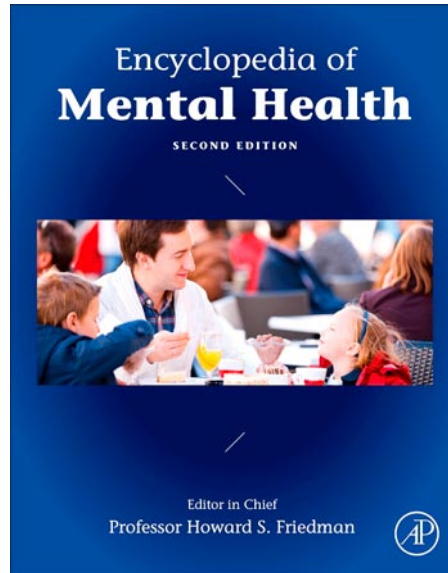


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Responses to Natural Disasters

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Glossary

Convenience sampling Selection of study participants based on ease and availability.

Externalizing disorders Disorders characterized by antisocial tendencies, aggression, impulsivity, and disruptive behaviors.

Natural disaster Stressful events that occur primarily as a result of natural sources in the environment and include events such as earthquakes, mudslides, tornadoes, hurricanes, tsunamis, wildfires, and floods.

Peritraumatic dissociation Feeling disconnected from one's surroundings immediately following a traumatic event.

Posttraumatic growth (PTG) Positive aspects of experiencing a negative event; outcomes may include improved relationships with others, spiritual growth, increased feelings of personal strength, the development of new interests, and focusing on new opportunities.

Posttraumatic stress disorder (PTSD) A psychopathological disorder that develops in response to a traumatic event and characterized by reexperiencing symptoms, avoidance symptoms, and hyperarousal symptoms.

Probability sampling Sample is representative of the population of interest.

Purposive sampling Nonrepresentative subsample chosen due to a specific set of features or experiences.

Resilience Absence of a psychopathological response or successful adaptation following exposure to stressful or potentially traumatic life events or life circumstances.

Stratified random sample Random samples drawn from segments of the population organized by common characteristics (e.g., demographic attributes and region of residence).

Overview, Definitions, and Historical Context

Natural disasters such as earthquakes, tsunamis, floods, wildfires, hurricanes, mudslides, and tornadoes are experienced by a substantial segment of the world's population (Briere and Elliott, 2000; Kessler *et al.*, 2012). Many disasters impact large geographic areas and may have long-term consequences for individuals and their communities (Norris *et al.*, 2002). Definitions of disasters have varied in the literature. Theorists have defined disasters as a function of the damage associated with the event (e.g., Baum, 1987; McLuckie, 1975), the duration of the event (Bolin, 1985), or the subjective psychological response (Davidson and Baum, 1986). Natural disasters have also been defined as 'disaster agents,' independent of the consequences (e.g., death toll and damage to property) of the event. This article will conceptualize natural disasters using the 'disaster agent' definition (cf. Baum, 1987; Dynes, 1970). This will allow for the inclusion of any study examining the impact of disasters associated with the natural world including tornadoes, mudslides, earthquakes, tsunamis, hurricanes, firestorms, and the subsequent events (e.g., levee breakage and flooding) that may occur in their aftermath, regardless of whether the study assessed magnitude of destruction or subjective appraisal of the experience. Although imperfect, this definition will allow for a broader discussion of the literature on natural disasters. It also enables a comparison of outcomes associated with disasters that cause severe destruction to a community with those events that may result in minimal, if any, physical damage. Because it is difficult to parse out human causes that may have worsened or even precipitated these 'natural disasters' (e.g., much of Hurricane Katrina's destruction was a result of levee breakage, poor building codes often result in more severe earthquake destruction, and

tsunamis cause greater death and property loss if government warning systems fail), any event involving the natural world may be included in this article.

In 2011, 820 natural disasters (broadly defined) caused 27 000 fatalities and approximately US\$380 billion in loss and damages worldwide (Munich Re, 2012). That same year, almost 8830 injuries, 1096 deaths, and US\$23 billion in property and crop damages were directly related to extreme weather events in the United States alone (National Oceanic and Atmospheric Administration, 2012). There has been a growing interest in understanding responses to natural disasters and in generating empirical research that guides evidence-based humanitarian outreach efforts and post-disaster service provision.

Formal empirical studies of natural disasters began following the 1972 Buffalo Creek flooding (Lifton and Olson, 1976), before trauma-related mental disorders were included in nosologies of psychiatric maladies. This highly destructive flood, resulting from a collapsed dam, destroyed all homes and businesses in its path and killed 125 people. Residents took legal action against the coal company that owned the collapsed dam; plaintiffs were then studied as part of the lawsuit. Through this process, researchers noted that a common constellation of symptoms was present in disaster survivors; many reported fears and anxiety about death, psychic numbing, sleep disturbances, nightmares, and inability to escape imagery of the event (Lifton and Olson, 1976). Some degree of psychiatric impairment continued 2 years post-disaster in over 90% of survivors assessed (Titchener and Frederic, 1978). Given that the sample was highly exposed and involved in litigious disaster-related actions, these findings could not be widely extrapolated to characterize all disaster survivors. However, they highlighted the potentially severe

and long-lasting repercussions of exposure to natural disasters, and marked the genesis of trauma research and treatments specific to such events.

Subsequently, *McFarlane and Raphael (1984)* began a series of longitudinal studies that followed survivors of the 1983 Ash Wednesday Australian Bushfires. Findings indicated that psychiatric problems emerged in several phases, beginning with an initial acute stress response. Similar to studies of the residents of Buffalo Creek, research on this disaster suggested that psychosocial problems may persist in some survivors for years after the precipitating event (*McFarlane, 1987*). Over the next three decades, psychosocial outcomes have been studied in response to a myriad of natural disasters, including hurricanes, volcanoes, earthquakes, floods, wildfires, and tornadoes. Recent review articles indicate that hundreds of samples have been collected on hundreds of disasters across a variety of psychosocial outcomes, yet making comparisons between studies is often difficult, given extensive variability in disaster severity, sampling designs, populations assessed, measurement instruments used, and temporal spacing of assessments (*Neria et al., 2002, 2008; Norris, 2006*). Despite these limitations, the burgeoning field of natural disaster research has the potential to inform clinical and policy recommendations, as government and nongovernmental organizations, community members, and service providers seek to best allocate limited resources to survivors, with the hope of alleviating suffering and helping afflicted communities rebuild and return to their pre-disaster functioning.

