



# The Impact of Natural Disasters on Youth: A Focus on Emerging Research beyond Internalizing Disorders

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## Abstract

**Purpose Of Review** This paper reviews youth outcomes following exposure to natural disaster, with a focus on three relatively understudied outcomes: externalizing behavior problems, physical health, and posttraumatic growth. Recent, high-impact studies focusing on each outcome are summarized.

**Recent Findings** Studies highlighted in this review utilize innovative and comprehensive approaches to improve our current understanding of youth broad-based physical and mental health outcomes beyond PTSD. The review concludes with recommendations to advance the field of youth disaster research by exploring how disasters may impact children across multiple domains, as well as using cutting edge ecobiological approaches and advanced modeling strategies to better understand how youth adjust and thrive following natural disaster.

**Keywords** Natural disasters · Youth externalizing disorders · Disaster-impacted health · Youth posttraumatic growth

## Introduction

Natural disasters, such as hurricanes, tornadoes, floods, and tsunamis, disrupt communities and impact all levels of an individual's social ecology [1]. Extensive research documents the negative mental health effects of disaster exposure for

youth (e.g., [2–4]). Further understanding of disaster impact on youth constitutes a matter of global health concern, given that such events collectively affect billions of individuals each decade [1]. It is important for researchers to examine the multiple outcomes youth may experience after disaster exposure. Disaster survivors contend with a variety of issues that impact their overall well-being in the short-term and long-term aftermath [5, 6]. Yet, the vast majority of youth disaster research to date focuses on PTS symptoms [6] or other internalizing disorder symptoms [7].

It has been approximately 15 years since Vernberg and Varela [8] suggested that a key to continued progress in the understanding of youth reactions to trauma is to propose and evaluate comprehensive models beyond posttraumatic stress (PTS) disorder that may explain how exposure to traumatic events influences developmental processes [8]. An expanded focus will allow us to learn more about the promotion of positive trajectories for youth, as well as the unique and combined effects of mental and physical health outcomes for disaster-exposed youth. Most importantly, a better understanding of the whole child will inform clinical practice.

The purpose of this paper is to review and highlight emerging work that focuses on the relatively under-researched outcomes of (i) externalizing behavioral problems, (ii) physical health, and (iii) posttraumatic growth for youth exposed to natural disasters. This focus stems from the growing attention paid to these particular outcomes in the literature over the last few years, and it is meant as a complement to the recently published papers in this journal that have focused on internalizing disorders [9] and substance abuse outcomes [10] among disaster-impacted youth. The population of focus for this review paper is on youth impacted by *natural* disasters. While there are similarities in youth responses following natural and human-made community-level disasters, it has been noted that youth experiencing violent, human-made occurrences may

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perceive a lower level of growth in comparison to those who experience naturally occurring events [11–13]. This is relevant given that posttraumatic growth is a primary outcome of focus in this review.

### Externalizing Behavioral Problems

Few studies have focused on the association between youth disaster exposure and behavioral problems. This is somewhat surprising, given the abundance of evidence linking other types of trauma exposure (e.g., maltreatment, violence-related trauma) to youth externalizing problems [14••]. Externalizing problems are very broad by definition, but such problems typically include maladaptive behaviors directed toward an individual's environment and/or disruptive behavioral symptoms, such as conduct problems [15]. Multiple pathways may link disaster exposure to externalizing behavior problems. First, disaster exposure may contribute to problems with emotion regulation and irritability. In turn, this may contribute to increased externalizing behaviors in response to relatively mild interpersonal provocation as part of a heightened activation of the stress-response system [14••, 16, 17]. Alternatively, emerging research suggests that disaster exposure disrupts children's friendship networks and social support systems [18]. This contributes to elevated externalizing problems, as well [19].

In terms of measurement, caregiver assessment and/or teacher assessment may be more reliable and accurate than self-report measures for externalizing symptoms [20, 21]. The opposite is often true for reports of internalizing symptoms [22, 23]. Furthermore, parents and children often do not have agreement in their report of objective events [21]. These issues are of utmost importance to consider in disaster research where data collection is complicated by the destabilization of the community; thus, maximizing the efficiency of processes and including the most valid reporters as participants is of critical value.

