DISASTERS AND YOUTH: A META-ANALYTIC EXAMINATION OF POSTTRAUMATIC STRESS

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ABSTRACT

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Objective: A sizable body of literature has now examined posttraumatic stress (PTS) symptoms in youth in the aftermath of disaster. Meta-analysis is the preferred tool with which to inform funding decisions, service delivery, and public policy. **Method:** The present meta-analysis quantitatively synthesized this literature (*k*=96 studies; Total *N* = 74,154), summarizing the magnitude of overall associations between disasters and youth PTS, and identifying child, disaster, and study method factors associated with variations in the magnitude of these associations. **Results:** Despite variability across studies, disasters had a significant effect on youth PTS symptoms, falling in the small-to-medium range of magnitude. Aspects related to pre-existing child characteristics, the disaster and the child's disaster exposure, and study methodology are significantly associated with variations in the magnitude of disaster effects on youth PTS symptoms. Specifically, female gender, higher death toll, closer proximity, personal loss, and perceived threat and distress at the time of the event were each associated with increased post-disaster PTS in youth. Regarding methodological factors, studies conducted within the first year post-disaster, studies that used established PTS measures, and studies that relied on child-report data identified a significant effect on youth PTS, whereas studies conducted after

the first year, studies relying on non-established measures, and studies relying on parent-report data did not. **Conclusion:** In the aftermath of disasters, governmental funding agencies and private foundations provide substantial resources for child services following disasters. The present meta-analytic findings can help to inform optimal allocation of these resources and targeted intervention efforts, as well as the development and refinement of new interventions for youth suffering in the aftermath of disasters.

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CHAPTER 1

BACKGROUND AND SIGNIFICANCE

Disasters are destructive occurrences that disrupt and overwhelm entire communities, confront every society, and collectively affect as many as thirty-three million individuals worldwide in a given year (International Federation of Red Cross and Red Crescent Societies, IFRC, 1998). There is evidence that the incidence of disasters is increasing (IFRC, 2004), and when disasters strike, a great many youth are in close proximity and are vulnerable to directly witnessing massive destruction, seeing dead or injured people, being involved in a school evacuation, losing a loved one, viewing physical damage or ruins, and/or being forced to relocate residency. Such diverse phenomena as hurricanes, earthquakes, floods, tsunamis, brushfires, terrorist attacks, mass transportation disasters, and nuclear waste accidents are associated with elevated rates of psychopathology and impairment in children and adolescents (e.g., Hoven et al., 2005; La Greca, Silverman, Vernberg, & Prinstein, 1996; March, Amaya-Jackson, Terry & Costanzo, 1997; Pynoos et al., 1993; see Furr, 2007 for a review). The most consistent finding is that youth living in regions that have experienced a disaster subsequently exhibit elevated rates of re-experiencing, avoidance/emotional numbing, and hyperarousal (i.e., posttraumatic stress, PTS, symptoms). PTS and posttraumatic stress disorder (PTSD) are associated with considerable impairment and difficulty, and when left untreated are associated with subsequent depression, anxiety, substance abuse, and conduct disorder, and overall impaired quality of life (e.g., Giaconia et al. 1995; Vernberg & Varela, 2001). Accordingly, examining the impact of disasters on youth PTSD and PTS symptoms constitutes a matter of great public health concern.

The extent to which individual children evidence PTS symptoms in the wake of disasters varies greatly (see Furr, 2007, unpublished manuscript). Acknowledging the multi-level ecology of child development (see Bronfenbrenner, 1979; Cicchetti & Cohen, 1995; Mohr, 2002), guiding frameworks offered by Green et al. (1991), La Greca and colleagues (1996; La Greca & Silverman, 2006; Silverman & La Greca, 2002; Vernberg, La Greca, Silverman, and Prinstein, 1996), and Weems and Overstreet (2008) broadly conceptualize domains of influence that affect children's post-disaster functioning. Among these domains of influence, *pre-existing aspects of the child* (e.g., gender, age), and *aspects of the disaster and disaster exposure* (e.g., child proximity to disaster, perceived threat to self) have been well studied. In addition, *aspects related to study methodology* (e.g., sampling, measurement, timing of assessment) may affect documented post-disaster PTS levels in youth (Pfefferbaum & North, 2008).

Across the child post-disaster literature, age and gender have been the most consistently studied *pre-existing characteristics of the child*. A number of studies that have included examination of gender effects find girls to evidence more PTS than boys (e.g., Barnes et al., 2005; Burke et al., 1986; Foa et al., 2001; Garrison et al., 1995; Gobble, Swenny, & Fishbein, 2004; Lengua et al., 2005; Whalen et al., 2004). Analyses of age has produced more mixed findings, with some studies finding no age differences (e.g., Jeney-Gammon et al., 1993; Schuster et al., 2001), and other studies finding older children to show greater PTS than younger children (e.g., Garrison et al., 1995; Saylor et al., 2003; Terr et al., 1997). Importantly, although analyses of age effects across studies have produced mixed findings, given that gender differences in internalizing symptoms typically emerge at puberty (e.g., Angold, Worthman, & Costello, 2003), there may exist

a gender by age interaction, such that the effect of gender on PTS symptoms is stronger for older youth.

Aspects of the disaster and disaster exposure have been examined, including objective and subjective elements of the child's disaster experience and environment that may be associated with post-disaster functioning. Regarding objective elements, many studies have examined "dose effects," and found that the child's physical proximity to the disaster is negatively associated with subsequent PTS symptoms (i.e., youth in closer proximity display greater PTS; e.g., Schuster et al., 2001; Stuber et al., 2002). In contrast, a handful of other studies have found limited support for a proximity effect (e.g., Evans & Oehler-Stinnett, 2006). Regarding subjective elements, a number of studies find peritraumatic distress (e.g., perceived life-threat and general distress at time of disaster), predicts post-disaster PTS (Garrison et al., 1995; Green et al., 1991; 1994; La Greca et al., 1996; 1998; Nader, Pynoos, Fairbanks, & Frederick, 1990; Pfefferbaum, North, et al., 2003; Pynoos, Frederick, et al., 1987; Pynoos, Nader et al., 1987; Thienkura et al., 2006; Vernberg et al., 1996). Personal loss (e.g., loss of a loved one) has also been associated with post-disaster PTS (e.g., Brown & Goodman, 2005; Goenjian et al., 1995; Green et al., 1994; Lengua et al., 2005; Pfefferbaum, North, et al., 2006; Pfefferbaum, Nixon, Krug, et al., 1999; Pfefferbaum, Nixon, Tucker, et al., 1999; Schwarz & Kowalski, 1991; Stuber et al., 2002; Thienkura et al., 2006). Importantly, between-disaster differences have not been examined within empirical studies (e.g., PTS differences following natural vs. man-made disasters, relationships between disaster death toll and PTS).

Less acknowledged in determining documented post-disaster PTS rates in youth have been *aspects related to study methodology*. A small number of studies used

structured diagnostic interviews (e.g., Asarnow et al., 1999; Bolton et al., 2000; Yule et al., 2000), whereas a majority of studies relied on diagnostic screeners or self-report questionnaires (e.g., Barnes et al., 2005; Goenjian et al., 1995; 2001; Green et al., 1991; Hoven et al., 2005; March et al., 1997; Pynoos, Frederick, et al., 1987; Scrimin et al., 2006; Thienkura et al., 2006), which identify "probable" rates of PTSD (i.e., individuals at high probability for meeting diagnostic criteria). Screeners and self-report questionnaires likely identify higher rates of pathology than diagnostic interviews (North & Pfefferbaum, 2002; Pfefferbaum & North, 2008). Cross-sectional comparisons of pre- vs. post-disaster PTS may provide different estimates than within-subjects comparisons. Due to recall bias, retrospective pre-disaster data (provided within-subjects at post-disaster) may also provide differential estimates of the effect of disasters on PTS symptoms in youth, as might post-disaster comparisons between exposed and non-exposed youth. Moreover, research has found parent-child concordance rates to range from low to moderate (Achenbach, McConaughy, & Howell, 1987; De Los Reyes & Kazdin, 2004), with concordance for childhood internalizing problems being particularly low (e.g., Comer & Kendall, 2004; Grills & Ollendick, 2003). Thus, it is likely that documented post-disaster PTS symptoms in youth are affected by *who* is reporting on them (e.g., parent, child, teacher). Finally, the post-disaster assessment period likely affects PTS findings. In the absence of evidence, it is misguided to infer that PTS symptoms identified during the recovery and reconstruction phases (i.e., months or years after the event; Silverman & La Greca, 2002; Valent, 2000) would be present at recoil (i.e., immediately after the event occurs), post-impact (i.e., days to weeks after the event), or upon long-term follow-up (e.g., greater than two years later).

Given research documenting the adverse impacts of disasters upon youth, associations devoted to the needs of youth have developed task forces and resolutions (e.g., American Academy of Pediatrics, Work Group on Disasters, 1995; Levant, 2002; Vogel & Vernberg, 1993; Vernberg & Vogel, 1993) that place the empirical understanding of children's needs in the aftermath of disasters at the forefront of their agendas. Governmental funding agencies and private foundations provide substantial resources for child services following disasters. To optimally inform the allocation of resources and targeted intervention efforts, there is a need to synthesize that which we have learned about the effects of disasters on children and adolescents.

Meta-analytic procedures provide a quantitative, accepted, and respected approach to the synthesis of a body of empirical literature. Literature reviews have moved away from the qualitative summary of studies to the quantitative analysis of the reported findings of the studies (e.g., Cooper & Rosenthal, 1980; Rosenthal & Rosnow, 1991). By summarizing the magnitude of overall relationships found across studies, determining factors associated with variations in the magnitude of such relationships, and establishing relationships by aggregate analysis, meta-analytic procedures provide more systematic, exhaustive, objective, and representative conclusions than qualitative reviews (Rosenthal, 1984). To understand the effect of disasters on PTS symptoms in youth, as well as the factors associated with variations in this effect, meta-analysis is the preferred tool with which to inform funding decisions, service delivery, and public policy.

CHAPTER 2

THE PRESENT STUDY

The present study used meta-analytic procedures to examine the magnitude of the effect of disasters on youth PTS symptoms, as well as factors associated with variations in the effect of disasters on youth PTS symptoms. Specifically, the present study evaluated: (a) the overall effect size of disasters on PTS symptoms; and examined (b) the magnitude of relationships between post-disaster PTS symptoms and pre-existing aspects of the child (i.e., age, gender, gender by age interaction), aspects of the disaster and disaster experience (i.e., proximity to disaster, peritraumatic distress, disaster type, death toll, personal loss), and aspects related to study methodology (i.e., measurement, type of comparison groups, informant, assessment period).