Commonly Studied Outcomes

Studies of responses to natural disasters tend to focus on several key psychosocial outcomes. Since its inclusion in the *Diagnostic and Statistical Manual of Mental Disorders (DSM)-III*, the most commonly studied response is posttraumatic stress disorder (PTSD) (*Green et al., 1992*). Briefly, as outlined in the *DSM-IV-TR (American Psychiatric Association, 2000)*, diagnostic criteria for PTSD require that one must have been directly exposed to a trauma involving actual or threatened death or injury to self or other (Criterion 1A) that caused associated fear, helplessness, or horror (Criterion A2) (Revisions have been made to diagnostic criteria in the new 2013 *DSM-5*. However, given that previous literature uses *DSM-IV* or *DSM-III* guidelines for probable-PTSD diagnoses, *DSM-5* criteria will not be addressed in this article.). Individuals must exhibit one or more reexperiencing symptoms (e.g., flashbacks and reliving the trauma), three or more avoidance symptoms (e.g., feeling emotionally numb, trouble remembering, feeling strong guilt, and depression or worry), and two or more hyperarousal symptoms (e.g., startles, feeling on edge, trouble sleeping, or angry outbursts) to satisfy Criteria B, C, and D, respectively. Symptoms must persist for at least 1 month (Criteria E) and cause significant impairment in functioning (Criteria F) (*American Psychiatric Association, 2000*). In addition to analyzing full diagnostic criteria for PTSD, some researchers assess partial or subthreshold PTSD (*Lai et al., 2005; Pfefferbaum, 1997*), or use continuous measures of posttraumatic stress (PTS) symptoms (*Kolaitis et al., 2003*). Self-report instruments like the posttraumatic disorder checklist (PCL)

(*Weathers et al., 1993*) are often used to calculate probable-PTSD diagnoses and a continuous measure of symptom severity. Thus, they may be particularly useful in post-disaster settings where it may be advantageous to capture a wide range of responses.

Following a natural disaster, peritraumatic dissociative experiences (i.e., feeling disconnected from one's surroundings immediately following a traumatic event) are one of the most robust predictors of subsequent PTSD (*Ozer et al., 2003*) and of long-term distress more generally (*Holman and Silver, 1998*). Unfortunately, conducting methodologically rigorous acute assessments in post-disaster settings can be formidable, so research on the relationship between natural disaster exposure and PTSD has been constrained. Disaster victims most commonly report reexperiencing and arousal symptoms, which may characterize normal distress responses to these events and may abate relatively quickly. Avoidance symptoms that occur in the wake of a trauma are less frequently endorsed, but may characterize symptom profiles in individuals who ultimately meet full diagnostic criteria for post-disaster PTSD (*Norris et al., 2002; Sprang and LaJoie, 2009*). Identification of these symptoms may provide an opportunity for relief workers and clinicians to identify survivors at risk for persistence of elevated PTSD over time (*Marx and Sloan, 2005*). Such findings coincide with other research that suggests avoidant coping strategies such as distraction, denial or thought suppression may be linked with higher likelihood of PTS (*Rosenthal et al., 2006; Silver et al., 2002*) and that avoidance symptoms may mediate the relationship between trauma exposure and the development of PTSD after a disaster.

PTSD has been studied in post-disaster populations with a wide range of exposures (*Bal, 2008; Pfefferbaum et al., 2001; Vernberg et al., 1996*) and has been linked with social, financial, and physical health problems. PTSD exhibits high comorbidity with other psychological problems (*Amaya-Jackson et al., 1999; Green et al., 1992*). In addition to causing suffering at an individual level, such maladies can lead to lost work days and may have large deleterious effects on the economy (*Schofield et al., 2011*). These repercussions may be particularly salient in the post-disaster context, when communities must simultaneously rebuild the physical infrastructure, economic engine, and social capital that may have been damaged or destroyed in the wake of the disaster.

Estimates of post-disaster PTSD prevalence rates have varied greatly, depending on the magnitude of destruction, time since disaster, sample representativeness, and measurement instrument employed. For example, 18 months after the 2005 earthquake in Pakistan and Kashmir, a study of tent-dwelling individuals reported that 55% of women and 33% of men suffered from PTSD (*Naem et al., 2011*). Given that tent dwellers might be those most heavily impacted by the disaster, such studies provide an illustration of how severely impacted individuals may respond to disasters, but limit inferences regarding broader impacts. A randomly selected sample of adults after the 1999 Taiwanese earthquake yielded PTSD prevalence rates between 10% and 19% (*Lai et al., 2005*). However, since almost 40% of the targeted households for recruitment could not be reached for an interview, this study may have under- or overestimated the prevalence of PTSD in those less severely exposed; unreachable individuals may have been forced to

relocate due to more intense exposure. Relocated individuals may be more distressed (due to heavier exposure) or less distressed (due to a potential increased availability of post-disaster resources), inhibiting precise estimates of psychopathology prevalence rates. More stringent survey techniques were employed by garnering a stratified random sample of participants 2 months after the 2004 Sumatra earthquake and resulted in much lower prevalence rates of PTSD: 12% of displaced and 7% of nondisplaced persons met criteria for probable-PTSD (Van Griensven *et al.*, 2006). However, it is difficult to assess whether variability in these prevalence rates is due to qualitative features of the disasters, cultural differences, or a variety of other factors (e.g., timing of the assessments).