A study by Lowe and colleagues examined externalizing disorders, as well as internalizing disorders, among youth who were in elementary school at the time of Louisiana's Hurricanes Katrina and Rita. Data were collected via mother-report 1 year prior to the disaster and 1 and 3 years post-disaster. Mothers were primarily African American, young, and single and were at heightened risk for negative adjustment following the disaster due to financial barriers, limited occupational opportunities, crime, and safety. Findings revealed that a greater number of hurricane-related stressors were associated with high maternal psychological distress, as well as greater school disruption for children (higher number of schools attended), which in turn were significantly associated with higher youth internalizing and externalizing symptoms 3 years post-disaster. These findings indicate that practices which bolster school and family readiness for disaster may impact the long-term symptomatology of disaster-impacted youth [19]. Moreover, these

findings suggest that children who change schools frequently may be appropriate targets for mental health assessment or services in the school or community setting.

A similar study conducted by Fujiwara and colleagues in Japan with children who were preschoolers at the time of the Great East Japan Earthquake examined child internalizing and externalizing problems, as reported by caregivers approximately 2 years following the disaster. Caregivers endorsed child internalizing problems at slightly higher rates than externalizing problems (27 versus 21%). A closer look at indicators of behavioral problems suggested that losing a relative was strongly associated with internalizing problems, and trauma experiences prior to the earthquake were associated with internalizing and externalizing behavioral problems. More specifically, children who experienced trauma prior to the earthquake had 2.4 times the risk of externalizing problems. Interestingly, no traumatic experiences pertaining to the earthquake were associated with externalizing problems [24]. Another study by Liberty et al. (2016) focused on youth post-earthquake outcomes in New Zealand collected teacher-report data on behavioral problems of children entering elementary school 12–18 months post-earthquake [25]. This study compared the outcomes of an earthquake-impacted sample of children entering school in the earthquake-impacted region 4 years prior to the earthquakes. As expected, higher rates of PTS and behavior problems were found for youth samples following the earthquakes than prior to the earthquakes. Notably, behavior problems reportedly more than doubled in the sample post-earthquakes.

A very recent study which focuses specifically on child aggression post-disaster by Lochman and colleagues examined 4th grade students prior to and following the Tuscaloosa, Alabama tornado in 2011 [26]. The study sample included a carefully selected, at-risk, aggressive sample who were involved in a prevention intervention study targeting aggressive children prior to the disaster. Parent-report data were collected at two time-points post-disaster, 6 months and 12 months post. Findings indicated that children's behavioral and emotional functioning in the year after the tornado was moderated by the degree of tornado exposure the children experienced. Children who had higher proximal and distal exposure to the tornado had less reduction in their internalizing problems and aggression in comparison to their peers, especially if they exhibited the lowest rates of anxiety prior to the tornado. Overall, this at-risk sample of aggressive children who were exposed to the tornado did not necessarily have worse outcomes than at baseline, but they did not show the improvement in functioning in response to the prevention intervention that was evident among their less-exposed peers.

Notably, each of the reviewed studies used either caregiver or teacher report as the primary method of data collection, as recommended for best practices in measurement of externalizing behavioral problems [20]. In addition, all the reviewed

studies included measures of internalizing outcomes. This is critically important as it has been postulated that child aggressive behavior exhibited post-disaster may be closely linked with PTSD symptoms, anxiety, and heightened activation [16, 17, 27–30]. Scott and colleagues explored this proposed pathway with 191 youth, 8 to 15 years of age, who were exposed to Hurricane Katrina. Students were screened at 24 months for PTSD symptoms and aggressive behavior and were assessed for academic achievement approximately 31 months post-Katrina. A direct association between disaster exposure and aggressive behavior did not emerge; however, an indirect link was found between disaster and aggression through PTSD symptoms. These models did not vary across youth in late childhood and early adolescence, suggesting that the indirect path to aggression may transcend transitional developmental periods [14••]. Lastly, aggressive behavior was negatively associated with a salient index of school impairment among disaster-exposed youth, even when considering the effects of disaster exposure, distress, and PTSD symptoms. In sum, the findings in this emerging literature suggest that the association of externalizing behaviors with disaster are complex and worthy of focus to better understand the comprehensive impact of disaster on youth.