It was hypothesized that across the literature, disasters would be associated with an overall effect on PTS symptoms in youth. Regarding pre-existing aspects of the child, it was hypothesized that girls would exhibit greater PTSD symptoms than boys, and that there would be a Gender by Age interaction, such that the effect of gender would be greater in older youth. Regarding characteristics of the disaster experience, the child's proximity to the disaster, as well as the death toll of the disaster, were both believed to be associated with PTS symptoms, with youth in closer proximity to the disaster, and youth assessed following disasters of greater death tolls, displaying greater PTS symptoms. It was also hypothesized that peritraumatic distress would be associated with post-disaster PTS, with youth experiencing higher levels of threat and distress at the time of the event reporting greater levels of post-disaster PTS. Additionally, youth who lost a loved one

were believed to exhibit greater PTS symptoms than youth who did not experience disaster-related loss.

Regarding aspects related to study methodology, it was hypothesized that the effect size documented in within-subjects comparisons would be greater in magnitude than that identified in between-subjects comparisons. Given the loss of power associated with treating outcome variables dichotomously (e.g., diagnosis either present or absent), it was also hypothesized that studies examining PTS in a categorical fashion would yield smaller effects than studies examining PTS in a continuous fashion. It was also hypothesized that the post-disaster timing of assessment would be associated with effect size, with studies assessing youth further in time from the occurrence of the disaster reporting a smaller effect than studies assessing youth closer in time to the occurrence of the disaster.

Research Design and Methods

Study Selection Criteria

Studies published prior to January 1, 2009 that satisfied six selection criteria were included in the meta-analysis. First, the study had to have examined PTSD or PTS symptoms (obtained from either a PTSD measure or diagnostic/clinical interview) after a distinct and identifiable disaster, as defined by Task Force on Psychological Responses of Children to Natural and Man-made Disasters (Vogel & Vernberg, 1993). This definition characterizes disasters as "events that are relatively sudden, highly disruptive, and time-limited (even though the effects may be longer lasting), and public (affecting children from more than one family)" (Vogel & Vernberg, 1993). Accordingly, studies examining the effects of war, ongoing political violence, or family violence were not included.

Studies that examined general behavior problems or non-PTSD psychopathology were also not included. Second, the study had to have included children and adolescents under the age of 18 at the time of the assessment, or in a few cases, children were below age 18 at the time of the disaster (included to examine the long-term impact of disasters). The majority of studies included children older than age 6, with only a few studies examining youth age 2 and older. Third, the sample size must have been large enough to afford statistical analyses. This excluded case studies, case series, or studies with $n<10$. Fourth, the study must have included quantitative (not just qualitative) analyses. Fifth, the study must have provided specific statistical information, including: means, standard deviations, correlation coefficients, *p*-values, sample size, standard error, variance, odd ratios, chi-squares, or enough data for the authors to obtain additional data to calculate the effect sizes needed for meta-analytic procedures. Lastly, for quality control the study must have undergone the peer-review process (dissertations and data published in book chapters were not included).

A number of strategies were used to identify studies satisfying these criteria. First, computerized searches were conducted in MEDLINE and PsycINFO using the following keywords: disaster(s), brushfire(s), earthquake(s), flood(s), hurricane(s), manmade disaster(s), natural disaster(s), PTSD, terrorism, tornado, trauma, or tsunami(s). These terms were then crossed with adolescent(s), child, children, schoolchildren, and youth. Second, the reference sections of each of the articles found via these computerized searches were reviewed to find additional studies not identified by computerized search. Third, tables of contents for the past two years of the study inclusion frame in journals that typically include studies on youth, trauma, PTSD, and child psychopathology were

also reviewed to identify other potential studies not included in the other above types of searches (i.e., *American Journal of Psychiatry*, *Archives of General Psychiatry*, *Behaviour Research and Therapy*, *British Journal of Psychiatry*, *Depression and Anxiety*, *Development and Psychopathology*, *European Child and Adolescent Psychiatry*, *Journal of Abnormal Child Psychology*, *Journal of Abnormal Psychology*, *Journal of Anxiety Disorders*, *Journal of the American Academy of Child and Adolescent Psychiatry*, *Journal of Child Psychology and Psychiatry*, *Journal of Clinical Child and Adolescent Psychology*, *Journal of Consulting and Clinical Psychology*, *Journal of Traumatic Stress, Pediatrics*). Finally, a search by author name was conducted using the names of known experts in the area to identify any work not yet included.

Variable Coding

Eligible studies were reviewed and coded for study, methodological, disaster, and child variables, as well as PTSD and PTS symptoms. Mean age, age range, and percentage of female participants were coded for each study. For gender X age analyses, studies were sorted into studies of mean age $\geq$ 12 years and studies of mean age < 12 years. Additional coding definitions are described below.

Study Methodology Variables

Study methodology characteristics include sample size, as well as a number of categorical codings. Control condition referred to the type of comparison against which PTS in the affected sample was compared, and included five levels: (1) *between-subjects post design* (i.e., affected sample's post-disaster PTS compared to post-disaster PTS in another sample deemed a priori to be less affected), (2) *within-subjects prospective desi*gn (i.e., affected sample's post-disaster PTS compared to affected sample's pre-

disaster PTS; pre-disaster data assessed prior to the disaster), (3) *within-subjects retrospective design* (i.e., affected sample's post-disaster PTS compared to affected sample's pre-disaster PTS; pre-disaster data assessed post-disaster via retrospective recall), (4) *cross-sectional pre-post design* (i.e., affected sample's post-disaster PTS compared to pre-disaster PTS in another sample), and (5) *within-subjects multiple post-disaster design* (i.e., affected sample's post-disaster PTS assessed at multiple post-disaster time-points post-disaster; time-points compared chronologically). Measurement quality for PTS assessment was considered dichotomously: (1) *sound methodological quality* referred to the use of an established measure (i.e., Childhood PTSD Interview, CHIPS, CPSS, CPTSD-RI, CRIES-13/IES, DISC-V, DPS, DSM-III and DSM-IV criteria, K-SADS, MINI-KID, NWS PTSD, PAPA, PED, PROP, PTSD Checklist, SADS, SCID, SR-PTSD Scale, and TMI) or report of psychometric properties for other measures, and (2) *methodological quality unknown*, referred to the use of a non-established measure without reporting psychometric properties. Informant referred to *parent-report*, *child self-report*, *teacher-report*, or *clinician diagnosis*. The definition of PTS was classified as *categorical* (i.e., symptoms present=yes/no, or diagnosis present=yes/no), *continuous*, and *both categorical and continuous*.

Disaster and Disaster Exposure Variables

Proximity to disaster was assessed as the sample's mean distance (in miles) from disaster epicenter. Disaster type was classified as *natural* (i.e., consequence of a natural hazard becoming a physical event interacting with a human inhabited area) or *man-made* (i.e., consequences of human intent, negligence, or error). Disasters that included both natural and man-made elements were classified according to the initial origin of the

disaster. For example, a hurricane leading to a dam break was categorized as a natural disaster because a natural event (hurricane) precipitated the man-made element (dam breaking). Assessment period was classified as *one year or less* (post-disaster assessment conducted mean of < 365 days) and *more than one year* (post-disaster assessment conducted mean of > 365 days). Disaster-related death toll was classified as ≤ *25 deaths, 26-100 deaths, 101-1000 deaths,* and > *1000 deaths*. When disaster-related death toll was not reported in the study, this information was obtained from publically available information provided by the Center for Disease Control (CDC). The percentage of the sample reporting perceived life-threat at the time of event, general/unspecified distress at the time of event, and loss of a family member or friend was recorded for all studies including such data.

Procedure

Coder Training

Coders were a clinical psychologist, a doctoral candidate in clinical psychology, and an advanced graduate student in psychology. Training of coders included (a) didactics, (b) practice coding, (c) trained-to-criterion testing, and (d) random, unannounced reliability checks.

Didactic training included a two-hour presentation by the PI of PTSD, PTS, the disasters literature, and the categories to be coded. Handouts summarizing the material were provided to augment training and meetings were held to discuss coding-related issues. Trainees spent five hours together as a group practice coding three studies from the adult disaster literature. These studies were drawn from Rubonis and Bickman's (1991) review of the adult disaster literature, and were selected for their inclusion of

variables included in the current youth meta-analysis. Coders were then each assigned three studies from the adult literature (again selected for their inclusion of variables included in the current youth meta-analysis) to code independently. Coders were given the same three studies to code and met with the PI to address discrepancies. Coders were then assigned a set of ten studies from the adult disaster literature to code independently. Coders obtained at least 80% inter-rater reliability on these adult studies and were thus deemed "trained-to-criterion" and prepared to code studies for the current meta-analysis.

Studies included in the present youth meta-analysis were divided among the coders, with a randomly selected 5% of studies assigned to all three coders. Coders met as a group once per month to address coding-related issues and to prevent potential rater drift. Inter-rater reliability was strong for the overlapping studies (all ICCs>.80)

Data Analysis

There are two types of models typically used in meta-analysis: fixed-effects (FE) and random-effects (RE) models. FE models assume that studies being analyzed have homogenous population effect sizes. Alternatively, RE models do not make this assumption, but rather assume that the population parameter values will vary from study to study; and are assumed to be a sample of all possible studies that might be conducted or exist on the subject (Field, 2001; Hedges, 1992; Hedges & Olkin, 1985; Hedges & Vevea, 1998). RE models were selected over FE models for the present meta-analysis due to several consistent problems with FE models and the advantages of the RE models. First, the FE models, although described as "the rule rather than the exception" throughout the literature by the National Research Council (1992), often lead to inflated Type I error rates and erroneously narrow confidence intervals, overestimating the

precision of the findings (Hunter & Schmidt, 2004; Lipsey & Wilson, 2000). In addition, RE models will have the appropriate 5% Type I error rate regardless of whether the population parameter values are homogenous or heterogeneous. RE models also offer the opportunity to generalize obtained meta-analytic means to the entire domain of studies in a research area (Hunter & Schmidt, 2004). Often times, there are theoretical, substantive, or methodological variables that create varied population parameters across studies, keeping the chances of inflating the Type I error rate to a minimum with the use of RE models (Lipsey & Morgan, 2000; National Research Council, 1992).

Accordingly, RE models have been recommended over FE models as more accurate and realistic, as real-world data are likely to have heterogeneous population effect sizes even in the absence of known moderator variables (Field, 2001). Monte Carlo comparisons of the available FE and RE models suggest the Hunter and Schmidt RE method (2004) tends to provide the most accurate estimates of the pooled population effect sizes when effect sizes are heterogeneous, which is the most common case in meta-analytic practice (Field, 2001). Accordingly, the Hunter and Schmidt's RE effects model (Hunter & Schmidt, 2004; Schmidt & Hunter, 1999) was applied to compute each pooled effect size, standard deviation of this pooled effect, and the standard error. To assess the significance of pooled effect sizes, *Z*-scores were calculated for each pooled effect by dividing the pooled effect size by the standard error of that pooled effect. *Z*-scores express the pooled effect size in terms of standard normal deviations, and a significance value (i.e., the probability of obtaining a *Z* score of such magnitude by chance) can then be computed. *Z*-scores greater than or equal to 1.645 correspond to significance at α=0.05. *Z*-scores greater than or equal to 2.33 correspond to significance at α=0.01. In

accordance with Hunter and Schmidt's RE method (2004), the homogeneity of effect sizes were assessed with chi-square statistics, calculated based on the sum of squared errors of the pooled effect size.