Acute stress disorder (ASD), a frequent precursor to PTSD, has been studied less frequently due to logistical difficulties in conducting early assessments soon after natural disasters (e.g., gaining funding and ethics approval). ASD occurs within the first month following a traumatic event and also differs from PTSD in that it requires experiencing at least three dissociative symptoms (numbing or detachment, lower awareness of surroundings, derealization, depersonalization, and dissociative amnesia). Given that dissociative symptoms often predict PTSD following a trauma, ASD can serve as a useful marker for identifying individuals who may be at risk for future PTSD or the development of subsequent health problems (Holman *et al.*, 2008). ASD assessments may be particularly important in post-disaster settings, where large segments of the population are exposed to a traumatic event, but not all will go on to develop PTSD. While retrospective reports of ASD have been linked with post-disaster PTSD (Soldatos *et al.*, 2006), unfortunately, limited disaster research has implemented prospective designs. Of note, some researchers have criticized the utility of the ASD diagnosis, given that it was developed primarily to predict a subsequent disorder (PTSD), and not all people who meet criteria for ASD meet criteria for subsequent PTSD and vice versa (see Bryant, 2006, for a discussion).

'Depression' is the second most common outcome measure studied in post-disaster settings. Major depressive disorder (MDD) is characterized by a constellation of symptoms including negative affect and anhedonia (the inability to experience pleasure). MDD and depressive symptomatology (i.e., subclinical levels of symptoms or symptom counts that may or may not meet criteria for a DSM diagnosis) can be evaluated using diagnostic criteria or through continuous measurement of symptom severity (Norris, 2006). Studies consistently find elevated rates of depression following natural disasters, as well as increases in related symptoms such as suicide and feelings of remorse (Warheit *et al.*, 1996). Even subclinical levels of depression may be disruptive and distressing to many individuals, warranting empirical inquiry into correlations between symptoms and their antecedents and consequences. Rates of MDD and depressive symptomatology have varied even after the same disaster, again highlighting the need for more consistency and rigor in post-disaster studies. For example, after the 1988 Armenian earthquake, one study found that 22% of treatment-seeking individuals met criteria for MDD (Goenjian, 1993), although another study estimated a 52% prevalence rate (Armenian *et al.*, 2002). Differences in assessment instrument – the former using clinical interviews

and the latter using a questionnaire – illustrate the inherent difficulty in making cross-study comparisons given divergent assessment tools. This is especially concerning given epidemiological research indicating low concordance between epidemiological screening instruments (e.g., Eaton *et al.*, 2000).

'Generalized anxiety,' a construct separate from PTSD, is also commonly studied in survivors of natural disasters, and is included in the literature as both continuous measurements of symptomatology and full DSM diagnoses. Increased anxiety has been observed after floods in Kentucky (Phifer, 1990), cyclones in Orissa (Kar *et al.*, 2004), earthquakes in Armenia (Goenjian *et al.*, 2000), and the 2004 tsunami in Thailand (Hussain *et al.*, 2011). Since anxiety can be experienced as fear of the trauma occurring again (Terr, 1981), this outcome is especially relevant for natural disaster research, as many areas that experience natural disasters are at risk for repeated exposures (e.g., coastal areas are susceptible to annual hurricanes or flooding, regions that lay over fault lines experience multiple earthquakes and aftershocks). Furthermore, since high anxiety does not necessitate a diagnosis of PTSD (Van Griensven *et al.*, 2006), measuring anxiety as a separate construct is important to capture the range of post-disaster distress responses. This may be especially relevant for continuous measures of anxiety: Similar to depressive symptomatology, symptoms of anxiety may be distressing for individuals, even when not severe enough to warrant a clinical diagnosis.

'Global or nonspecific' distress often encompasses constructs such as somatization (experiencing psychological distress in the form of physical complaints), anxiety, general negative affect, or perceived stress (Phifer and Norris, 1989; Thompson *et al.*, 1993); elevated levels of global distress have been evident years after the precipitating disaster (Guarnaccia *et al.*, 1993). Nonspecific distress can be measured using symptom checklists such as the Brief Symptom Inventory (BSI, Derogatis, 2001) that concurrently evaluate symptoms of anxiety, depression, and somatization; such measures have indicated elevated distress responses in a number of short- and long-term studies following earthquakes (Bland *et al.*, 2005; Kulkarni and Pole, 2008) and hurricanes (Norris and Uhl, 1993). Other investigations using structured or clinical interviews have also reported heightened levels of general distress symptomatology after disasters (Armenian *et al.*, 2002; Goenjian, 1993). Measures of nonspecific distress may be especially useful in the post-disaster setting, as it might be advantageous to understand psychological afflictions in people who may not otherwise meet criteria for DSM diagnoses, which by definition entail severe and specific expressions of psychiatric problems.

Increases in 'physical health complaints,' such as cardiorespiratory (e.g., chest pain and difficulty breathing), neurological (e.g., headache and dizziness), and gastrointestinal (e.g., stomach pain and heartburn) problems have also been reported after natural disasters (Keskinen-Rosenqvist *et al.*, 2011; Neria *et al.*, 2008; Norris *et al.*, 2002). Such problems have been documented in individuals with and without physical injury, suggesting that psychological mediators may influence post-disaster physiological responses (Keskinen-Rosenqvist *et al.*, 2011). Sleep disturbances (Titchener and Frederic, 1978) and elevated cortisol (Benight *et al.*, 1997), a physical indicator of an elevated stress response, have also

been linked with disaster exposure. Heightened 'substance use' was reported after Hurricanes Katrina and Rita (Cepeda *et al.*, 2010) and after the 2004 Indian Ocean tsunami (Vetter *et al.*, 2008). However, such increases were not seen after the Great Midwestern Floods of 1993 (North *et al.*, 2004) and alcohol sales did not increase after the Great Hanshin earthquake in Japan (Shimizu *et al.*, 2000). Although psychosocial assessments of disaster survivors do not frequently include questions relating to physical health, given the potential correlation between deteriorated physical and mental health and natural disasters, such information should be incorporated into future post-disaster surveys.