## Physical Health

Physical health of children is also critically important to examine following natural disaster exposure. Disasters may have both direct and indirect effects on child health [31], highlighted by the recent 2016 Climate Health Report [32]. Existing studies demonstrate how disaster exposure may impair youth short- and long-term health, including but not limited to somatic complaints, headaches, fatigue, muscular-skeletal problems, and respiratory problems (e.g., [6, 33–36]). Important work has emerged in the last few years to further explicate the association between disaster and child physical health, how this relates to psychological health, and how behaviors in the aftermath environment may be associated with long-term physical health.

In one of the first investigations to explore the impact of small and moderate disasters on childhood morbidity, physical growth, and immunizations in India, Datar and colleagues combined household data on over 80,000 children from three waves of the Indian National Family and Health Survey with an international database of natural disasters [31]. Findings suggested that for children under 5 years, exposure to a natural disaster in the past month increased the likelihood of acute illnesses such as diarrhea, fever, and acute respiratory illness by up to 18%. Furthermore, exposure to a disaster in the past year not only negatively impacted the height and weight of young children, but it also reduced the likelihood of having full age-appropriate immunization coverage. It is important to note that the study findings suggest girls and children from families with low socioeconomic resources may be more

negatively impacted post-disaster, and that breastfed infants may be protected from health issues as the result of lower rates of malnutrition. This study is unique in that it includes a timeframe for which 228 disasters took place in India, as compared to the majority of other studies in disaster research that focus on one specific disaster, and the resulting health effect.

A study by Lai and colleagues examined how Hurricane Ike impacted child physical outcomes, as well as how these outcomes may be influenced by posttraumatic stress symptoms, [7]. The sample included 3rd and 4th grade children assessed approximately 8 months post-disaster, with a focus on how disaster exposure and recovery stressors can influence physical health through the well-documented association between stress and health. Findings indicated that child hurricane exposure and number of recovery stressors were linked to increased time spent in sedentary activities, a health risk behavior associated with poor chronic health outcomes, as well as posttraumatic stress symptoms. Notably, children's average sedentary activity levels post-disaster were on average 41.37 h per week (5.91 h per day), which is substantially higher than levels reported in non-disaster samples (approximately 24 to 29 h per week) [37]. Importantly, posttraumatic stress symptoms emerged as a potential mediator of the relationship between stressors and sedentary activity, demonstrating the important associations between stress, mental health, and physical health in post-disaster settings.

Felix and colleagues recently published findings focusing on several youth health outcomes following disaster, namely, global rating of health, medical problems, and medical visits. Participants in this study were Puerto Rican youth ages 4 to 17 years and their parents, who were exposed to Hurricane George [38••]. Data were collected at 18- and 30-month post-disaster. Importantly, the authors assessed how internalizing psychopathology, as well as how the affective component of the parent-child relationship, might influence the impact of disaster on physical health. Hurricane exposure was found to be significantly related to all three health outcomes at both the 18-month and 30-month time points. Further, positive parent-child relationship quality was found to be a protective factor for some of the health outcomes, but complicated interactions emerged with child gender, indicating a need for further study to explicate these relations. Internalizing symptoms were indicative of worse health outcomes, supporting the comprehensive effects of disaster on physical and mental health. This study further documents the lasting impact that disaster has on physical health well into the long-term recovery period.

In summary, several recent high impact studies have solidified the significant relationship between disaster exposure and physical health. The inclusion of mental health functioning, as well as factors that may moderate the associations between disaster exposure and physical health are imperative to understanding the pathways by which health is negatively impacted post-disaster [7, 38••]. Additional research is

warranted to greater explore how child age and child gender may influence health, as well as how innovations in health care access and policy post-disaster may improve youth health outcomes. As documented in research by Self-Brown and colleagues (2013), following Hurricane Katrina mobile medical and mental health units were deployed to help Katrina impacted families [39]. Further study of how mobile medical care can be helpful in postdisaster situations in both developed and undeveloped countries is imperative. Further, a better understanding of how to fund and reimburse such medical care efforts and the factors that can enhance sustainability throughout the recovery period is key.