As effect sizes are interchangeable, all effects sizes drawn from studies were first converted to *r* prior to meta-analytic synthesis. Only one estimate of effect size was used per construct per study. This decision allowed the samples to remain independent, rather than using several effect sizes from one study for a construct (e.g., a study using multiple measures of PTS symptoms), which could have created dependent samples and violated the assumptions of statistical analyses (Glass, McGaw, & Smith, 1981; Rosenthal, 1984). To address this issue, multiple effect sizes for a single construct within single studies were averaged prior to the synthesis with effect sizes from other studies. All pooled correlations were interpreted using Cohen's (1988) guidelines for sample-weighted average correlations effect sizes, including a small effect (r = .10), medium effect (r = .30), and large effect (r = .50).

Potential Publication Bias

Studies with significant findings are more likely to be submitted and accepted for publication. The "file drawer effect" is the probability that unpublished null findings would eliminate the obtained results (Rosenthal, 1991). Often times, these manuscripts are those in which findings were not significant, methodology quality was lacking, or the author decided to not publish the findings due to a lack in magnitude of the findings (Lipsey & Wilson, 2000; Rosenthal, 1979). If the studies that do not find differences are not accurately represented in the sample of studies included, publication bias may result. To account for the "file-drawer problem," an Orwin "fail-safe N" (FSN; Orwin 1983)

was calculated for significant results, which corresponds to the number of null results that would be needed to overturn a significant result (the number of studies would make $p >$ .05). If the FSN is greater than or equal to five times the number of studies in the analysis plus 10 (i.e., FSN$\geq 5k + 10$), the results are considered to be robust against the file-drawer effect (Rosenthal, 1991).

CHAPTER 3

RESULTS

Characterizing the Literature

Applying the study selection search criteria and methods, 96 studies were identified that examined PTSD or PTS symptoms in 74,154 total youth (see Table 1 for characteristics of studies). Of the 96 studies, 73% (*k* =70 studies) provided control data against which to compare the PTS of exposed youth. Of these 70 studies, 61.4% (*k*=43 studies) included a *between-subjects post design* (i.e., affected sample's post-disaster PTS compared to post-disaster PTS in another sample deemed a priori to be less affected) and 8.6% (*k*=6 studies) included a *within-subjects prospective desi*gn (i.e., affected sample's post-disaster PTS compared to affected sample's pre-disaster PTS; pre-disaster data assessed prior to the disaster) (groups were not mutually exclusive). Only one study (1.4%) included a *within-subjects retrospective design* (i.e., affected sample's post-disaster PTS compared to affected sample's pre-disaster PTS; pre-disaster data assessed post-disaster via retrospective recall). Two studies (2.9%) utilized a *cross-sectional pre-post design* (i.e., affected sample's post-disaster PTS compared to pre-disaster PTS in another sample). A quarter of the studies (*k*=18, 25.7%) included a *within-subjects multiple post-disaster design* (i.e., affected sample's post-disaster PTS assessed at multiple post-disaster time-points post-disaster; time-points compared chronologically) into their study.

Study Design and Measurement

Table 2 presents the methodological characteristics of empirical studies examining posttraumatic stress in youth following a disaster. As expected, the number of

studies examining the effects of disasters on youth increased over time from 1986 to 2008, with only 3 studies prior to 1990 meeting search criteria, and up to 12 studies in 2006 and 2007 meeting search criteria. Of the studies included, over half were conducted in the United States (52.1%, *k*=50), with the next highest number of studies (*k*=8, 8.3%) being conducted in Turkey. The majority of studies (87.5%, *k*=84) used in-person methods for data collection. A small number of studies used either telephone (10.4%, *k*=10) or mail (7.3%, *k*=7) data collection procedures. The post-disaster assessment period ranged from 3 days (Schuster, Stein, Jaycox, Collins, Marshall, Elliott, et al., 2001) to 17 years (Green, Grace, Vary, Kramer, Gleser, & Leonard, 1994). The majority of studies were conducted within the first year post-disaster (67.0%, *k*=63), whereas roughly thirty percent of studies were conducted more than twelve months post-disaster (*k*=31).

Regarding methodological quality, most studies addressed missing data or participant non-response, or at least made reference to non-response as a limitation (72.6%, *k* = 69). Roughly 70% of studies included control data (*k* = 70), and almost 90% used established measures of PTS or provided psychometric data for non-established measures (*k* = 84). Importantly, only 18 studies (18.9%) incorporated multi-method assessment.

Regarding informant, the majority of studies used a child self-report questionnaire (79.2%, *k*=76) to obtain PTS data. A parent-report questionnaire was used in roughly 16% of studies (*k*=15) to obtain PTS data. A diagnostic interview with the child was used in roughly 40% of studies *(k*=42). Across the measures used to assess child PTS, the most commonly used was the CPTSD-RI and related adaptations (47.9%, *k*=46),

followed by the CRIES-13/IES (10.4%, *k*=10), the CPSS (8.3%, *k*=8), the PTSS (7.3%, *k*=7), KSADS/SADS (6.3%, *k*=6). Using these measures, PTSD symptoms were examined most often (50.0% of the studies, *k*=48), followed by examining both PTSD symptoms and diagnosis (40.6%, *k*=39). Roughly ten percent (*k*=9) used only a diagnosis of PTSD with which to characterize PTS in their study participants.

Characteristics of the Disaster and Disaster Experience

Table 3 presents the characteristics of disasters and disaster experiences in empirical studies examining posttraumatic stress in youth following a disaster. A wide range of disasters was examined in the studies that met search criteria for the present meta-analysis. A majority of the studies examined youth in the aftermath of natural disasters (64.6%, *k*=62), whereas roughly thirty-five percent were conducted following man-made disasters (35.4%, *k*=34). A total of 38 distinct disasters were examined. Of the disasters studied, the September 11, 2001 attacks were the most examined (12.5%, *k*=12), followed by the 2004 Indian Ocean Tsunamis (7.3%, *k*=7), Hurricane Andrew (7.3%, *k*=7), Hurricane Katrina (6.3%, *k*=6), and the 1999 Turkey Earthquake (6.3%, *k*=6). The majority of post-disaster youth studies (66.7%, *k* = 64) were conducted following earthquakes, hurricanes, or terrorist attacks (see Figure 1).

Across the disasters studied, the disaster-related death toll ranged from 0 to 310,000 people (Mean death toll=17,070.27). Almost half of the studies examined a disaster with a death toll greater than 1000 (*k*=41). In contrast, 23.3% of the studies examined disasters with a death toll less than or equal to 25 (*k*=25) (see Table 3). In addition, roughly 40% of the studies examined whether the children experienced the loss of a family member in the disaster (39.6%, n=38); 30.2% examined whether children

experienced the loss of a friend (*k*=29). Across the subset of studies examining loss, the prevalence of loss of a family member was higher among affected youth (12.29%) than comparison youth (0.84%) (see Figure 2). Similarly, affected youth lost more friends in the disasters (32.01%) than did comparison youth (4.54%).

Regarding proximity, a higher weighted percentage of affected youth were within one mile of the disaster relative to comparison youth (64.17% vs. 20.63%). Similarly, the weighted percentage of comparison youth that were 25 or more miles from the disaster was greater than that of affected youth (38.39% vs. 17.17%).

Regarding peritraumatic distress, only 16.7% of the studies measured children's perceived threat to self at the time of the event *(k*=16). General or unspecified distress at the time of the disaster was also assessed in 12.5% *(k*=12) of the studies. Within this subset of studies, a weighted percentage of over 40% of youth in the overall sample, as well as in the affected and comparison samples, reported perceiving threat to self at the time of the disaster. A weighted percentage of roughly 64% of the affected children reported elevated levels of general or unspecified distress at the time of the disaster, whereas 51% of the comparison youth reported similar distress (Figure 3).

Characteristics of the Child

The overall mean age of children assessed across the sample, including disaster-affected and comparison youth, ranged from 3.00 to 25.50 years (Weighted M_{age} = 12.54, SD = 3.19). The mean age of disaster-affected youth across the studies ranged from 3.00 to 25.50 years (Weighted M_{age} = 12.56, SD = 3.45). The mean age of comparison youth across studies ranged from 4.50 to 21.60 years (Weighted M_{age} = 12.13, SD = 3.99). Gender was evenly distributed across the overall sample (51.83% female), and across the

affected youth (51.91% female) and comparison youth (53.34% female). Forty-eight studies (50%) examined associations between gender and youth post-disaster PTS.

Rates of PTSD and PTS

Elevated rates of probable PTSD pooled across studies, weighted by sample size, were observed in both the affected (13.85%) and comparison samples (10.38%; see Figure 4). Similarly, pooled rates of diagnosed PTSD, weighted by sample size, were elevated in both samples (13.18% in affected and 11.75% in comparison samples; see Figure 4). Even greater weighted rates of the PTSD symptom clusters were found among the youth in both samples post-disaster (rates ranging from 28.93% to 53.27%; see Figure 5). All symptom clusters were near 50% in the affected sample, including 48.45% reexperiencing, 47.65% avoidance, and 48.98% arousal symptoms. Across studies that broke down PTSD diagnosis by gender, a weighted percentage of roughly 31% of females met diagnostic criteria for PTSD, whereas roughly 25% of males met criteria. Similarly, across studies that broke down probable PTSD by gender, a weighted percentage of roughly 15% of females exhibited probable PTSD, whereas roughly 9% of males exhibited probable PTSD (see Figure 6).

Analysis of All Effect Sizes

As recommended by Rosenthal (1995), Table 4 shows a stem-and-leaf plot of computed effect sizes. The modal effect sizes of the distribution are around 0-.1 and around .2-.3, after which a fairly even number of effect sizes cluster around the intervals between .3 and .7. The standard deviation of computed effect sizes (calculated in accordance with Hunter & Schmidt, 2004) was .18, which is higher than the average variability found in meta-analyses published in *Psychological Bulletin* from 1997-2002

(Field, 2005). A chi-square test of homogeneity of effect sizes was highly significant, $\chi^2(42)=1127.13, p<.001$.

