |
| Mather, Tate, & Hannan (2003) | MVA/(TBI) | 43 | PTSD vs. non-PTSD; TBI vs. non-TBI | P | Current? | Child and Parent | CPTS-RI |
| McDermott & Cvitanovich (2000) | MVA | 26 | PTSD vs. non-PTSD | P | Current | Child and Parent | PTSD-RI |

| | | | | | | | |
|---|-------|-----|--|---|----------------------|------------------|----------------|
| Mirza, Bhadrinath, Goodyer, & Gilmour (1998) ^g | MVA | 119 | PTSD vs. non-PTSD | P | Unclear | Child and Parent | PTSD-RI/K-SADS |
| Saxe, Stoddard, & Sheridan (1998) ^g | Burns | 72 | PTSD vs. non-PTSD | P | Current | Child | CPTSD-RI |
| Stallard, Velleman, & Baldwin (1998) ^h | MVA | 119 | Sports injuries; MVA PTSD vs. MVA non-PTSD | P | Current | Child | CAPS-CA |
| Stoddard, Norman, Murphy, & Beardslee (1989) ⁱ | Burns | 30 | PTSD vs. normal controls | R | Current and Lifetime | Child and Parent | DICA/SCID |
| Zink & McCain (2003) | MVA | 143 | PTSD vs. non-PTSD | P | Current | Child and Parent | DICA-R |

NOTE: PTSD = posttraumatic stress disorder; PTSD-RI = Posttraumatic Stress Disorder-Reaction Index; PSS = PTSD Symptom Scale; IES = Impact of Event Scale; TSC = Trauma Symptom Checklist; CPTSD-RI = Child Posttraumatic Stress Disorder-Reaction Index; IES-R = Impact of Events Scale-Revised; SCID = Structured Clinical Interview for DSM-IV; DIS = Diagnostic Interview Schedule; UCLA-PTSD-RI = UCLA Posttraumatic Stress Disorder-Reaction Index; CPTSD-RI = Child Posttraumatic Stress Reaction Index; CAPS-CA = Clinician-Administered PTSD Scale (Child and Adolescent version); PCL = Posttraumatic Stress Disorder Checklist; PCL-C = Posttraumatic Stress Disorder Checklist-Civilian Version; RIES = Revised Impact of Event Scale; DICA = Diagnostic Interview for Children and Adolescents; DICA-R-C = Diagnostic Interview for Children and Adolescents-Revised-Child Version; DICA-R-P = Diagnostic Interview for Children and Adolescents-Revised-Parent Version; K-SADS = Schedule for Affective Disorders and Schizophrenia for School-Age Children.

a. Based on data from Gerring et al. (2002); Keppel-Benson, Ollendick, and Benson (2002).

b. Based on data from Gerring et al. (2002); Keppel-Benson, Ollendick, and Benson (2002); Mather, Tate, and Hannan (2003); Stallard, Velleman, and Baldwin (1998).

c. Based on data from Gerring et al. (2002); Mather, Tate, and Hannan (2003); Stallard, Velleman, and Baldwin (1998).

d. Based on data from Daviss et al. (2000); Kassam-Adams and Winston (2004).

e. Based on data from Bryant, Mayou, Wiggs, Ehlers, and Stores (2004); Saxe, Stoddard, and Sheridan (1998).

f. Based on data from Aaron, Zaglul, and Emery (1999); Mather, Tate, and Hannan (2003); McDermott and Cvitanovich (2000).

g. Based on data from Gerring et al. (2002); Stallard, Velleman, and Baldwin (1998).

h. Based on data from Bryant, Mayou, Wiggs, Ehlers, and Stores (2004); McDermott and Cvitanovich (2000); Stallard, Velleman, and Baldwin (1998).

i. Based on data from Daviss et al. (2000); Gerring et al. (2002); Keppel-Benson, Ollendick, and Benson (2002); Saxe, Stoddard, and Sheridan (1998); Stallard, Velleman, and Baldwin (1998).

criteria. Many research and clinical settings tend to interpret scores in these ranges as indicative of clinically meaningful levels of PTSS or PTSD (e.g., Levi et al., 1999). If multiple time point assessments were conducted, the estimates closest to the trauma (within at least 1 month to allow for the emergence of PTSD symptoms) were included. Any follow-up data related to the trauma and rates of PTSD were included when it was available.