## Posttraumatic Growth

Youth who have experienced disaster contend with a variety of life stressors resulting from both the event and the recovery period after disasters. Although these experiences are associated with an increased risk for negative outcomes, they may also offer opportunities for post-traumatic growth [40–42]. Posttraumatic growth refers to a positive change experienced as a result of undergoing a traumatic event and often includes feelings of strength, closer relationships, an appreciation of life, a recognition of new possibilities, and spiritual development [40, 43]. It is thought that the level of adversity is critical to the opportunity for growth, and at least one study has shown that when there were few secondary adversities following disaster exposure, youth exhibited less posttraumatic growth [44]. Other factors associated with youth posttraumatic growth have included parents' reports of their own posttraumatic growth [45], subjective disaster exposure, current posttraumatic stress symptoms [44], positive reappraisal [46], and negative and constructive rumination [41]. This is a burgeoning area of youth disaster research, with several recent studies documenting the association between youth disaster and posttraumatic growth, as well as with the protective and potentiating factors that influence youth trajectory.

Ying et al. [47] explored posttraumatic growth following the 2008 Wenchuan earthquake in China [47]. Data were collected from 3000 children ages 8 to 19 years at four time points: 12, 18, 24, and 30 months post-disaster. In addition to examining the association between disaster and posttraumatic growth, control beliefs, namely primary control and secondary control beliefs, were explored. Interestingly, at 12 and 30 months post-disaster, indirect exposure to disaster, such as loss or separation from parent or worry about others, was related to youth posttraumatic growth. However, exposure, such as being trapped during the earthquake, was not. Ying and colleagues suggested that indirect exposure might be more enduring post-disaster than the direct experiences, and this sustaining power may promote posttraumatic growth for a longer period. Both types of control beliefs and worry (i.e., indirect exposure) were significantly associated with

posttraumatic growth 12 months post disaster. Beliefs continued to be important to posttraumatic growth 30 months post-disaster; however, worry was no longer a significant predictor. Curiously, primary control beliefs (personal sense of control) also emerged as a moderator variable, suggesting that participants who expressed low worry about others after the earthquake and who had high primary control beliefs, reported greater posttraumatic growth. This suggests that that individuals accustomed to shaping their environment to meet their needs may do less well when confronted by events that are clearly outside their control.

In another study focused on youth and parental posttraumatic growth post-disaster, Felix and colleagues (2015) assessed adolescent youth and their parents, 1 year after being exposed to a California wildfire [48]. This was a severely impacted sample, with 100% of participants having been evacuated and 30% reporting loss of home. The sample was somewhat unique from other disaster-related samples, as the parents were mostly college educated and affluent. Several noteworthy factors were examined in this study, including youth fire-related stress, emotional regulation, life stressors, mental health, social support, and coping skills. Greater perceived fire stress was associated with more posttraumatic growth for parents and youth. For youth, younger age, being female, greater perceived stress, and more life stressors were associated with posttraumatic growth. Further, youth experienced greater posttraumatic growth if they reported a cognitive emotional regulation style that included positive reappraisal, which involves attaching positive meaning to an event or stressor in terms of growing as a person, personal strength, or fortitude [49]. For adults, different factors emerged as correlates of posttraumatic growth, indicating that there are likely significant developmental influences on protective factors among youth and adults who have experienced disaster. No significant relationship emerged for mental health functioning and posttraumatic growth for either youth or parents. This is somewhat unexpected given that theoretical formulations of posttraumatic growth suggest that distress and growth can co-occur [50] and given the prior research supporting associations between PTS and posttraumatic growth [51, 52].

A recently published study by Jieling and Xinchun [53••] examined posttraumatic growth trajectories, and the relation of these with PTS trajectories, 8 months post-disaster among 618 child survivors of China's 2013 Ya'an earthquake [53••]. Three patterns were identified among youth: (1) *thriving*—youth reporting mild PTS and moderate posttraumatic growth (76.2%); (2) *resilient*—youth reporting mild levels of PTS and posttraumatic growth (9.1%); and (3) *stressed and growing*—youth reporting clinically significant PTS and moderate posttraumatic growth (14.7%). Interestingly, no pattern emerged indicating a set of clinically significant levels of PTSD with low levels of growth. Study findings, however, did demonstrate that several influential factors can impact PTS and

posttraumatic growth that should be further considered in future research. For instance, those with a higher level of loss and injury and subjective fear during the earthquake were more likely to fall into the pattern with a high level of PTSD symptoms (stressed and growing) compared to the other patterns with a low level of PTSD symptoms (resilient or thriving). This study highlights the capacity of youth to adjust and thrive following a major disaster. Importantly, even for youth experiencing PTS, growth can be experienced simultaneously, which may account for differential trajectories for youth with PTS symptoms over time. This association is overlooked when researchers and clinicians are solely focusing on diagnostic outcomes.