Across the literature, the overall average effect size of disasters on PTS, weighted in accordance with the Hunter and Schmidt (2004) RE method, was $r = .19$ ($SE_r=.03$, $k=42$), which corresponds to a significant z score ($z = 6.30, p < .0001$). This is a small to medium effect when evaluated by Cohen's (1988) criterion. File-drawer analysis (Rosenthal, 1995) indicates that 25,831 unpublished null findings would be required to weight this average effect into a non-significant effect [i.e., Failsafe Number (FSN)=25,831].

Across studies that broke PTS down by symptom clusters, small effects were found for disasters on youth re-experiencing, avoidance, and hyperarousal symptoms. The average effect size of disasters on *re-experiencing* symptoms, weighted in accordance with the Hunter and Schmidt RE method (2004), was $r = .136$ ($SE_r=.048$, $k=12$), which corresponds to a significant z score ($z = 2.82, p < .01$; FSN=411). Overall there was considerable variability across re-experiencing effect sizes ($\chi^2(12)=255.91$, $p<.001$). The average effect size of disasters on *avoidance* symptoms, weighted in accordance with Hunter and Schmidt RE method (2004), was $r = .115$ ($SE_r=.058$, $k=15$), which corresponds to a significant z score ($z = 1.98, p < .05$; FSN=310). There was considerable variability across avoidance effect sizes ($\chi^2(15)=568.62, p<.001$). The average effect size of disasters on *hyperarousal* symptoms, weighted in accordance with Hunter and Schmidt RE method (2004), was $r = .121$ ($SE_r=.071$, $k=12$), which corresponds to a significant z score ($z = 1.69, p<.10$; FSN=140). There was considerable variability across avoidance effect sizes ($\chi^2(12)=673.78, p<.001$).

Youth PTS Effects and Pre-existing Aspects of the Child

Across studies examining associations between child *age* and youth post-disaster PTS (k=26; Total N=24,657), there was significant variability across age effects ($\chi^2(26)=545.74$, $p<.001$) and overall a significant age effect was not found (r = -.05, SD_r = .156, z = -1.61, $p > .10$). Among studies examining associations between *gender* and youth post-disaster PTS (k=48; Total N=41,909), a small gender effect was found via the Hunter and Schmidt (2004) RE method (r = .14, SD_r = .01), corresponding to a significant z score (z = 9.73, $p < .0001$; FSN=80,527). Table 5 shows a stem-and-leaf plot of computed gender effect sizes. The modal effect size of the distribution is around 0-.2, after which a fairly even number of effect sizes cluster around the intervals between .2 and .4. A test of homogeneity revealed significant variability across gender effect sizes ($\chi^2(48)=557.54$, $p<.001$). Gender effects were roughly comparable across samples with mean age less than 12 years [r = .11, SD_r = .10, z = 4.48, $p < .0001$; FSN=2,123; $\chi^2(17)=104.64$, $p<.001$] and samples with mean age greater than or equal to 12 years [r = .15, SD_r = .10, z = 6.96, $p < .0001$; FSN=11,163; $\chi^2(25)=379.05$, $p<.001$].

Youth PTS Effects and Aspects of the Disaster and Disaster Exposure

Overall PTS effect sizes were comparable across natural (r=.16, SD_r = .183, z = 4.05, $p<.001$; k=23; Total N = 9,173; *FSN*=2,657) and man-made disasters (r=.20, SD_r = .175, z = 5.05, $p<.001$; k=19; Total N = 23,724; *FSN*=3,383). Disaster-related death toll was associated with post-disaster youth PTS. Specifically, whereas there was no significant effect of disasters on youth PTS in disasters of death toll $\leq$ 25 (r=.09, SD_r = .332, z = 0.98, $p>.05$; k=12; Total N = 4,169), the effect grew steadily for disasters resulting in 26-100 deaths (r=.12, SD_r = .100, z = 2.40, $p< .05$; k=4; Total N = 1,251;

FSN=30), disasters resulting in 101-999 deaths (r=.19, SD_r = .186, z = 2.65, p< .01; k=6; Total N = 5,978; *FSN*=81), and disasters resulting in ≥ 1000 deaths (r=.22, SD_r = .120, z = 7.76, p<.0001; k=19; Total N = 21,418; *FSN*=8,006). This trend is depicted in Figure 7.

Table 6 presents a summary of meta-analytic findings on the effect of child proximity, peritraumatic distress, and disaster-related loss on youth post-disaster PTS. Medium and medium-to-large effect sizes were identified for the overall effects of child proximity to the disaster (r = .33, p<.0001), child perceived threat to self at the time of the disaster (r = .34, p<.0001), and general/unspecified peritraumatic distress at the time of the disaster (r = .38, p<.0001). Disaster-related loss of a loved one or friend had an overall small but significant effect on youth post-disaster PTS (r = .16, p<.0001). There was significant variability across effect sizes for proximity, peritraumatic distress, and loss (p of all χ^2 homogeneity analyses <.001).

Youth PTS Effects and Aspects of Study Methodology

Table 7 presents a summary of meta-analytic findings on the effects of disasters on youth PTS by measurement psychometric quality, informant, study period, and measurement mode. A small-to-moderate effect of disasters was found among studies that used established PTS measures or reported acceptable psychometric properties for non-established measures (r = .20, p<.0001), whereas studies that relied on non-established measures and did not report acceptable psychometric properties of these measures did not collectively find a significant effect of disasters on youth PTS (p>.05). A small-to-moderate effect of disasters was found among studies relying on child-report data (r=.20, p<.0001), whereas studies relying on parent-data did not collectively find a significant effect of disasters (p>.05). Similarly, a small-to moderate effect of disasters

was found among studies conducted in the first year post-disaster (r = .20, p<.001), whereas studies conducted after the first year post-disaster did not collectively find a significant effect of disasters (p>.05). Effect sizes were comparable across studies that used mono- vs. multi-method assessment. PTS effect sizes were lower across studies that used between-subjects comparisons (r=.19, SD_r = .18, p<.001) than across studies that used within-subjects comparisons (r=.31, SD_r = .15, p<.001). Effect sizes were comparable across studies that used mono- vs. multi-method assessment, and across studies that treated PTS continuously versus categorically.

CHAPTER 4

DISCUSSION

A sizable body of literature has examined youth PTS symptoms in the aftermath of disasters (see Comer & Kendall, 2007; La Greca et al., 2002; Lonigan et al., 1994; Shannon et al., 1994; Vogel & Vernberg, 1993; Weems & Overstreet, 2008). The present meta-analysis represents the first study to quantitatively synthesize this literature (Total *N* = 74,154 youth), summarizing the magnitude of overall associations between disasters and youth PTS, and identifying factors associated with variations in the magnitude of these associations. Despite considerable variability across studies, disasters had a significant effect on youth PTS symptoms (overall $r = .19$, corresponding to a pooled d of .4), falling in the small-to-medium range of magnitude. Importantly, aspects related to pre-existing child characteristics (i.e., gender), the disaster and the child's disaster exposure (i.e., disaster-related death toll, child proximity to disaster, peritraumatic distress, personal loss), and study methodology (timing of assessment) are significantly associated with variation in the magnitude of disaster effects on youth PTS symptoms.

Regarding the impact of aspects of the disaster and the child's disaster exposure, the cause of the disaster (e.g., natural vs. man-made) matters far less than the actual extent of destruction (e.g., death toll), where the child was situated during the destruction (proximity), the child's subjective response at the time of the destruction (perceived threat to self, general/unspecified distress), and whether they lost a loved one or friend in the event. In fact, proximity and peritraumatic distress evidenced medium-to-large associations with youth PTS. These findings are consistent with Kazdin's (2007) assertion that

> "the source (of disasters)… may not be as critical as the disruption, immediate impact, and alarm caused by the event… Severity, shock, loss, and disruption may be among the key dimensions perhaps, not whether there was a human hand in the planning" (Kazdin, 2007, p. 217).

Regarding pre-existing aspects of the child, gender, but not age, was significantly associated with youth PTS. This finding is consistent with Tolin and Foa's (2006) meta-analytic conclusion on sex differences in PTSD across the lifespan that females are at roughly twice the odds of suffering from PTSD than males (OR = 1.98, corresponding to r = .19). At present, it remains unclear whether gender effects are associated with biological (e.g., hormonal differences; Yehuda, 1999) or psychosocial variables (e.g., environmental differences, gender socialization), or some interaction of the two. Although age effects have been among the most consistently examined with regard to post-disaster youth PTS, the present meta-analytic failed to identify a significant age effect. Importantly, Silverman and La Greca (2002) note that few studies have had sufficiently large samples of youth representing wide age ranges to adequately investigate developmental differences. Of note, the gender effect was consistent across youth above and below the age of 12.

Regarding aspects related to study methodology, *how* PTS is measured, *when* PTS is measured, and *who* provides the data each seem to contribute to the extent to which youth PTS is identified following a disaster. Studies that used established measures of youth PTS (or used non-established measures while providing documentation of favorable psychometric properties) found a significant effect, whereas studies that relied on non-established measures and did not provide psychometric data failed to identify a significant effect. Given the unpredictable nature of disasters, the vast majority of studies

on disaster-affected youth are initiated post-disaster, and as such, less time is afforded for planning than is afforded in investigations of more predictable phenomena. That said, the present findings underscore the importance of measurement considerations when designing post-disaster research—specifically the importance of using established measures in order to detect youth PTS following disasters.

The timing of assessment was found to affect the strength of association between disasters and youth post-disaster PTS. Studies conducted in the first year post-disaster found a stronger effect of disasters on youth PTS than studies conducted beyond one year post-disaster. The first year post-disaster constitutes what has been referred to as the recoil, post-impact, and initial recovery phases (Silverman & La Greca, 2002; Valent, 2000), during which time many children are forced to relocate, change schools, and/or cope for the first time with the loss of a loved one. These forms of disaster-related life disruption can, in turn, be associated with increased risk of developing post-disaster PTS (e.g., Comer et al., in press; La Greca et al., 1996). Importantly, although the present study did not find a significant effect of disasters on youth PTS among studies conducted after the first year, there was considerable heterogeneity among these studies. For example, whereas Swenson et al. (1996) failed to find a significant effect on youth PTS 14 months after Hurricane Hugo, Mullett-Hume et al. (2008) found a large effect of the 9/11 World Trade Center attack on PTS among youth after two-and-a-half years. Moreover, elevated rates of disorders other than PTSD (e.g., separation anxiety disorder, depression, and generalized anxiety) have been identified during the extended recovery and reconstruction phase (see La Greca, 2007; Silverman & La Greca, 2002),

highlighting the critical importance of conducting long-term follow-up assessments in the aftermath of disasters.