Subthreshold PTSD has been defined differently within the literature, such as the endorsement of at least one, two, or three PTSSs (Marshall et al., 2001) or of at least two of the three symptom clusters (Aaron et al., 1999). The authors employed the criteria of endorsing at least two PTSSs to meet criteria for subthreshold PTSD, as this was basically consistent with the methodologies noted above. Also important to note is that there was often a great deal of variability in the comparison groups used in the studies reviewed in this article (e.g., normal controls, comparing those developing PTSD vs. those who do not after the experience of a trauma; see Table 1). As such, the various PTSD predictors and correlates described within this article are to be interpreted cautiously. Because very few studies examined similar variables that related to either of the traumas, a predictor needed to be examined in at least two independent studies for inclusion in the current analysis (per Rosenthal, 1991).

Data Analytic Plan

For each study that met inclusion criteria, the authors coded descriptive information including the mean age of youth at the time of PTSD assessment, percentage of the sample that was female, mean PTSD, and partial PTSD prevalence rates along with other study characteristics, such as type of trauma and informant of PTSS. Next, predictors for the development of PTSD among youth exposed to illnesses and injuries were evaluated. Studies that utilized between-group designs typically reported *t*, *F*, and chi-square statistics, whereas studies using correlational designs reported either Pearson *r* or phi statistics. Per Rosenthal (1991, 1994) and Hedges and Olkin (1985), all of the statistics were converted to Cohen's *d* to yield a single common measure of effect size. The use of effect size statistics for both group differences and correlational data is consistent with current standard statistical practices (Lipsey & Wilson, 2001). Conventional social sciences research

generally interprets Cohen's *d* effect size values as .2 for small, .5 for medium, and .8 for large effects, with higher *d* values indicating a stronger relationship with PTSD.

Q statistics were examined to test for homogeneity among the effect sizes associated with any given predictor. In general, significant *Q* statistics indicate that the variability among effect sizes is greater than what would result from subject-level sampling error alone. As such, for those predictors with significant *Q* statistics, the authors chose to report effect sizes individually (rather than as part of an aggregate). This approach is consistent with statistical standards (e.g., Durlak, 1995). Moreover, because of the exploratory nature of the current manuscript, this approach seemed preferable than simply utilizing a random effects model, which would have obscured the potential significant differences between certain effect sizes. For those predictors in which the *Q* statistics were not significant, the effect sizes were averaged (aggregated) and weighted by the sample sizes associated with the predictors.

In accordance with the rules described above, several predictors and correlates were culled from the literature. For both groups, the associations between mean age of youth, gender rates, and PTSD prevalence rates were computed as was the lag between the trauma and the appraisal of symptoms (see Table 2). For youth experiencing injuries, 8 unique predictors were identified: (a) socioeconomic status (SES), (b) Internalizing scale on the Child Behavior Checklist (CBCL; Achenbach, 1991), (c) comorbid depressive symptoms, (d) comorbid anxious symptoms, (e) comorbid dissociation, (f) acute stress disorder (ASD), (g) social impairment, and (h) appraisal of trauma severity (and/or life appraisal). For youth with illnesses, the years since active treatment, appraisal of trauma severity (and/or life appraisal), and social support emerged as important PTSD predictors (see Table 3).

Results

Injury

As Table 2 demonstrates, 11 of the 18 studies (61%) involved MVAs, whereas the remainder included participants experiencing burns ($n = 2$), TBIs or closed-head injuries ($n = 3$), and a variety of physical injuries ($n = 2$). The mean age of participants was 11.3 years ($SD = 1.41$ years), and 41% of the studies' participants were female (weighted by sample size).