Given that the majority of disaster victims experience distress responses that abate over time, there is an increased awareness that assessments of positive adjustment, such as resilience and posttraumatic growth (PTG), should be administered alongside those of negative outcomes (Bonanno, 2004). PTG measures the positive effects of experiencing a trauma (Tedeschi and Calhoun, 1996); potential positive outcomes may include feelings of personal strength, developing new interests, focusing on new opportunities, better relationships with others, spiritual growth, and a greater appreciation of life. PTG tends to correlate positively with increased stress responses and higher scores of PTS, which suggests that people may experience PTG as a result of dealing with their distress (Pooley *et al.*, 2013). Focusing on ways to increase PTG may be especially relevant for those who report distress symptoms, as this may be one potential way to promote positive post-disaster adaptation (Pooley *et al.*, 2013). More research is necessary on prevalence of PTG and the relationship between PTG and adaptation over time, as much of the extant research focuses on pathology rather than positive adaptation (Bonanno, 2004). Another psychological resource, coping self-efficacy, or the perception of one's ability to cope with adverse events (Bandura, 1977; Schwarzer and Jerusalem, 1995), has been linked with more positive psychological adjustment after natural disasters (Benight, 2004), lower psychological stress scores in areas susceptible to natural disasters (Miller *et al.*, 1999), and lower probability of developing PTSD (Luszczynska *et al.*, 2009). Future research should seek to explore these and other potential positive outcomes empirically; obtaining such knowledge may help inform ways to enhance these psychological resources in people exposed to natural disasters.

Risk and Protective Factors

Demographic characteristics, such as gender, have been extensively studied as predictors of post-disaster outcomes. In the vast majority of studies, female disaster survivors report more severe symptoms compared to male survivors (Norris *et al.*, 2002). Examples include findings obtained after the 2004 Sumatra earthquake and tsunami, where women reported more anxiety and depression (Van Griensven *et al.*, 2006); after Hurricane Mitch, where women reported more PTSD (Caldera *et al.*, 2001), and after the 1999 Taiwanese earthquake, where women reported more PTSD and general psychiatric morbidity (Chen *et al.*, 2007). However, a gender difference is not universally seen across all outcomes of

maladjustment and some differences do not favor men. For example, men are more likely to abuse alcohol after a disaster than are women (Dooley and Gunn, 1995; Gleser *et al.*, 1981; McMillen *et al.*, 2000). One explanation for women's poorer outcomes is that women may interpret traumatic events differently than men (Norris *et al.*, 2002), and may either experience events as more distressing or be more likely to endorse symptoms of distress when probed. Such effects may be particularly relevant in cultures where pre-disaster gender differences are more pronounced, an important consideration in international contexts.

Marital status is also a frequently studied indicator of post-disaster outcomes, with mixed findings. Three years after the 1999 Taiwanese earthquake, married individuals reported better quality of life than individuals who were not married (Wu *et al.*, 2006). Similarly, 2 months after the 1987 Ecuadorian earthquake, single, separated, or widowed individuals were most likely to be distressed (Lima *et al.*, 1989). Yet, potential interaction effects between gender and marital status have yielded inconclusive results: in some studies, being married was a risk factor for distress in women, whereas other studies found that married women were less distressed (Norris *et al.*, 2002). Findings after Hurricane Hugo suggested that marital stress may be a mechanism for such contradictory findings; since interpersonal difficulties may be intensified after a disaster, over time chronic marital difficulties may increase one's overall level of distress (Norris and Uhl, 1993). Studies that assess specific characteristics of partner relationships, in addition to noting marital status categorically, may help clarify the nature of these associations.

Findings regarding age have also been mixed. In general, middle-aged adults exhibit worse outcomes than do younger or older adults and older individuals tend to be more resilient than younger adults (Logue *et al.*, 1981; Phifer, 1990; Thompson *et al.*, 1993). For example, following the southeastern Kentucky floods of 1984, adults 55–64 years old exhibited elevated anxiety, depression, and somatic symptoms. After Hurricane Agnes, women over 65 were at lower risk of experiencing depression (Logue *et al.*, 1981). Thompson and collaborators (1993) found a curvilinear relationship between age (as a continuous variable) and distress; in the presence of a disaster, middle age adults reported more distress symptoms. Of note, older adults reported greater somatic complaints, which may have been a function of factors (e.g., age-related diseases) not connected to the disaster. Older adults may be protected by an 'inoculation effect,' whereby past experience with some disaster buffers people from the psychological consequences of future disasters (Norris and Murrell, 1988). Norris and colleagues (2002) suggest that middle-aged adults may have more daily stress (e.g., mortgage payments and taking care of children or elderly parents), which may compound the impact of disaster exposure and counteract the potential inoculation effects derived from negative events experienced in their youth. However, not all studies have supported these hypotheses. When compared to old-old individuals (ages 76+), the young old (ages 55–77) and middle age adults (30–54) were found to be less distressed before and after the 1994 Northridge earthquake (Knight *et al.*, 2000), and a study of responses to the 1989 Newcastle earthquake found that adults older than 65 were more likely to

have PTSD when compared to adults under 65, despite the older individuals reporting less severity of exposure to the actual trauma (Ticehurst *et al.*, 1996). Recent work has suggested that correlations between disaster-related distress responses and age may vary according to type of stressor experienced, temporal occurrence of subsequent stressors, and the specific type of outcome assessed (Scott *et al.*, 2013). Clearly, delineating the relationship between age and distress in the post-disaster setting needs further elucidation.