Child-informant data indicated a significant effect of disasters on youth post-disaster PTS, whereas parent-informant data did not. Given that many PTS symptoms are internal phenomena (e.g., intrusive recollections, dreams, feelings of detachment, sense of foreshortened future), PTS may manifest largely beyond parents' awareness. In addition, observable symptoms of PTS may occur only in situations outside of the home (e.g., at school, with friends). Moreover, parents of disaster-affected youth are typically coping with the disaster as well, which may encroach upon their ability to reliably report on their child's symptoms. The present findings suggest that child-provided symptom endorsements are the preferred source of data in the assessment of youth PTS in the aftermath of disaster.

Limitations and Future Directions

Although the present study documents an overall significant effect of disasters on youth PTS, and the importance of child, disaster, and study variables in determining the magnitude of this effect, a number of limitations warrant comment. First, as with any meta-analysis, the present findings speak to the broader population of disasters of which the available body of literature is representative. Currently, the literature on disasters and youth has disproportionately focused on American youth (roughly 52% of studies). Importantly, disasters in developing countries are more lethal than disasters in industrialized countries, with disasters killing an average of 300 people in developing countries and disasters killing an average of 44 people in industrialized countries (IFRC, 2004). It is likely that developing countries have lower functioning medical and

emergency assistance systems, which may result in greater spread of disaster and/or slower response after disaster. Developing countries may also lack early warning systems or other resources that would allow coordinated evacuation efforts, which could mitigate loss of human life (e.g., Pfefferbaum, North et al., 2003). Accordingly, future empirical work is needed to evaluate the impact of disasters on youth PTS in developing regions of the world.

Secondly, although the present analysis evaluated a host of child, disaster, and study variables as they relate to youth PTS, a number of key variables not included in the present analysis may play important roles, as well. Much has been written about the roles of pre-existing psychopathology, prior trauma, child coping resources, social support, repeated disaster-related media exposure, the availability of mental health services, prejudice and discrimination, and parental psychopathology (Comer, Furr, Beidas, Weiner, & Kendall, 2008; Comer & Kendall, 2007; Karol et al., 1999; La Greca et al., 1996; Silverman & La Greca, 2002; Swenson et al., 1996; Weems & Overstreet, 2008). Regrettably, only a small handful of post-disaster studies have evaluated each of these variables, and there is tremendous variability in how these constructs are measured, and so it is unclear whether studies including these variables can meaningfully synthesized. Although the literatures on these potentially important variables are not yet ready to be meta-analyzed, future post-disaster work needs to systematically incorporate these variables into study. In addition, there is a need to develop more standardized assessments of these constructs so that data across studies can be meaningfully integrated.

Finally, the present meta-analysis evaluated youth PTS symptoms. Although PTS has been the most consistently studied outcome of disasters in youth, clearly this is just one of many potential outcomes. Other negative outcomes, to name just a few, can include other anxiety disorders, depression, complicated and traumatic grief, externalizing disorders, and academic and social impairments. Resilience as an outcome (Luthar, 2003), and factors that promote resilience, needs to be incorporated into post-disaster research, as well as consideration of posttraumatic growth.

Conclusions

Historically, the majority of research on the psychological effects of disasters has been conducted with adult samples (see Norris et al., 2002; North, 2007; Rubonis & Bickman, 1991). Only more recently have the effects of disasters on youth begun to be systematically examined. Early clinical presentations on the effects of disasters on youth relied on descriptive techniques, case study, or very small samples of youth, precluding statistical analysis (Freud & Burlingham, 1943; Honig, Grace, Lindy, Newman, & Titchener, 1993; Levy, 1945). Over the past 25 years, increasingly rigorous empirical work with youth samples has paralleled the continued refinement of the Diagnostic and Statistical Manual of Mental Disorders (DSM) categorizations of childhood psychopathology, allowing for greater overlap between children's reactions to disasters and diagnosable childhood disorders (e.g., childhood specifiers of PTSD only began being included in DSM-IV; American Psychiatric Association (APA), 1994).

The present study used meta-analytic methods to aggregate data from more than 74,000 youth to produce a reliable estimate of the association between disasters and youth PTS symptoms. This association fell in the small-to-moderate range of magnitude,

although there was considerable variability that was explained, in part, by aspects of the disaster, child, and study. Specifically, female gender, high death toll, closer proximity, peritraumatic distress, and personal loss were each associated with increased post-disaster PTS in youth. In the aftermath of disasters, governmental funding agencies and private foundations provide substantial resources for child services following disasters. The present meta-analytic findings can help to inform the optimal allocation of these resources and targeted intervention efforts, as well as the development and refinement of new interventions for youth suffering in the aftermath of disasters.

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Table 1. Characteristics of Empirical Studies Examining Posttraumatic Stress in Youth Following a Disaster

Study	**Disaster**	**N**	**Age range (in years)[a]**	**Assessment Period(s)**	**Informant**
Asarnow, Glynn, Pynoos, Nahum, Guthrie, et al. (1999)	1/17/94 Northridge, CA earthquake	49	8.59-18.60	1.22 years post-disaster	Child
Bal (2008)	1999 Marmara Earthquake in Turkey	293	8-15	3 years post-disaster	Child
Bal & Jensen (2007)	1999 Marmara Earthquake in Turkey	293	8-15	3 years post-disaster	Child
Barnes, Treiber, & Ludwig (2005)	9/11/2001 WTC and Pentagon attacks	406	*M*=16.1	3 months post-disaster	Adolescents
Bhushan & Kumar (2007)	2004 Tsunami	130	10-16	1 year post-disaster	Child
Bokszczanin (2002)	1997 Flood in Poland	335	11-20	20 months post-disaster	Child
Bokszczanin (2007)	1997 Flood in Poland	533	11-21	28 months post-disaster	Child

Table 1 cont.

Bolton, O'Ryan, Udwin, Boyle, & Yule (2000)	10/21/88 Jupiter ship sinking in Greek waters	294	11-18 at time of disaster	5 months post-disaster; 5.7 to 7.9 years post-disaster	Child
Breton, Valla, & Lambert (1993)	Montreal Industrial Fire disaster	86	6-11	12-15 months post-disaster	Child
Bromet, Goldgaber, Carlson, Panina, Golovakha, et al. (2000)	1986 Chornobyl nuclear power plant accident	300	10-12	11 years post-disaster	Child, Parents, Teachers
Brown & Goodman (2005)	9/11/2001 WTC and Pentagon attacks	83	8-18	Mean = 321 days (SD=127) post-disaster	Child, Parents
Bulut, Bulut, & Tayli (2005)	1999 Marmara Earthquake in Turkey	300	Unknown	11 months post-disaster	Child
Catani, Jacob, Schauer, Kohila, & Neuner (2008)	2004 Tsunami	296	9-15	Not reported	Child

Table 1 cont.

Duarte, Hoven, Wu, Bin, Mandell, Nagsawa, et al. (2006)	9/11/2001 WTC and Pentagon attacks	8236	9-21	6 months post-disaster	Child
Eksi, Braun, Ertem-Vehid, Peykerli, Saydam, Toparlak, & Alyankak (2007)	1999 Earthquake in Turkey	160	9-18	6 – 20 (mean 16.3) weeks post-disaster	Child
Endo, Shioiri, Toyabe, Akazawa, & Someya (2007).	2004 Niigata-Chuetsu earthquake	756	Preschool and School-aged children	Pre-disaster; immediately post-disaster; 1 week, 1 month, and 5 months post-disaster	Parents
Evans & Oehler-Stinnett (2006)	May 1999 tornado in Stroud and Mulhall, OK	152	6-12	1 year post-tornado	Child
Foa, Johnson, Feeny, & Treadwell (2001)	1994 Northridge, CA earthquake	75	8-15	2 years post-disaster	Child

Table 1 cont.

Garrison, Bryant, Addy, Spurrier, Freedy, & Kilpatrick (1995)	Hurricane Andrew	400	12-17	6 months post-disaster	Adolescents, Parents
Giannopoulou, Strouthos, Smith, Dikaiakou, Galanopoulou, & Yule (2006)	1999 Athens earthquake	2036	9-17	6-7 months post-disaster	Child
Goenjian, Molina, Steinberg, Fairbanks, Alvarez, et al. (2001)	Hurricane Mitch in Central America	158	*M*=13	6 months post-disaster	Child
Goenjian, Pynoos, Steinberg, Endres, Abraham, Geffner, & Fairbanks (2003)	1988 Armenian earthquake	64	*M*=14	6.5 years post-disaster	Child
Goenjian, Pynoos, Steinberg, Najarian, Asarnow, Karayan, et al. (1995).	1988 Armenian earthquake	218	*M*=12.97	1.5 years post-disaster	Child

Table 1 cont.

Goenjian, Walling, Steinberg, Karayan, Najarian, & Pynoos (2005).	1988 Armenian (Spitak) earthquake	125		5 years post-disaster; 1.5 years post-disaster comparison	Child
Green, Grace, Vary, Kramer, Gleser, & Leonard (1994).	1972 Buffalo Creek dam collapse	99	Aged 2-15 at time of disaster	17 years post-disaster	Children (now adults)
Green, Korol, Grace, Vary, Leonard, et al. (1991).	1972 Buffalo Creek dam collapse	179	Age 2-15 at time of disaster	1.5 - 2 years-post disaster	Child, Parents
Groome & Soureti (2004)	1999 Greek Earthquake	178	9-17	5 months post-disaster	Child
Hamada, Kameoka, Yanagida, & Chemtob (2003)	1992 Hurricane Iniki	3732	6-15	26 months post-disaster	Child

Table 1 cont.

Hamada, Kameoka, Yanagida, & Chemtob (2007).	1992 Hurricane Iniki	4,184	6-15	Study 1: 3-4 months post-disaster Study 2: 26 months post-disaster	Child
Handford, Mayes, Mattison, Humphrey, Bagnato, et al. (1986).	1979 Three Mile Island (TMI) nuclear accident	35	6-19	1.5 years post-disaster	Child, Parents
Hensley, & Varela (2008)	Hurricane Katrina	302	10-15	5-8 months post-disaster	Child
Hoven, Duarte, Lucas, Wu, Mandell, et al. (2005)	9/11/2001 WTC and Pentagon attacks	8236	9-21	6 months post-disaster	Child
Hsu, Chong, Yang, & Yen (2002)	1999 Taiwan Earthquake	323	12-14	6 weeks post-disaster	Child
Joseph, Brewin, Yule, & Williams (1993)	1988 Jupiter Ship sinking	16	13-15	5 months, 1 year post-disaster	Child

Table 1 cont.