Table 2. Demographics and Prevalence Rates of PTSD Among Pediatric Injury and Illness Populations

| Injury Population (<i>n</i> = 18 studies) | Weighted Mean | Illness Population (<i>n</i> = 8 studies) | Weighted Mean |
|--|--------------------|--|--------------------|
| Age | 11.30 (1.41) | Mean age | 13.39 (2.67) |
| Percentage female | 41.01 | Percentage female | 50.29 |
| PTSD prevalence rates | 19.82 (9.94) | PTSD prevalence rates | 12.04 (7.87) |
| Partial PTSD rates | 25.03 (8.06) | Partial PTSD rates | 37.58 (11.98) |
| Sample size | 70.39 (46.38) | Sample size | 61.75 (51.96) |
| PTSD correlates | Pearson's <i>r</i> | PTSD correlates | Pearson's <i>r</i> |
| Mean age | .04 | Mean age | -.48 |
| Gender (female) | .09 | Gender | .04 |
| Gender (and partial PTSD) | .50 | Gender (and partial PTSD) | .88 |
| Trauma and assessment lag | -.26 | Years since active treatment | -.63* |

NOTE: PTSD = posttraumatic stress disorder.

**p* < .05.

Table 3. Predictors of PTSD Among Pediatric Injury and Illness Populations

| | Cohen's <i>d</i> | | Cohen's <i>d</i> |
|---------------------------------------|-------------------------------|-----------------------------|------------------|
| SES ^a | -0.45 | Appraisal ^l | .39 |
| CBCL Internalizing Scale ^b | 1.03 | Social Support ^k | .14 |
| Depressive Symptoms ^c | 1.06, 1.09, 1.57 | | |
| Anxious Symptoms ^d | 0.90, 0.90, 1.64, 1.96 | | |
| Dissociation ^e | 3.53, 1.19 | | |
| Acute Stress Disorder ^f | 0.94, 1.35 | | |
| Appraisal of Life Threat ^g | 0.82 | | |
| Trauma Severity ^h | -0.39, 0.19, 0.44, 0.85, 1.32 | | |
| Social Impairment ⁱ | 0.41 | | |

NOTE: Cohen's *d* effect size values are *d* = .2 for small, .5 for medium, and .8 for large effects. The effect sizes for Depressive Symptoms, Anxious Symptoms, Dissociation, Acute Stress Disorder, and Trauma Severity are presented separately (instead of as part of a weighted mean), as *Q* statistics indicated a significant amount of heterogeneity between them. PTSD = posttraumatic stress disorder; SES = socioeconomic status; CBCL = Child Behavior Checklist.

a. Based on data from Gerring et al. (2002); Keppel-Benson, Ollendick, and Benson (2002).

b. Based on data from Aaron, Zaglul, and Emery (1999); Mather, Tate, and Hannan (2003); McDermott and Cvitanovich (2000).

c. Based on data from Gerring et al. (2002); Mather, Tate, and Hannan (2003); Stallard, Velleman, and Baldwin (1998).

d. Based on data from Gerring et al. (2002); Keppel-Benson, Ollendick, and Benson (2002); Mather, Tate, and Hannan (2003); Stallard, Velleman, and Baldwin (1998).

e. Based on data from Bryant, Mayou, Wiggs, Ehlers, and Stores (2004); Saxe, Stoddard, and Sheridan (1998).

f. Based on data from Daviss et al. (2000); Kassam-Adams and Winston (2004).

g. Based on data from Bryant, Mayou, Wiggs, Ehlers, and Stores (2004); McDermott and Cvitanovich (2000); Stallard, Velleman, and Baldwin (1998).

h. Based on data from Daviss et al. (2000); Gerring et al. (2002); Keppel-Benson, Ollendick, and Benson (2002); Saxe, Stoddard, and Sheridan (1998); Stallard, Velleman, and Baldwin (1998).

i. Based on data from Gerring et al. (2002); Stallard, Velleman, and Baldwin (1998).

j. Based on data from Brown, Madan-Swain, and Lambert (2003); Shemesh et al. (2000); Stuber et al. (1996).

k. Based on data from Brown, Madan-Swain, and Lambert (2003); Pelcovitz et al. (1998).

1. One study (Brown, Madan-Swain, & Lambert, 2003) contained a few childhood cancer survivors who were 23 years old. Despite this, the study was included because it was mostly composed of adolescents.

2. Several studies were excluded because the injury versus illness categories were not differentiated (Balluffi et al., 2004; Landolt, Vollrath, Ribl, Gnehm, & Stennhauser, 2003).