Lower socioeconomic status (SES), frequently operationalized as income, education, or occupational status, has been consistently correlated with greater post-disaster maladies (Armenian *et al.*, 2002; Caldera *et al.*, 2001; Norris *et al.*, 2002; Phifer, 1990). Measures of SES were linked with greater psychological distress following the 1999 Taiwanese earthquake (Chen *et al.*, 2007), the 2008 Wenchuan earthquake (Xu and Wu, 2011), and the 2005 Pakistani earthquake (Naeem *et al.*, 2011). Of note, the study of the Pakistani earthquake did not find consistent results across all measures of SES; this finding may have resulted from confounds such as amount of property lost or low-SES variability in the population assessed. Interaction effects between disaster-related stressors and low SES have been demonstrated, such that low-SES individuals are impacted exponentially (Galea *et al.*, 2007; Ginexi *et al.*, 2000; Phifer, 1990). This suggests that it may be the associated consequences of low SES that may drive the link between economic disadvantage and negative outcomes.

Pre-event mental health problems are consistently correlated with PTSD and other forms of post-disaster maladjustment (Madianos and Evi, 2010; Norris *et al.*, 2002). Typically, retrospective reports are used to assess prior psychopathology (e.g., Caldera *et al.*, 2001), which is unfortunate given inherent problems with inaccurate reporting of past events. However, pre-disaster assessments have also supported this link. For example, a sample of 1735 Iowa residents assessed 1 year before and 1–3 months after the 1993 Midwest Floods found strong and independent effects of prior mental health on post-disaster distress (Ginexi *et al.*, 2000). Prior to the Northridge earthquake, 66 children were assessed for a variety of mental health problems; results indicated that preexisting anxiety was a strong predictor of PTSD symptoms 1 year after the earthquake (Asarnow *et al.*, 1999). People who meet pathological levels of avoidance symptoms and full PTSD criteria are generally more likely to have had prior mental health problems (McMillen *et al.*, 2000), suggesting that the tendency to implement avoidant coping strategies after a disaster may be a function of previous maladaptive responses to threatening environments.

Event-Exposure Characteristics

In general, distress responses are linked with severity of exposure, although a linear dose–response relationship is not universally indicated (Neria *et al.*, 2008). Living in more severely distressed geographic areas was associated with more depression and PTSD following the 1999 Turkish earthquake (Kilic and Ulusoy, 2003); similar correlations were obtained after the 1994 Kentucky flooding (Phifer, 1990). Type of dwelling (e.g., tall apartment building that sways), which can

intensify the experience of an earthquake, was linked with distress following the 1999 Taiwanese earthquake (Chen *et al.*, 2007). Yet some studies have not found such associations; for example, neither neighborhood nor housing damage predicted depression scores following the Northridge earthquake (Knight *et al.*, 2000). It may be that subsequent stressors, which may occur either as a result of the disaster (e.g., relocation) or due to other factors in the individual's life (e.g., loss of a loved one to an unrelated illness) may be the mechanism whereby natural disaster experiences are intensified. It is also important to note that events that are perpetrated or worsened by human negligence or failures may be more likely to elicit psychological stress (Baum, 1987), as there may be a responsible party to blame, and blameworthiness has been indicated as a factor that may exacerbate distress responses following negative events (Delahanty *et al.*, 1997; Hickling *et al.*, 1999). Moreover, number of stressors experienced often positively correlates with negative outcomes (Briere and Elliott, 2000; Norris *et al.*, 2002; Thompson *et al.*, 1993). The World Health Organization World Mental Health Surveys found that personal secondary stressors (e.g., job loss and disability) occurring after natural disasters tended to be associated with affective and anxiety disorders (Kessler *et al.*, 2012). More specifically, Galea and collaborators (2007) found that after Hurricane Katrina, practical problems occurring as a result of the disaster, such as physical adversity, were linked with more post-hurricane distress. These findings suggest that it is not merely the magnitude of the actual disaster, but the cumulative effect of the stressful events experienced in the aftermath, that drive the distress response (see also Garfin *et al.*, 2014). Future research should explore the correlation between post-disaster secondary stressors and psychosocial problems; at present, this relationship, which may be essential for truly capturing the intensity of the disaster experience, is underexplored (Kessler *et al.*, 2012).

Property and Financial Loss

Loss of property has been explored as a potential factor influencing post-disaster psychosocial outcomes. A study of over 6400 survivors assessed 2 years after the Chi-Chi earthquake in Taiwan indicated that both full and partial destruction of property, as well as living in a prefabricated house, was associated with increased risk of PTSD (Chen *et al.*, 2007). Earthquake-related financial loss was linked to poorer mental health in an Italian study, and deleterious effects of this loss persisted for over a decade (Bland *et al.*, 2005). Major property damage was predictive of both lower life satisfaction and probable PTSD after the 2005 earthquake in Pakistan (Naeem *et al.*, 2011). In contrast, home ownership, which could intensify the individual economic cost of a disaster, was not related to distress after the 1999 Turkish earthquake (Kilic and Ulusoy, 2003); this study failed to address financial loss specifically, so inferences were speculative. Property loss and financial difficulties could be another proxy for chronic strain, which has been associated with elevated levels of distress (Baum, 1990; Dura *et al.*, 1990) and the development of PTSD in particular (Adessky and Freedman, 2011; Green *et al.*, 1994; McFarlane and Van Hooff, 2009). Measurement instruments

that more specifically ascertain these effects are necessary for a more comprehensive conceptualization of this relationship.

Personal Loss and Injury

Injury and threat to life are often included in post-disaster assessments, and they exhibit strong correlations with PTSD, perhaps not surprising since a PTSD diagnosis requires that one experience or witness a traumatic event. Personal injury has been linked with a variety of other negative outcomes in both the short- and long-term (Norris *et al.*, 2002); after the Chi-Chi earthquake, seeking medical services (a proxy for personal injury) was associated with PTSD (Chou *et al.*, 2005). Three years after the Chi-Chi earthquake, death or injury of a family member was related to role limitations due to emotional problems, but not to global mental health (Wu *et al.*, 2006); loss of friends or relatives was predictive of PTSD 17 years after the Buffalo Creek flood (Green *et al.*, 1994). Conversely, 1 month after the Marathwada earthquake in Western India, destruction of possessions and destruction of home were associated with PTSD, whereas death of a relative, injury to a relative, personal hospitalization, or injury to self were not correlated with PTSD (Sharan *et al.*, 1996); similar findings were reported after the 2005 Pakistani earthquake (Naem *et al.*, 2011). Such variability highlights the failure of empirical research to support a universal process for dealing with grief and loss (Wortman and Silver, 1989).