Kar & Bastia (2006)	1999 Super-cyclone in Orissa, India	108	*M* = 14.28	14 months post-disaster	Child
Kar, Mohapatra, Nayak, Pattanaik, Swain, & Kar (2007)	1999 Super-cyclone in Orissa, India	447	7-17	1 year post-disaster	Child, Parents, Teacher
Kiliç, Özgüven, & Sayil (2003)	1999 Turkish Earthquake (Bolu)	49	7-14	3 months post-disaster	Child
Kolaitis, Kotsopoulos, Tsiantis, Haritaki, Rigizou, Zacharaki, et al. (2003)	1999 Greek Earthquake	163	*M* =11.05	6 months post-disaster	Child
Koplewicz, Vogel, Solanto, Morrissey, Alonso, et al. (2002)	1993 WTC bombing	22	Grades 2, 3, 5	3-months; 9- months post disaster	Child, Parents
Korol, Green, & Gleser (1999).	1984 Nuclear waste disaster in Fernald, OH	180	7-15	5 years post-disaster	Child, Parents

Table 1 cont.

La Greca, Silverman, Vernberg, & Prinstein (1996).	Hurricane Andrew	442	Grades 3-5	3-months, 7-months, 10-months months post-disaster	Child
La Greca, Silverman, & Wasserstein (1998).	Hurricane Andrew	92	Grades 4-6	15 months pre-disaster; 3-months, 7-months post-disaster	Child, Peers, Teachers
Lack, & Sullivan (2008)	2001 Tornado	102	8-12	13 months post-disaster	Child
Laor, Wolmer, Kora, Yucel, Spirman, & Yazgan (2002)	1999 Marmara Earthquake in Turkey	303	*M*=8.52	4-5 months post-disaster	Child
Lengua, Long, & Meltzoff (2006)	9/11/2001 WTC and Pentagon attacks	147	9.13-13.65	1, 2 years pre-disaster; 1 month post-disaster	Child, Parents
Lengua, Long, Smith, & Meltzoff (2005)	9/11/2001 WTC and Pentagon attacks	207	9.13-13.65	1, 2 years pre-disaster; 1 month, 6 months post-disaster	Child, Parents

Table 1 cont.

Levine, Whalen, Henker, & Jamner (2005)	9/11/2001 WTC and Pentagon attacks	81	14-18	3 months; 8 months post-disaster	Adolescents, Parents
Liu, Tan, Zhou, Li, Yang, Sun, & Wen (2007)	1998-1999 Hunan Floods in China	6703	7-15	8-15 months post-disaster	Child
Lonigan, Anthony, & Shannon (1998)	Hurricane Hugo	5687	9-19	3 months post-disaster	Child
McFarlane (1987)	1983 Australian Bushfire	808	*M*=8.2	2 months, 8 months, 26 months post-disaster	Child, Parents, Teacher
March, Amaya-Jackson, Terry, & Costanzo (1997).	1991 Imperial foods chicken processing plant explosion and fire in Hamlet, NC	1,019	10-16	9 months post-disaster	Child, Teachers
Marsee (2008)	Hurricane Katrina	166	14-18	15-18 months post-disaster	Child
McDermott, Lee, Judd, & Gibbon (2005)	2003 Australian Wildfire	222	8-18	6 months post-disaster	Child, Parents

Table 1 cont.

McDermott & Palmer (2002)	5-day Bushfire in New South Wales, 1994	2379	8-19	6 months post-disaster	Child
Mirzamani, Mohammadi, & Ali Besharat (2006)	1992 Tehran City Park Boat Sinking Disaster	19	13-15	18 months post-disaster	Child
Mullett-Hume, Anshel, Guevara, & Cloitre (2008)	9/11 WTC attack	204	12-16	2.5 years post-disaster	Child
Nader, Pynoos, Fairbanks, & Frederick (1990).	1984 Sniper attack on elementary school playground	100		14 months post-disaster	Child
Najarian, Goenjian, Pelcovitz, Mandel, et al. (1996)	1988 Armenian Earthquake	74	11-14	2.5 years post-disaster	Child
Neuner, Schauer, Catani, Ruf, & Elbert (2006)	2004 Tsunami	264	8-14	3- to 4- weeks post-disaster	Child
Pfefferbaum, Nixon, Tucker, Tivis, Moore, et al. (1999)	1995 Oklahoma City bombing	3218	Grades 6-12	7 weeks post-disaster	Child

Table 1 cont.

Pfefferbaum, North, Doughty, Gurwitch, Fullerton, & Kyula (2003)	1998 American Embassy bombing in Nairobi, Kenya	562	9-17	8-14 months post-disaster	Child
Pfefferbaum, North, Doughty, Pfefferbaum, Dumont, Pynoos, et al. (2006)	1998 American Embassy bombing in Nairobi, Kenya	156	10-12	8-14 months post-disaster	Child
Pfefferbaum, Sconzo, Flynn, Kearns, Doughty, et al. (2003)	1995 Oklahoma City bombing	2720	Grades 6-12	7 weeks post-disaster	Child
Pfefferbaum, Seale, McDonald, Brandt, Jr., Rainwater, Maynard, et al. (2000)	1995 Oklahoma City bombing	69	Grade = 6	2 years post-disaster	Child
Pfefferbaum, Stuber, Galea, & Fairbrother (2006)	9/11/2001 WTC and Pentagon attacks	161	12-17	6-9 months post-disaster	Adolescents; Parents

Table 1 cont.

Pina, Villalta, Ortiz, Gottschall, Costa, & Weems (2008)	Hurricane Katrina	46	*M* = 11.43	6-7 months post-disaster	Child
Prinstein, La Greca, Vernberg, & Silverman (1996).	Hurricane Andrew	506	Grades 3-5	7 months post-disaster	Child, Parents, Teachers, Peers
Proctor, Fauchier, Oliver, Ramos, Rios, & Margolin (2007)	1994 Northridge Earthquake	117	4-5 at time of disaster	Pre-earthquake; 8.74 months post-earthquake	Parents
Pullins, McCammon, Lamson, Wuensch, Mega (2005)	Hurricane Floyd	612	5-19	3.5 months post-disaster	Child
Pynoos, Goenjian, Tashjian, Karakashian, et al. (1993)	1988 Armenian Earthquake	231	8-16	1.5 years post-disaster	Child

Table 1 cont.

Pynoos, Nader, Frederick, Gonda, et al. (1987).	1984 Sniper attack on elementary school playground	251	6-13	1 year post-disaster	Child
Roussos, Goenjian, Steinberg, Sotiropoulou, Kakaki, Kabakos, et al. (2005).	1999 Earthquake in Ano Liosia, Greece	1937		3 months post-disaster	Child
Russoniello, Skalko, O'Brien, McGhee, Bingham-Alexander, & Beatley (2002)	Hurricane Floyd	150	9-12	6 months post-disaster	Child
Sahin, Batigun, & Yilmaz (2007)	1999 Earthquake in Turkey	1260	6-11	5-8 months post-disaster; 8-11 months post-disaster comparison	Parents
Saylor, Cowart, Lipovsky, Jackson, & Finch, Jr. (2003)	9/11/2001 WTC and Pentagon attacks	179	5-11	1 month post-disaster	Child, Parents

Table 1 cont.

Scheeringa, & Zeanah (2008)	Hurricane Katrina	70	3.1-6.8	5 months post-disaster	Child
Schuster, Stein, Jaycox, Collins, Marshall, Elliott, et al. (2001)	9/11/2001 WTC and Pentagon attacks	170	5-18	3-5 days post-disaster	Child, Parents
Schwarz, & Kowalski (1991).	Shooting attack on elementary school and 2nd grade classroom	64	5-14	6-14 months post-disaster	Child, School Personnel
Scrimin, Axia, Capello, Moscardino, Steinberg, & Pynoos (2006).	2004 terrorist attack, 3-day hostage takeover, and terrorist mine explosion on School Number 1 in Beslan, Russia	22	6-14	3 months post-disaster	Child, Parents
Shannon, Lonigan, Finch, & Taylor (1994)	Hurricane Hugo	5687	9-19	3 months post-disaster	Child

Table 1 cont.

Shaw, Applegate, & Schorr (1996).	Hurricane Andrew	30	7-13	8-months, 21-months post-disaster	Child, Teachers
Shaw, Applegate, Tanner, Perez, Rothe, Campo-Bowen, & Lahey (1995).	Hurricane Andrew	144	6-11	8-weeks, 32- weeks post-disaster	Child, Teachers
Spell, Kelley, Wang, Self-Brown, Davidson, Pellegrin, Palcic, et al. (2008)	Hurricane Katrina	260	8-16	89-219 days (mean = 162 days) post-disaster	Child
Swenson, Saylor, Powell, Stokes, Foster, & Belter (1996).	Hurricane Hugo (Charleston, NC)	331	2-10	14 months post-disaster	Parents (Mothers)
Terr, Bloch, Michel, Shi, Reinhardt, & Metayer (1997)	1986 Challenger spacecraft explosion	153		5-7 weeks post-disaster; 14 months post-disaster	Child, Adolescents

Table 1 cont.

Thienkura, Cardozo, Chakkraband, Guadamuz, Pengjuntr, Tantipiwatanaskul, et al. (2006).	2004 Tsunami	417	7-14	2-months, 9- months post-disaster	Child
Vernberg, LaGreca, Silverman, & Prinstein (1996)	Hurricane Andrew	568	Grades 3-5	3 months post-disaster	Child
Vijayakumar, Kannan, & Daniel (2006)	2004 Tsunami	230	11-14	11 months post-disaster	Child
Vila, Porche, & Mouren-Simeoni (1999)	2005 hostage and bomb threat event of elementary school classroom near Paris, France	47	6-9.5	2 months; 4 months; 7 months; 18 months post-attack	Child

Table 1 cont.

Vila, Witowski, Tondini, Perez-Diaz, Mouren-Simeoni, & Jouvent (2001)	Industrial disaster in Briey region	93	4-13	6-7 months post-disaster	Child, Parents
Weems, Pina, Costa, Watts, Taylor, & Cannon (2007).	Hurricane Katrina	52	*M*=11.35	17 months pre-disaster; 6-7 months post-disaster	Child
Whalen, Henker, King, Jamner, & Levine (2004)	9/11/2001 WTC and Pentagon attacks	171	14.8-18.7	1, 2, 3 years pre-disaster; 2-5 months post-disaster	Adolescents
Wickrama & Kaspar (2007)	2004 Tsunami	325	12-19	4 months post-disaster	Child
Wolmer, Laor, Dedeoglu, Siev, & Yazgan (2005)	1999 Earthquake in Turkey	287	9-17	3.5 years post-disaster	Child, Parents, Teachers
Yule, Bolton, Udwin, Boyle, O'Ryan, & Nurrish (2000)	10/21/88 Jupiter ship sinking in Greek waters	304	11-18 at time of disaster	5 months post-disaster; 5.7 to 7.9 years post-disaster	Child

Note: See methods section for description of study search criteria; WTC = World Trade Center; PTSD = posttraumatic stress disorder

[a] When age range not given, mean age or grade range provided

Table 2. Methodological Characteristics of Empirical Studies Examining Posttraumatic Stress in Youth Following a Disaster (*k*=96; Total N=74,154)

Variable	***k***	**% of studies**
Control condition		
None	26	27.1
Between-subjects Post	43	44.8
Within-subjects Prospective	6	6.3
Within-subjects Retrospective	1	1.0
Cross-sectional Pre-Post	2	2.1
Within-subjects Multiple Post	18	18.8
Data Collection		
In Person	84	87.5
Telephone	10	10.4
Mail	7	7.3
Methodological rigor		
Addressed missing data	69	72.6
Used comparison data	70	72.9

Table 2 cont.