While research focused on youth posttraumatic growth is newly emerging, the published work presented here highlights that this is a critically important outcome to continue assessing in future work, especially in the context of youth mental health following disaster. Of note, limited work has focused on the associations of posttraumatic growth and physical health or externalizing disorders. It is recommended that next steps in research include a broader assessment of child well-being to garner a more comprehensive understanding of post-disaster growth. Lastly, a focus on how one's developmental stage may influence growth post-disaster is important to explore given the findings of Felix and colleagues (2015). This is especially true for young children post-disaster (children under age 8 years), who have largely been ignored in research on growth to date. This may be due to difficulty measuring this construct with children under 8 years of age. Further work is warranted to determine if this is the case, or whether more appropriate assessment measures need to be developed.

## Conclusions and Future Directions

The studies highlighted in this review have made a significant impact on the field of youth disaster research, due to the innovative and comprehensive approaches used to improve our current understanding of youth broad-based physical and mental health outcomes. Each of the studies highlighted in this review explored multiple youth outcomes, commensurate with the recommendations of [8] to move beyond PTS to better understand youth reactions to trauma [8]. Although the field is making much progress, we offer two primary recommendations for disaster researchers related to cutting-edge science and emerging statistical methods.

First, an application of the bio-ecological approach to the study of the outcomes highlighted in this review is warranted. Weems [54] identifies the relevance of further exploring the central nervous system, hormonal activation, and psychophysiology of disaster-exposed youth to better understand how genetic factors shape reaction to disaster [54]. There is mounting research examining a bio-ecological approach to disaster-

impact youth PTS outcomes (e.g., [55–59]). However, there is a paucity of research examining this approach to study the outcomes of externalizing disorders, physical health, and post-traumatic growth. More studies similar to the pioneering work of Kujawa and colleagues, which document the role of neural reactivity in predicting externalizing symptoms in children ages 9 to 12 years following Hurricane Sandy [60], are sorely needed. Further understanding of the bio-ecological variables, including the neurobiology and genetic influences, that interact with and predict positive and negative outcome trajectories can lead to novel and effective approaches to treatment of disaster-impacted youth.

Second, advanced modeling strategies may provide insight into many of the questions posed in this review. To date, research has primarily focused on understanding how different variables relate to each other in disaster contexts (i.e., variable-centered approaches). Newer approaches to modeling, however, allow us to examine profiles of youth and how symptoms and risk factors may cluster within individuals (i.e., person-centered approaches). As an example, researchers focused on internalizing symptoms among disaster affected youth have applied these approaches to understand profiles of youth symptoms after disasters (e.g., [21, 61]). However, for the outcomes of focus in this review, only Jieling and Xinchun [53••] applied this type of approach [20]. These methods allow for the exploration of co-occurring patterns of outcomes, which is of value as researchers continue to apply more comprehensive approaches to a focus on child well-being. Further, methods such as integrative data analysis may allow researchers to pool information from multiple studies of disasters to better understand how youth are affected.

As a collective field, what can we do to bolster science in these innovative directions? We need to train our graduate students in advanced statistical methods. Advanced statistical training is necessary to test bio-ecological models and to use novel modeling strategies. We also need to shift the focus of research to the whole child post-disaster, versus specific diagnostic categories of interest. High levels of comorbid symptoms exist among youth post-disaster (e.g., [62]). Further, syndromes interact to influence youth trajectories (e.g., [53••]). Thus, we must consider how these findings should shape the design of future studies in disaster-impacted communities, as well as guide the clinical practice for serving and treating youth negatively impacted by disaster.

## Compliance with Ethical Standards

**Conflict of Interest** Shannon Self-Brown, Betty Lai, Alexandria Patterson, and Theresa Glasheen each declare no potential conflicts of interest.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

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