Longitudinal Reactions

In general, people's distress following natural disasters abates over time (Norris *et al.*, 2002). Nevertheless, deleterious psychological consequences persist in a minority of individuals and may continue to impact the community for years and even decades after initial exposure. For example, 2 years after the 1999 Chi-Chi Taiwanese earthquake, over 20% of a sample of 6412 survivors met criteria for probable PTSD (Chen *et al.*, 2007), although given this study's cross-sectional design, it is difficult to determine how these individuals fared initially, or how their symptoms changed over time. After the Newcastle, Australia earthquake, a longitudinal study selected participants from electoral polls and followed them for 2 years. This study found that psychological morbidity decreased for the first year and a half, stabilized at about 12 months, and remained elevated in some individuals for the duration of assessments. At the final assessment, 18 months post-earthquake, morbidity scores (greater than 3 according to traditional cutpoint guidelines) on the General Health Questionnaire ranged from 13% in the low exposure group to 34% in those who experienced the most severe exposures; morbidity rates on the Impact of Events Scale (scores greater than 25 indicate significant PTS) ranged from 3% in the lowest exposure group to 19% in the highest exposure group (Carr *et al.*, 1997a,b). Fifty years after exposure to a series of highly devastating earthquakes that occurred near the island of Cephalonia, Greece, adult survivors (age 62–86 at the time of assessment) reported present-day persistent reliving of symptoms and a lasting impact of this experience on their daily lives (Lazaratou *et al.*, 2008).

Such findings emphasize that natural disasters may indeed leave a lifetime legacy in some survivors.

In addition, linear declines in symptomatology do not necessarily occur: Behavioral disorders did not decrease significantly over the 18-month period that followed the Australian bushfires (McFarlane, 1987), and 20 years later, survivors were more likely than individuals not exposed to meet lifetime prevalence for anxiety disorders; 75% of bushfire survivors endorsed some degree of long-term bushfire-related distress (McFarlane and Van Hooff, 2009). PTS symptoms remained elevated during a 3-year assessment period following the 1988 Armenian earthquake, although depression symptoms decreased in severity (Goenjian *et al.*, 2000). Some studies have found complex relationships between time and symptom severity with regard to PTSD symptoms. For example, following Hurricane Hugo, assessments at 6 and 30 months post-disaster indicated that intrusion and arousal symptoms declined over time, but avoidance symptoms increased (Norris *et al.*, 1999). Evidence for possible delayed-onset PTSD further highlights the importance of longitudinal research designs (Carty *et al.*, 2006).

Children's Responses to Natural Disasters

A growing body of work has examined children's responses to disasters (Eisenberg and Silver, 2011; Masten and Osofsky, 2010). Outcomes including PTSD, the most commonly studied post-disaster psychiatric condition in children, have been linked to long-term adjustment problems (Broberg *et al.*, 2005). Although not initially included in PTSD conceptualization (Groome and Soureti, 2004), in 1987 the DSM-III-R mentioned PTSD in children specifically. At present, the notion of childhood PTSD is widely accepted, although symptom presentation may be different, and perhaps even more severe, than that of adults (Bulut, 2005; Dyregrov and Yule, 2006; Norris *et al.*, 2002). Psychopathology and general distress may be critical components of the post-disaster response in children and may have negative repercussions in other domains of functioning. Children's exposure to community disasters has been linked to personality change and school problems (Terr, 1979), decreased academic motivation (Widyatmoko *et al.*, 2011), elevated delinquency (Norris *et al.*, 2002), cognitive difficulties (Shannon *et al.*, 1994), conduct disorder, and antisocial behavior (Chimienti *et al.*, 1989). Similar to studies of adult reactions to disaster, prevalence rates have varied markedly as a function of assessment tool used, severity of the disaster, country of disaster, age of children, and time since the precipitating event.

As with adult populations, variability in post-disaster adjustment in children has been examined as a function of demographic, event-exposure and preexisting psychological characteristics (Rowe *et al.*, 2010). Demographic variables such as age, gender, and ethnicity are frequently cited as significant predictors of PTS and other forms of distress among children (for an extensive review, see the meta-analysis conducted by Furr *et al.*, 2010). Girls tend to exhibit worse outcomes compared to boys (Lonigan *et al.*, 1991); this finding has been found cross-culturally in studies conducted in China (Fan *et al.*, 2011; Zhang *et al.*, 2010), Greece (Groome and

Soureti, 2004; Roussos *et al.*, 2005), and Turkey (Sahin *et al.*, 2007). Minority status (Groome and Soureti, 2004) and younger age (Endo *et al.*, 2009) have been implicated as risk factors for greater distress after earthquakes. For example, in a study of 6–10-year-old children studied after the 1999 Turkish earthquake, 6-year-old children reported more symptoms on the Traumatic Dissociation and Grief Scale compared to 8-year-old children, more perceptual distortions compared to 7-year-old children, and more self-distortions than children over 6 (Laor *et al.*, 2002). Of note, age effects are not universally supported empirically (Pynoos *et al.*, 1993). Interaction effects between disaster exposure and age may drive contradictory findings: after the 1999 Athens earthquake, when compared to 14-year-old children, 9-year-old children were more vulnerable in the most distressed regions, but 9-year-old children were less distressed than 14-year olds in the less damaged areas (Groome and Soureti, 2004).