Established PTS measure/reported psychometrics	84	87.5
Multi-method assessment	18	18.9
PTS measurement type/informant		
Child self-report questionnaire	76	79.2
Child diagnostic interview	42	43.8
Parent-report questionnaire	15	15.6
Parent diagnostic interview	8	8.3
Teacher report	3	3.1
Frequently used PTS measures		
CPTSD-RI and related measures	46	47.9
CRIES-13/IES and related measures	10	10.4
CPSS	8	8.3
PTSS	7	7.3
KSADS/SADS	6	6.3
PTS variable		
Symptoms	48	50

Table 2 cont.

Diagnosis	9	9.4
Both	39	40.6
Time since disaster		
≤ 1 year	63	65.0
> 1 year	31	33.0

Note: *k* = number of studies

Table 3. Characteristics of Disasters and Disaster Experiences in Empirical Studies Examining Posttraumatic Stress in Youth Following a Disaster (*k*=96; Total N=74,154)

Variable	***k***	**% of studies**
Publication Year		
Prior to 1990	*3*	3.1
1990-1999	*24*	25.0
2000-2008	*69*	71.9
Country of study		
United States	*50*	52.1
Turkey	*8*	8.3
Armenia	*5*	5.2
India	*5*	5.2
Greece	*4*	4.2
Sri Lanka	*3*	3.1
Australia	*3*	3.1
United Kingdom	*3*	3.1
France	*2*	2.1

Table 3 cont.

Kenya	*2*	2.1
Poland	*2*	2.1
Canada	*1*	1.0
China	*1*	1.0
Iran	*1*	1.0
Japan	*1*	1.0
Nicaragua	*1*	1.0
Russia	*1*	1.0
Taiwan	*1*	1.0
Thailand	*1*	1.0
Ukraine	*1*	1.0
Disaster type		
Natural	*62*	64.6
Man-made	*34*	35.4
Disaster category		
Earthquake	*23*	23.96
Hurricane	*21*	21.88

Table 3 cont.

Terrorism	*20*	20.83
Tsunami	*7*	7.29
Flood	*5*	5.21
Tornado	*4*	4.17
Fire/wildfire	*4*	4.17
Boat disaster	*4*	4.17
Nuclear waste disaster	*3*	3.13
Sniper attack/shooting	*3*	3.13
Other explosion	*2*	2.08
Most studied specific disasters		
9/11 attacks	*12*	12.5
2004 Indian Ocean Tsunamis	*7*	7.3
Hurricane Andrew	*7*	7.3
Hurricane Katrina	*6*	6.3
1999 Turkey Earthquake	*6*	6.3
Death Toll		
< 25	*21*	23.3

Table 3 cont.

26-100	*16*	17.8
101-1000	*12*	13.3
1001+	*41*	45.6
Loss of family member	*38*	39.6
Loss of friend	*29*	30.2
Peritraumatic threat to self	*16*	16.7
General/unspecified peritraumatic distress	*12*	12.5

Note: *k* = number of studies

Table 4. Stem-and-Leaf Plot of All Effect Sizes (*r*s)

Stem	Leaf
.7	
.6	13, 30, 36
.5	08, 18, 22, 42
.4	11, 82
.3	10, 57, 99
.2	05, 06, 09, 10, 30, 50, 50, 54, 96
.1	43, 69, 87
.0	00, 00, 40, 55, 56, 80, 85, 92, 95, 97
-.0	03, 30
-.1	00
-.2	10, 79
-.3	12
-.4	
-.5	00
-.6	
-.7	35
-.8	

Note: Values in left column represent the first digit of the effect size, the correlation coefficient (*r*), and the values in the right column represent the second and third digits of the effect size.

Table 5. Stem-and-Leaf Plot of Gender Effect Sizes (*r*s)

Stem	Leaf
.5	
.4	00, 00
.3	50, 50, 90, 90
.2	10, 11, 20, 30, 80
.1	00, 00, 10, 13, 20, 20, 30, 30, 37, 40, 40, 50, 60, 70, 70, 70, 80, 80
.0	10, 10, 29, 39, 50, 50, 50, 55, 59, 70, 80
-.0	20, 38
-.1	40, 49, 60
-.2	
-.3	
-.4	28, 52
-.5	

Note: Values in left column represent the first digit of the effect size, the correlation coefficient (*r*), and the values in the right column represent the second and third digits of the effect size.

Table 6. Effects of Proximity, Peritraumatic Distress, and Disaster-related Loss on Youth Post-disaster PTS: Results of Random-Effects Meta-analyses

Analysis	**K**	**Total N**	**Pooled r**	**SD_r**	**SE_r**	**Z**	**FSN**	χ^2
Proximity to Disaster	14	14,834	.33	.198	.05	6.24	2,810	1315.11
Peritraumatic Distress								
Threat to Self	13	11,593	.34	.110	.03	11.32	80	322.97
General / Unspecified	14	12,347	.38	.150	.04	9.50	6,523	358.3
Loss of loved one or friend	22	7,763	.16	.142	.03	5.38	5,157	219.82

Note: K = number of studies included in analysis; Total N = number of children included in analysis; Pooled r = pooled correlation effect size; SD_r = standard deviation of pooled r; SE_r = standard error of pooled r; Z = z-score of pooled r; FSN = fail-safe number of studies needed to overturn the significant findings; χ^2 = chi-square random effects model variability of pooled r.

Table 7. Effects of Disasters on Youth PTS by Measurement Psychometric Quality, Informant, Study Period, and Measurement Mode: Results of Random-Effects Meta-analyses

Analysis	**K**	**Total N**	**Pooled r**	**SDr**	**SEr**	**Z**	**FSN**	**$\chi 2$**
Measurement quality								
Sound	37	30,689	.20	.161	.026	7.48	28,239	1238.59
Methodological quality unknown	5	2,208	.11	.329	.147	.76	-	297.41
Informant								
Child	39	31,189	.20	.168	.027	7.43	31,016	1369.51
Parent	10	3,192	.12	.256	.081	1.49	-	268.5
Post-disaster Period								
< 1 year	28	30,234	.20	.15	.028	7.08	14,495	1071.76
> 1 year	14	2,663	.09	.354	.095	.933	-	400.54
Measurement Mode								
Multi-method	9	3,358	.20	.155	.052	3.86	438	123.77
Mono-method	33	29,539	.19	.181	.032	6.07	14,770	1478.16
PTS Definition								
Continuous	25	11,735	.21	.13	.03	7.10	11,618	228.81

Table 7 cont.

Categorical	32	26,413	.19	.20	.04	5.29	10,558	1655.31

Note: K = number of studies included in analysis; Total N = number of children included in analysis; Pooled r = pooled correlation effect size; SD_r = standard deviation of pooled r; SE_r = standard error of pooled r; Z = z-score of pooled r; FSN = fail-safe number of studies needed to overturn the significant findings; χ^2 = chi-square random effects model variability of pooled r.