The average sample size was approximately 70.39 (*SD* = 46.38) participants. Caucasians composed the large majority of the study samples at 70%, whereas African American and Hispanic populations constituted

24% and 5%, respectively, of the samples. Finally, the average lag time between the occurrence of the trauma and the assessment of PTSS/PTSD was 4.97 (*SD* = 3.77) months.

Average PTSD prevalence rates ranged from 0% to 37.5%, with a mean of 19.82% ($SD = 9.94$) weighted by sample size. Of the 18 studies involving injuries, more than half ($n = 11$) provided enough information to calculate that 25% of the samples met criteria for partial PTSD. With respect to specific clusters, 50.47%, 32.53%, and 17.90% of the participants endorsed sufficient symptoms to meet criteria for the re-experiencing, arousal, and avoidance clusters, respectively. A paired sample t test revealed that all these rates were significantly different from each other (i.e., arousal vs. avoidance, $t(4) = 3.66$, $p < .05$; reexperiencing vs. avoidance, $t(4) = 10.13$, $p < .005$; reexperiencing vs. arousal, $t(4) = 3.13$, $p < .05$). It is conceivable that the greater number of youth meeting criteria for the re-experiencing cluster is due to the fact that only 1 re-experiencing symptom needs to be endorsed to meet diagnostic criteria. Indeed, of the three studies that reported percentages of specific symptoms, the re-experiencing symptoms of intrusive recollections and psychological exposure to trauma-related cues were among the most highly endorsed symptoms, with weighted percents of 61.46% and 51.32%, respectively.

Among youth experiencing injuries, PTSD prevalence rates were not strongly associated with mean age of youth, $r(15) = .04$, n.s., or female gender, $r(15) = .09$, n.s. (see Table 2). However, females exhibited relatively high rates of subthreshold PTSD at $r(10) = .50$, n.s. There was a statistical trend for PTSD prevalence rates to be inversely related with the lag between the occurrence of the trauma and the assessment of symptoms at $r(16) = -.26$, $p < .10$. This suggests that injured youth tended to exhibit lower rates of PTSD as more time lapsed between the experience of the trauma and the assessment of PTSD.

Among youth experiencing injuries, SES was a significant, though small to moderate, predictor of PTSS ($Q = 3.35$ [1], n.s.; mean weighted $d = -.45$ [95% confidence interval (CI) = -0.30 to -0.60]). This suggests that youth from a lower SES were somewhat more likely to develop PTSSs after experiencing an injury. PTSS and PTSD were also often related to the experience of other internalizing disorders. Specifically, injured children with PTSSs tended to endorse significantly higher clinical elevations on the CBCL Internalizing scale ($Q = 3.55$ [2], n.s.; mean weighted $d = 1.03$ [95% CI = 0.85 to 1.21]) as well as a greater number of anxiety symptoms ($Q = 58.85$ [3], $p < .0001$; $ds = 0.90$, 0.90 , 1.64 , and 1.96 , respectively) as compared to youth

who sustained injuries but who did not endorse PTSSs. Similarly, the endorsement of significant depressive symptoms was also strongly related to increased PTSS rates ($Q = 18.26$ [2], $p < .0005$; $ds = 1.06$, 1.09 , and 1.57), with large to very large effect sizes indicating considerable comorbidity between PTSD and depressive symptoms.

With two effect size estimates in the large to very large range, dissociation served as a very robust predictor of PTSD diagnosis ($Q = 65.34$ [1], $p < .0001$; $ds = 3.53$ and 1.19 , respectively) among youth sustaining injuries. This result is logical, as dissociation can often be a core symptom of PTSD. ASD was also a strong predictor of PTSSs among injured youth, with two reported effect sizes in the large range ($Q = 6.34$ [1], $p < .05$; $ds = 0.94$ and 1.35 , respectively). Finally, injured youth with PTSD demonstrated small to moderate impairments in social functioning ($Q = .08$ [1], n.s.; mean weighted $d = .41$ [95% CI = 0.39 to 0.43]).