Children's distress responses have also been linked with physical injury, death of a family member (Hsu *et al.*, 2002), and post-earthquake relocation (Kilic *et al.*, 2011), yet findings regarding a strict dose-response relationship are inconclusive. One year after the 2008 Chinese earthquake, a representative sample of children from more highly exposed areas exhibited more mental health problems when compared to children with lower exposure (Zhang *et al.*, 2010); similar findings were found in school-aged and adolescent children 5 months after the 1999 Athens earthquake (Groome and Soureti, 2004), 3 months after the Ano Liosia Greek earthquake (Roussos *et al.*, 2005), and 6 months after the 1988 Armenian earthquake (Goenjian *et al.*, 1995). In contrast, researchers who studied a representative sample of 200 children after the 1999 Marama earthquake did not find a direct relationship between exposure and distress; children from both high- and low-impact areas demonstrated similar prevalence rates and severity of PTSD (Bulut, 2005). Similarly, after Hurricane Andrew, children in high- versus low-impact schools were not statistically different in presenting rates of PTSD, although children in more high-impact areas indicated higher overall PTS (Shaw *et al.*, 1995).

Prior mental health and preexisting psychological vulnerabilities have been less extensively studied in child populations, but preliminary findings have linked certain psychological predispositions to poorer post-disaster outcomes. Children with higher trait anxiety and negative affectivity prior to Hurricane Katrina were more at risk for post-disaster PTSD (Weems *et al.*, 2007), although the small sample size in this study ($N=52$) limits generalizing its findings. Similarly, children assessed 3 months after Hurricane Andrew who had higher preexisting trait anxiety exhibited higher scores on the arousal subscale of PTSD (Lonigan *et al.*, 1994). Nonetheless, post-disaster reporting of trait anxiety precludes causal inferences; prospective data collection would enable stronger conclusions.

At present, links between PTS and externalizing disorders, characterized by antisocial or disruptive behaviors, are unclear. Three months after Hurricane Andrew, preexisting anxiety and hyperactivity, but not conduct problems, predicted PTS symptoms; at 7 months, only preexisting anxiety predicted distress (LaGreca *et al.*, 1996). Similarly, a study of 100 children referred to an inner city psychiatric facility indicated that externalizing symptoms did not correlate with PTSD post-trauma (Silva *et al.*, 2000). In sum, results suggests that it

might be preexisting internalizing symptoms, rather than externalizing ones, that are associated with PTSD in children following a traumatic event. More research that incorporates pre-disaster psychological assessments with longitudinal follow-ups is needed to further elucidate these relationships.

A variety of potential protective factors may help buffer children from some of the deleterious consequences of natural disasters. Third to fifth grade children's self-reported levels of social support have been negatively correlated with distress post-disaster (Dubow *et al.*, 1991). After the September 11th (9/11) terrorist attacks, adolescents (mean age=15.27, $SD=1.14$) who reported (in a web-based survey) greater perceived parental support and more positive parental affect exhibited lower distress, suggesting that positive qualities in the parent and in the parent-child relationship may help mitigate the deleterious consequences of a disaster (Gil-Rivas *et al.*, 2004). Likewise, after Hurricane Katrina, children (ages 7–10) who reported more caregiver warmth (assessed in face-to-face interviews with trained research assistants) also reported higher coping competency (as adapted from the Children's Competency Belief Scale) (Kilmer and Gil-Rivas, 2010). Of importance, few studies have been able to implement designs where multiple respondents report on these qualities; such methods may be a fruitful area in which to focus future research.

Although longitudinal assessments are limited in studies of children, persistent deleterious effects have been indicated in existing research. For example, whereas a prospective study conducted after Hurricane Andrew found that levels of PTSD declined between 3 and 10 months (LaGreca *et al.*, 1996), PTSD prevalence was still elevated when compared to typical estimates in general epidemiological studies (Dyregrov and Yule, 2006). Distress in children did not greatly abate 18 months after the Australian bushfires (McFarlane *et al.*, 1987) and remained elevated in these individuals 20 years post-disaster (McFarlane and Van Hooff, 2009). Similar findings were reported after Buffalo Creek; 37% of youth surveyed had probable-PTSD 2 years post-disaster (Green *et al.*, 1991), and a 17-year follow-up indicated lasting repercussions for adult mental health (Green *et al.*, 1994). In addition to the general scarcity of research on these topics, most longitudinal post-disaster studies of children have exceedingly small sample sizes. Longitudinal post-disaster studies of children are a promising area for future research, given the dearth in the extant literature and the potential benefits of gaining a more comprehensive understanding of how children respond to natural disasters.

Methodological Concerns

Conducting research on natural disasters entails a unique set of challenges. In order to provide the most useful information to policy makers, clinicians, and service providers, it is important to conduct longitudinal studies that include acute, short-term, and long-term assessments using large and representative segments of the population. However, logistical difficulties often preclude such designs. Barriers to conducting methodologically stringent and widely applicable post-disaster research include obtaining rapid ethics board approval, garnering sufficient funding in a truncated time

period, making contacts in the field, accessing distressed or demolished communities, and recruiting participants who are engaged in managing the personal repercussions of the disaster or have relocated due to damaged or destroyed homes. Access to pre-disaster data, essential to making strong inferences, is rare (for exceptions, see [Asarnow et al., 1999](#); [Bravo et al., 1990](#)). Given that it is hard to predict exactly when and where a disaster may occur, most studies with pre-event measures are the result of researchers accessing a population previously enrolled in a study prior to the occurrence of the disaster. An additional problem in the disaster literature is that those most at risk for problems (i.e., children, minorities, and populations in developing countries) are often more difficult to access, enroll, and evaluate ([Norris, 2006](#)). For example, assessing individuals in developing countries is difficult due to lack of cross-validation of psychiatric measurements, in addition to the inherent problem of accessing rural or displaced populations ([Widyatmoko et al., 2011](#)).