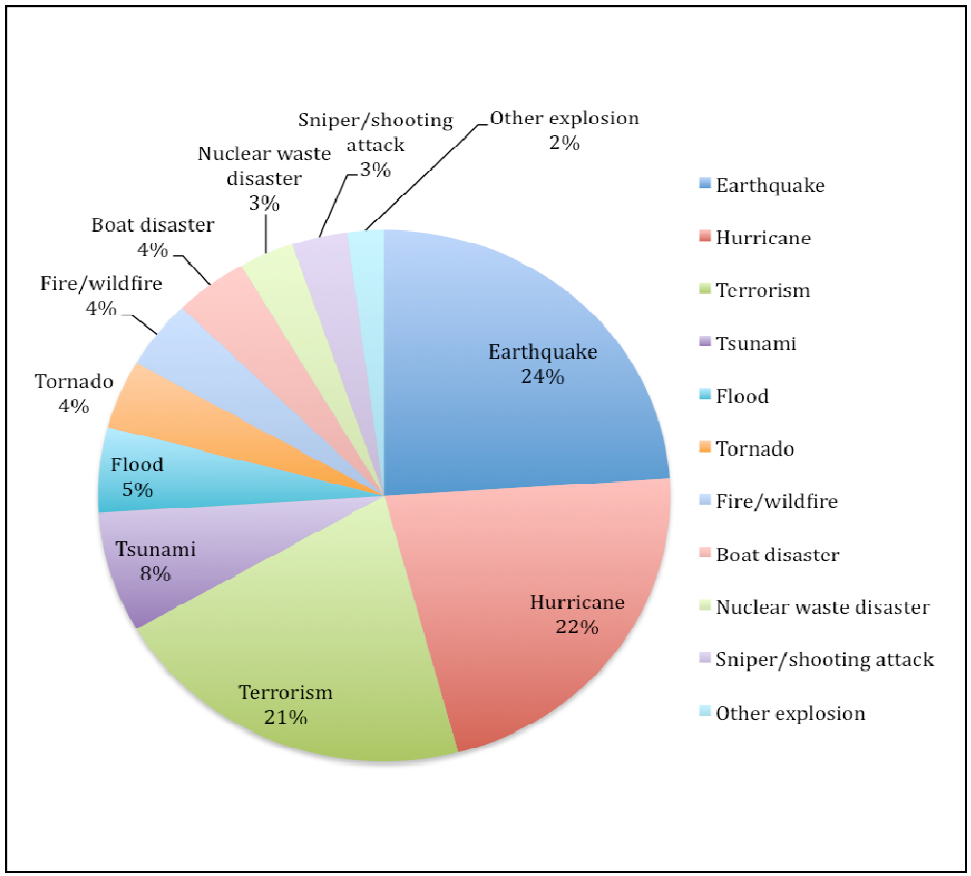

Figure 1. Percentage of Type of Disaster

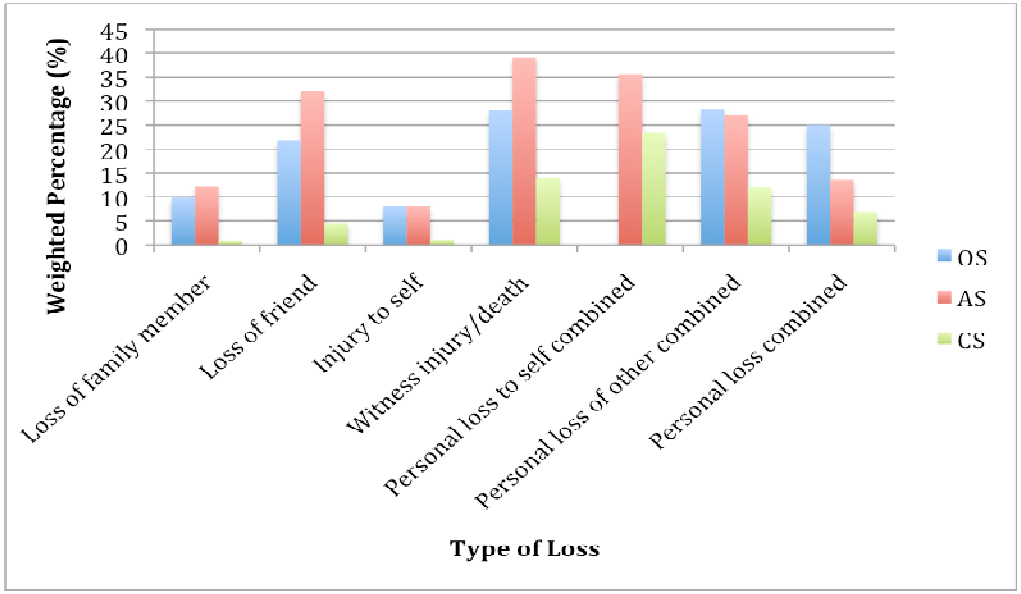

Figure 2. Weighted Prevalence of Post-disaster Loss and Injury

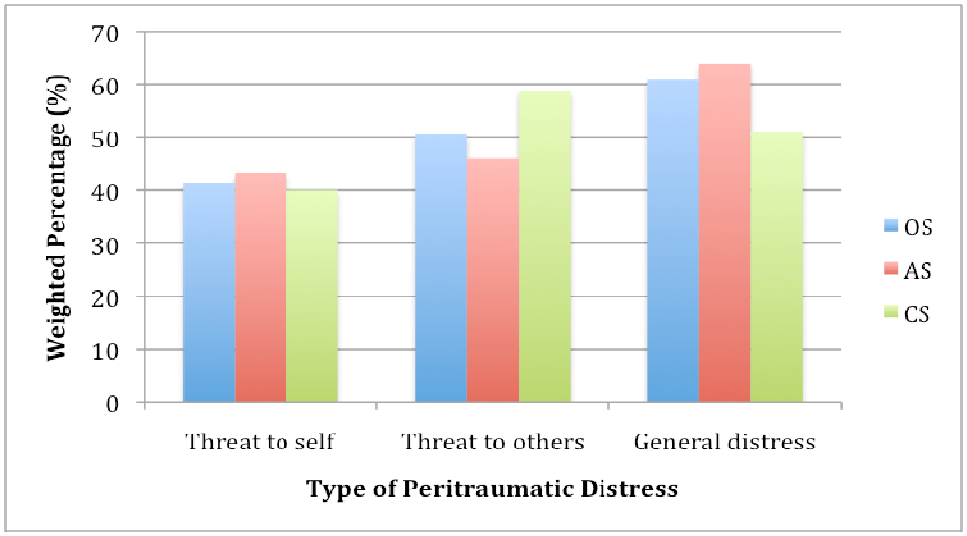

Figure 3. Weighted Prevalence of Peritraumatic Distress in the Overall, Affected, and Combined Samples

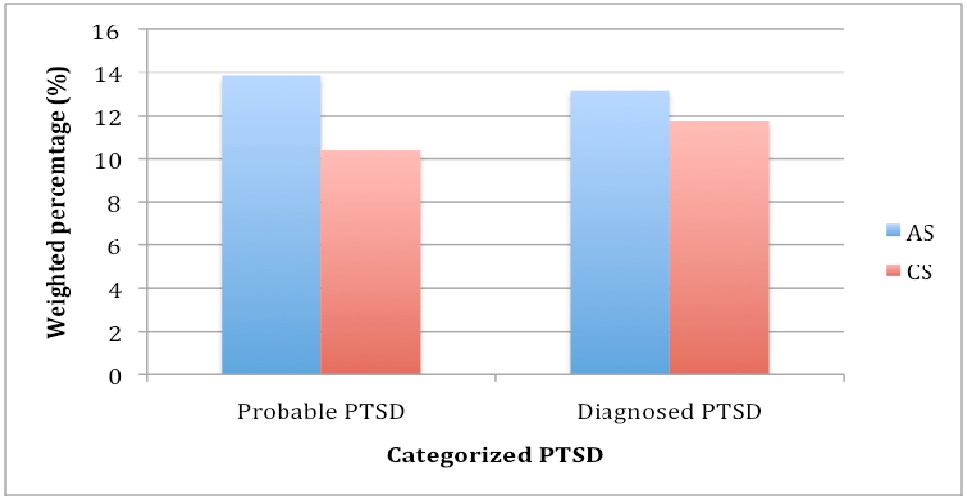

Figure 4. Weighted Prevalence of Probable and Diagnosed PTSD in the Affected and Comparison Samples

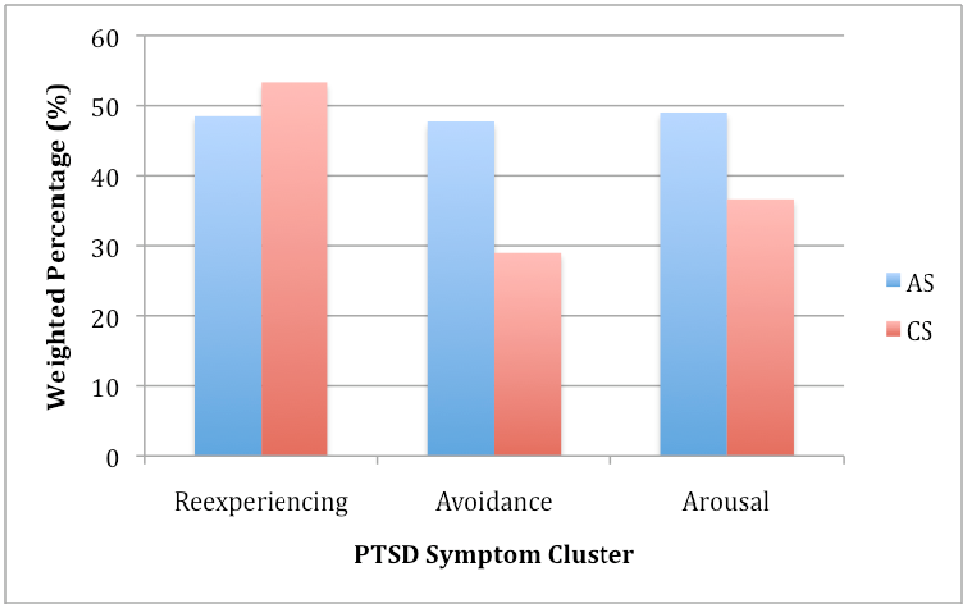

Figure 5. Weighted Prevalence of Reexperiencing, Avoidance, and Arousal Symptoms in the Affected and Comparison Samples

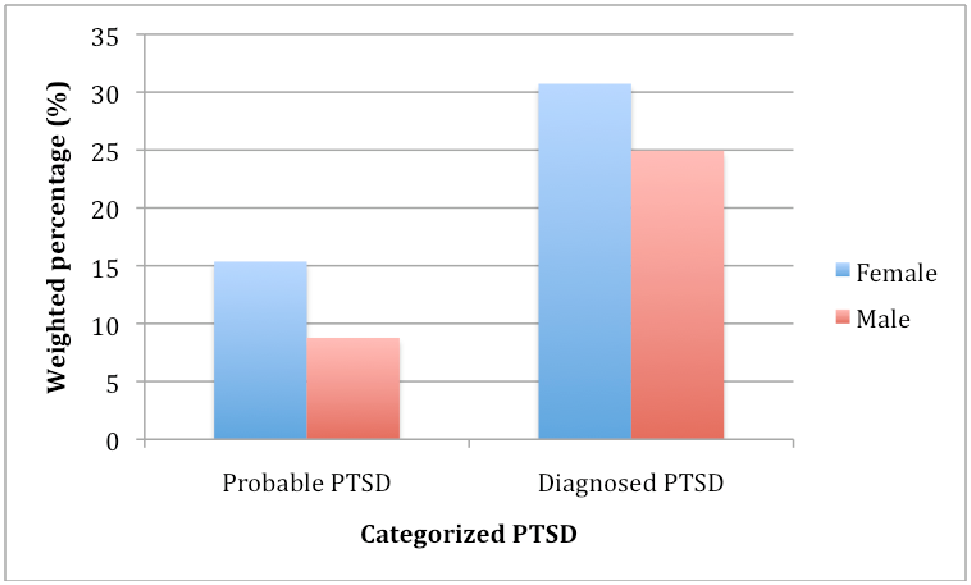

Figure 6. Weighted Prevalence of Probable and Diagnosed PTSD by Gender

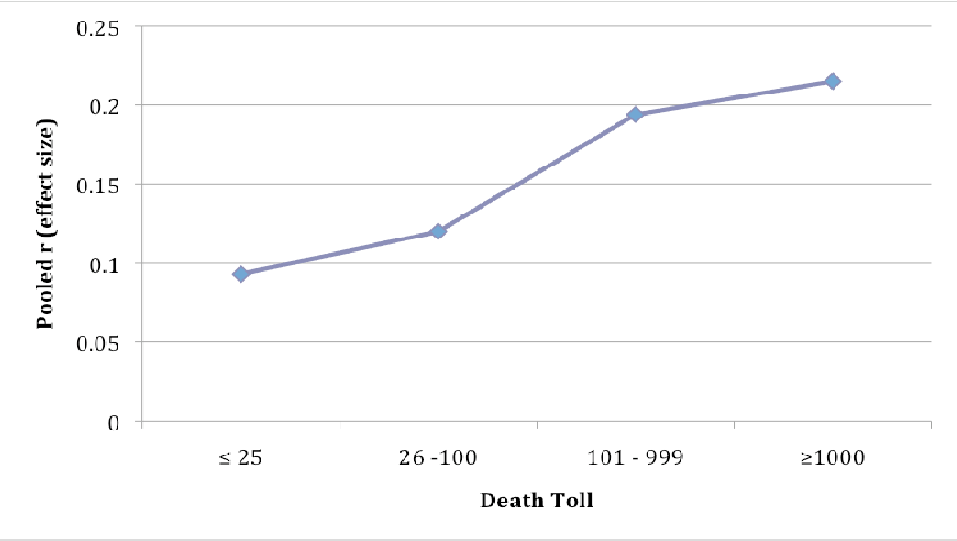

Figure 7. Linear Trend in Pooled *r* Effect Size of PTS Symptoms in Relation to Death Toll