A particularly interesting finding is that the individual's subjective appraisal of the life threat involved in the injury was a robust predictor of PTSD ($Q = 4.78$ [2], n.s.; mean weighted $d = .82$ [95% CI = 0.67 to 0.97]). This indicates that among injured youth, the perception of threat to one's life or physical integrity was usually strongly related to the development of PTSSs. Somewhat concordant with this finding was the relationship between PTSSs and the vaguely defined "trauma severity" construct, which was rated either by the clinician, parent, or youth. Various effect sizes were reported for this association ($Q = 85.58$ [4], $p < .0001$; $ds = -0.39$, 0.19 , 0.44 , 0.85 , and 1.32), with some in the small to moderate range and others in the large to very large range. It is likely that the varied perspectives of different raters contributed, at least in part, to the variability in the effect sizes. For example, a clinician might focus on the more objective severity (e.g., acuity, intensity, length of exposure to trauma) associated with an injury, whereas the parents and child will likely appraise the trauma severity more subjectively (e.g., involvement of any pain). In addition, because severity was defined somewhat differently between studies, it was difficult to identify meaningful trends regarding specific informants attached to the varied effect sizes.

Illness

Six of the eight studies involved pediatric or adolescent cancer survivors, whereas the other two focused on

pediatric liver transplantees. The mean age of participants was 13.39 years ($SD = 2.67$ years), and about half (50.29%) of the participants were female. The average sample size for youth experiencing illnesses was 61.75 ($SD = 51.96$) participants. More than three quarters (75%) of the study participants were Caucasian, and the remaining 25% were divided among African Americans, Hispanics, Asians, and Other. Finally, the mean number of years since active treatment had ended and the assessment of PTSD/PTSS was 3.65 ($SD = 2.04$) years.

Among ill youth, the average PTSD prevalence rates ranged from 0% to 32%, with a mean of 12.04% ($SD = 7.87$) weighted by sample size. Insufficient data precluded providing information about the symptom clusters among youth experiencing illnesses. Among these youth, female gender was not associated with PTSD prevalence rates, $r(6) = .04$, n.s. However, the mean age of the youth appeared to be inversely related with PTSD prevalence, $r(7) = -.48$, n.s., suggesting that the younger the youth, the more likely they were to display PTSSs. Subthreshold PTSD rates for ill youth were fairly high at 37.58% ($SD = 11.98$), with females tending to exhibit relatively high rates at $r(3) = .88$, n.s.

Of the six studies that described youth who had been survivors of (as compared to youth still undergoing) illnesses or procedures, there was a robust and statistically significant association between PTSD prevalence rates and the time since youth had finished their active treatments and/or medical procedures, $r(6) = -.63$, $p < .05$. That is, youth exhibited lower rates of PTSD when more time had lapsed between the illness/procedure and the assessment of their trauma symptoms. This suggests that among youth experiencing illnesses, PTSD is likely to occur shortly following traumatic exposure (with delayed onset less common), or alternatively, that trauma symptoms diminish over time. Because most studies that involve ill youth do not pinpoint the time when PTSSs have emerged, and evaluate current as compared to past symptoms, the data more likely indicate that symptoms decrease with time, and, thus measure chronicity.

The association between perceived severity of trauma (and/or life threat) and PTSSs was small to moderate ($Q = 5.47$ [2], n.s.; mean weighted $d = .39$; 95% CI = 0.16 to 0.62). Three studies contributed to this finding; one study involved a clinician's assessment and the other two were made by the youth. Finally, the social support construct (broadly

defined as support from one's family and friends) was investigated within two pediatric illness studies. Among ill youth, social support exhibited a relatively small relationship with the development of PTSS ($Q = .08$ [1], n.s.; mean weighted $d = .14$; 95% CI = 0.11 to 0.17). This is surprising, as past literature has noted the importance of social support as a buffer against the development of PTSD. It is possible that this finding is an artifact of the protracted assessment lag that occurred for these youth.