Much of the disaster literature has focused on convenience samples, although probability samples are also used ([Norris, 2006](#)). Other common sampling types include census sampling (used more often in developed nations), where an entire community is assessed; purposive sampling (used in developing nations), which is a quasi-random sampling technique that tends to yield samples with demographic characteristics closely matching the true population; and clinical sampling (used least commonly in studies of natural disasters), where litigants or those seeking or referred to health care facilities are assessed. Since children are most commonly accessed in school settings, convenience samples comprise the majority of the samples for this group. Convenience samples provide useful preliminary information on responses to disaster, but more stringent techniques will provide stronger empirical evidence to make scientific inferences and policy and clinical recommendations. Fortunately, more methodologically rigorous post-disaster research is emerging. Although the vast majority of assessments are still cross-sectional ([Norris, 2006](#)), and only a few studies have followed people for a decade or longer after the initial event ([Green et al., 1994](#); [Lazaratou et al., 2008](#)), research incorporating longitudinal designs is growing ([Jia et al., 2013](#); [Knight et al., 2000](#); [van Griensven et al., 2006](#); [Wang et al., 2000](#)). Although acute assessments (<1 month post disaster) are still rare, the majority of studies commence within 6 months, providing useful information for short- and medium-term psychosocial outreach efforts.

As alluded to earlier, one glaring problem in the field is the vast number of assessment tools commonly employed. Many researchers use clinical, structured or semi-structured interviews; among these, many measures exist. For example, the National Institute of Mental Health (NIMH) Disaster Interview Schedule/Disaster Supplement ([Robins and Smith, 1983](#)), the Mini-International Neuropsychiatric Interview ([Sheehan et al., 1998](#)), and the Structured Clinical Interviews for DSM-IV (SCID; [First et al., 1997](#)) are all commonly used in post-disaster settings, often yielding divergent estimates. A variety of questionnaires are also available. Some, such as the child-specific UCLA-Posttraumatic Stress Reaction Index (UCLA-PTSD RI-1; [Pynoos et al., 1998](#)), can be administered to children and adolescents via interview or in paper-and-pencil format for children who are able to read and write; when

administered in a paper-and-pencil format, research staff should be available to answer questions or provide clarification in addition to monitoring for possible distress. Researchers often decide what tool to implement based on a combination of cost, time constraints, and available personnel. For example, self-administered paper-and-pencil surveys are cheaper and faster to administer to large populations and require less project staff when compared to interviews. However, interviews may be preferred to ascertain more complex diagnoses, more nuanced information, or when assessing young children or illiterate populations.

Policy Issues, Recommendations, and Future Directions

Given the robust findings linking natural disasters to psychosocial problems that may persist long after the structural debris has been cleared, evidence-based policies are essential to appropriately meet the short- and long-term needs of a distressed population. However, interventions and service provisions to minimize PTSD and other forms of psychological distress can be costly and labor intensive ([DiMaggio et al., 2007](#); [Feeney et al., 2005](#)). Identifying populations most in need – and timing appropriate delivery of services – is essential to maximize limited relief funds. While the decade following the 9/11 terrorist attacks ushered in much research that has helped guide evidence-based interventions to help minimize post-disaster maladjustment ([Watson et al., 2011](#)), methodological limitations in many post-disaster studies have precluded researchers' ability to endorse definitive recommendations for targeting specific populations most at-risk ([Bonanno et al., 2010](#)). As such, an ongoing problem for humanitarian relief organizations is how to connect the immediate post-disaster response from government and nongovernmental agencies with the short- and long-term psychological, social and health services needs of the community ([Psychology Beyond Borders, 2010](#)).

Current state-of-the-art research recommends that interventions be targeted towards specific populations in temporally appropriate sequences ([Vernberg et al., 2008](#)). First, prevention policies should be implemented in preparation for a potential disaster. These law and public policy-related efforts should help mitigate potential harm and additional trauma exposure from natural disasters before they occur (e.g., making sure emergency plans are in place and building structures with appropriate integrity to withstand earthquakes). Secondary prevention is then delivered within days of the event. Whereas psychological debriefing, or having people verbally process the trauma in an individual or group setting, appears not to be efficacious at reducing symptoms and may even exacerbate distress responses ([Rose et al., 2009](#)), providing information and social support can help survivors cope with the immediate aftermath of the disaster ([Hobfoll et al., 2007](#)). Providing concrete assistance in the form of food, rest, and facts can be especially helpful. Within the first few weeks after the disaster, survivors should be evaluated for high risk of future problems; those who show high likelihood of future distress (e.g., endorse high ASD symptomatology) should be followed and be targeted with available services should symptoms continue ([Shalev et al., 2012](#)).

Further recommendations for post-disaster interventions focus on maintaining awareness of the importance of being sensitive to the enormous variability in response, both immediately and over time. It is not uncommon for many people to experience distress in the immediate aftermath, and thus clinicians and community members should avoid pathologizing normal responses to abnormal events; natural recovery processes will generally occur in a majority of individuals. Assistance is best received when it comes from people in the community (e.g., churches and community groups). Public service announcements are helpful to inform people about services, to communicate that feelings of distress are normative, and to encourage people to seek professional assistance if symptoms persist.

Research on natural disasters continues to grow in terms of number and sophistication of research techniques. Methodological advancements such as increased sample size and representativeness, particularly with respect to studies of children, will help generalize findings to broader populations. Although challenging, research with disadvantaged populations, particularly in developing nations, is needed to inform international humanitarian relief efforts, especially since disasters in developing nations tend to result in greater death, destruction, and economic hardship. Standardizing preferred instruments for use in the field and validating measures for use in international settings is also needed. The development of recommendations for researchers seeking to choose the most appropriate instrument given a particular disaster, population, and methodological design would be of great benefit to the field. More longitudinal studies are essential in order to evaluate the potential for delayed-onset PTSD and to examine the likely interaction between exposure to disaster and subsequent life stressors on psychological and physical health.

In sum, while the past four decades have advanced knowledge in the field of post-disaster responses, continued innovations in methodology will further enhance our understanding of this important topic. A body of methodologically rigorous research will enable the development of stronger evidence-based recommendations for policy makers, clinicians, and community members seeking to ameliorate the deleterious psychological consequences of exposure to natural disasters.

See also: Anxiety, Panic, and Phobias. Childhood Stress. Demography of Mental Health. Depression. Posttraumatic Growth. Posttraumatic Stress Disorder. Resilience. Self-Efficacy. Socioeconomic Status. Stress. Stress-Related Growth

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