Differences Between the Groups on Prevalence Rates and Time of Assessment

Several important differences between the injury and illness groups emerged in this review. First, a chi-square test of proportions indicated that the prevalence rates of PTSD differed significantly between youth experiencing injury versus illness ($\chi^2 = 14.45$ [1], $p < .0005$). Injured youth exhibited a mean of 19.82% ($SD = 9.94$), whereas ill youth displayed a mean of 12.04% ($SD = 7.87$). Another important finding is that the mean effect size differences between the groups on the perceived life threat and/or assessment of trauma severity variable were approaching statistical significance (difference between independent d s; $z = 1.90$, $p = .06$), with children in the injury group endorsing higher rates of perceived trauma severity and/or life threat. This disparity might be attributed to significant differences in the mean lag of PTSD assessment for youth in both groups ($t = 8.55$ [1,215], $p < .0001$). Specifically, youth experiencing illnesses were often followed up *years* after the diagnosis and treatments for their illness, whereas youth exposed to injuries were often assessed *months* after their experienced trauma.

The availability of Time 2 PTSD assessment data in a subset of studies involving injured youth made it possible to formally examine this hypothesis. Nine of the 18 studies (50%) measured PTSS and PTSD prevalence rates at multiple time points, allowing for a comparison of PTSD prevalence rates at different time points among the same trauma group. Within these 9 studies, Time 1 assessments occurred an average of 3.40 ($SD = 3.38$) months after the trauma occurrence, whereas Time 2 assessments occurred an average of 6.48 ($SD = 2.64$) months after the trauma. The mean PTSD prevalence rates of 24.61% ($SD = 9.15$) at Time 1 were significantly higher than

the PTSD prevalence rates of 16.25% ($SD = 9.77$) at Time 2 ($\chi^2 = 19.61$ [1], $p < .0005$). This finding supports the notion that delayed onset of PTSSs is not common and likely occurs only in a minority of injured youth. In addition, it appears that among injured youth, PTSSs subside with time, a pattern consonant with that manifested by ill youth.

Discussion

The goal of the current meta-analysis was to review and synthesize studies addressing PTSD in youth exposed to medical illness or injury. Several interesting findings emerged from this investigation. Among the most important is that the injury- and illness-related trauma literatures have not examined many similar or overlapping predictors of PTSD. The sparseness of replication data with respect to potential predictors makes it difficult to investigate meaningful comparisons across studies, either between the phenomenology of PTSD or PTSD predictors.

This review highlights that a minority of youth experiencing illnesses or injuries typically developed PTSD or PTSSs. The prevalence rates of PTSD appeared higher among youth experiencing injuries as compared to illness. However, it is crucial to highlight that this result might be the product of methodological artifact. Specifically, although some of the cancer and transplant studies followed children for a considerable number of years, follow-up periods for injured youth were shorter and more proximal to the traumatic event, thus resulting in a possible inflation of differences in PTSD rates between the groups. In fact, support for this notion comes from Time 2 assessment data among injured youth, where PTSD rates were significantly lower at follow-up as compared to the initial assessment.

Age at the time of PTSD assessment appears to be more closely related to the development of PTSD/PTSSs among youth with illnesses as compared to those with injuries. Specifically, the older the ill youth, the less likely they were to exhibit significant PTSSs. This might be consistent with research suggesting that older youth possess more cognitive capacities to implement coping strategies after a trauma than do younger youth (Joseph, Brewin, Yule, & Williams, 1993). Alternatively, the relationship between mean age and PTSD rates within the illness group might also be the result of the time gap between the termination of active medical treatment and the evaluation of symptoms. That

is, the lag between PTSD assessment and trauma occurrence may be masking the actual association between age and PTSD.

Although females were more likely than males to display PTSSs (and subthreshold PTSD), the current meta-analysis indicated there did not appear to be significant gender differences in rates of diagnostic PTSD among youth experiencing injuries and illnesses. Although the adult literature consistently indicates that women are at higher risk for developing PTSD following various traumas (Breslau et al., 1998; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995), these data do not typically include medically ill samples and thus might not be the most appropriate for comparison with the current findings. Another explanation might be that the degree of trauma severity, whether subjective or objective, might have differed between males and females, thus leading to differences in symptom rates. Although there are reported differences in exposure to various traumas among males and females, with males typically exposed to greater rates of community and physical violence (e.g., Jaycox et al., 2002) and females to greater rates of sexual abuse (e.g., Putnam, 2003), there is no literature comparing the severity of experienced traumas between the genders.

Internalizing symptoms, particularly those associated with depression and anxiety, appear to be highly comorbid with PTSD in injured youth. This is helpful clinical information, as it suggests that PTSSs will typically not occur in isolation from other psychiatric symptoms. This finding is consistent with research that reports high levels of comorbidity among adults with PTSD (e.g., Kessler et al., 1995). Finally, although temporal order of onset is difficult to establish, it is possible that preexisting internalizing disorders, such as anxiety, serve as a diathesis that places people at higher risk for developing PTSD after a trauma (Bradley, 2000).

The appraisal of life threat and trauma severity is a construct that requires further study. There are many components to consider, including but not limited to, medical late effects, future necessary treatments, and other individuals directly affected by the trauma. The relationship between the appraisal of trauma severity and PTSD was moderate to large in both the illness and injury groups. However, given the ambiguity of the construct (i.e., is severity simply a proxy for life threat?), it is difficult to make conclusive interpretations about these data. Future studies would be well served to integrate both objective

and subjective (e.g., including collateral family reports) trauma severity ratings to make comparisons between trauma groups.

Research conducted to date has important implications for identifying those youth who are at risk for developing PTSD in response to illnesses or injuries. First, it is important for clinicians and researchers to assess uniform predictors and correlates, including appraisal of life threat, academic functioning, family functioning, social support, cognitive strategies, dissociation, and perceived levels of stress. It is only through replication by independent research groups that predictors will gain credibility. Further potential support for the role of these identified factors can be useful to practitioners in assessing and preventing psychiatric symptoms and/or improving functioning. Perhaps with more conclusive research of predictors and moderators of PTSD with youth experiencing illnesses and injuries, clinicians and programs serving these youth (such as schools and medical clinics) will have a better understanding of services and types of treatment that need to be provided.

Second, studies should include more ethnically diverse youth, as the composition of many of the studied samples was predominantly Caucasian. Third, to facilitate comparisons across studies, researchers should clearly describe the rationale and methods of selecting populations, as understanding potential sample limitations is vital for drawing generalizations from study results. Fourth, to understand the familial context of PTSD, family members affected by the trauma should be assessed for PTSD and other psychopathology. Finally, the recent literature has addressed the importance of posttraumatic growth in the context of an experienced trauma (Milam, Ritt-Olson, & Unger, 2004; Salter & Stallard, 2004). As such, assessing the resilience and strengths of youth undergoing a trauma would allow for a more comprehensive understanding of the youth's psychological functioning after the trauma.

This study has several limitations. Various potential predictors could not be analyzed because they were not included in a sufficient number of independent studies. Unfortunately, much of the pediatric trauma research has been hindered by a lack of measurement of uniform variables. Specifically, it appears that of the 11 variables for which effect sizes were calculated, 5 of them only included information from only two independent studies. In addition, the literature regarding illness (with only eight studies meeting criteria and two predictors) may be

less advanced than the literature pertaining to injuries (with 18 studies and eight identified predictors). Moreover, several studies reported statistics (e.g., multiple regressions) about PTSD predictors that were not included in this review because the values depended on the constellation of covariates used in the original study. Another significant limitation is that the comparison groups (e.g., normal controls, all traumatized) often differed between the injury and illness samples, rendering comparisons across the trauma groups quite difficult. Finally, null findings not reported in the literature might limit the generalizability of the findings from this review.

In summary, there is much more research that needs to be conducted before conclusive statements can be made about the predictors for the development of PTSD in trauma-exposed youth. Despite the limitations discussed above, data suggest that among injured youth, SES and social impairment were small to moderate correlates of PTSD, whereas depressive and anxious symptoms, dissociation, ASD, and the appraisal of trauma severity and life threat served as robust predictors of PTSD. Among ill youth, social support and the appraisal of illness severity and life threat emerged as small to moderate predictors of PTSSs. Rather than constituting a rigid set of predictors, these factors should be conceptualized as a rough heuristic that clinicians can employ when appraising trauma-exposed youth. Accordingly, clinicians should closely monitor at-risk individuals who exhibit many of the predictors identified in this article in an attempt to prophylactically address psychiatric symptoms before they become chronic.

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