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The Hurricane Exposure, Adversity, and Recovery Tool (HEART): Developing and Validating a Risk Screening Instrument for Youth Exposed to Hurricane Harvey

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The Hurricane Exposure, Adversity, and Recovery Tool (HEART): Developing and Validating a Risk Screening Instrument for Youth Exposed to Hurricane Harvey

Hurricane Harvey made landfall as a Category 4 Hurricane in Texas in August of 2017. Harris County, Texas' most populous county and home to over 4 million residents, was one of the areas most affected by the storm. There were 68 deaths directly related to Harvey statewide, making it the most fatal Hurricane in Texas in nearly 100 years (Lindner & Fitzgerald, 2018). More than 60,000 Harris County residents were rescued, resulting in over 30,000 displaced residents living in shelters as a result of storm damage or flooding (Lindner & Fitzgerald, 2018). Much of the destruction caused by Harvey was due to flooding, with total rainfall records of three to four feet in the Houston metropolitan area and over five feet in other areas (Blake & Zelinsky, 2018). The resulting damage to property and infrastructure has been estimated at \$125 billion (Harris County Flood Control District, 2018).

As the intensity of such high-impact weather events increases (Walsh et al., 2016), more children will be exposed to potentially traumatic natural disasters, including hurricanes and hurricane-related flood events. Hurricane and flood exposure place youth at risk for a number of negative mental health outcomes, including posttraumatic stress disorder (PTSD), depression, and anxiety (J. D. Osofsky, Kronenberg, Bocknek, & Hansel, 2015; Rubens, Vernberg, Felix, & Canino, 2013; Vernberg, La Greca, Silverman, & Prinstein, 1996). In the aftermath of a natural disaster, evidence-based risk screening and assessment instruments are critically important tools for efficiently and effectively allocating post-disaster resources and mental health services (Kaplow, Layne, & Rolon-Arroyo, 2018). School personnel and healthcare professionals are frequently tasked with identifying youth at risk for persisting psychological distress and referring them to appropriate psychological and behavioral supports. Accordingly, developing screening tools that can be utilized in the short-term aftermath of hurricanes to identify youth at risk for persisting posttraumatic distress reactions is necessary for effective disaster relief.

Drawing on prior models for intervening in post-war and post-disaster settings (Layne et al., 2009), Kaplow and colleagues (2018) propose a four-stage model for assessing youth following a natural disaster. Stages of the model include (a) *situation analysis*, (b) *mental health needs assessment*, (c) *in-depth ecological assessment*, and (d) *ongoing assessment of client well-being*. First, *situation analysis* focuses on collecting factual details of what occurred and how the disaster

unfolded, including prevalence rates of exposure to specific risk types of factors (e.g., serious injuries, loss of a pet, and home displacement). Situation analysis also involves tracking the causal consequences of those initial exposures. This includes identifying “chain reaction” cascades of adversities that typically commence with the disaster, (e.g., loss of home, change in school, and financial strains) but over time can assume a life of their own and become separate sources of stress that exacerbate and extend beyond the initial effects of disaster-related exposures (Kaplow et al., 2018).

Second, *mental health needs assessment* aims to address the causal consequences of risk factor exposure, with the aim of preventing or ameliorating long-term distress and dysfunction. This phase of assessment focuses on gathering information regarding prevalence rates of mental health problems (e.g., posttraumatic stress reactions, depression, grief reactions) theorized to arise from, or to be exacerbated by, one’s specific exposure profile (Kaplow et al., 2018). Third, *in-depth ecological assessment* involves evaluating the recovery environment, including up-to-date information regarding potential vulnerability and protective factors, secondary adversities set in motion or exacerbated by initial risk factors, and trauma reminders (Layne et al., 2006). Ecological assessment also includes *ongoing surveillance*, which can be viewed as an abbreviated, ongoing repetition and extension of the initial situation analysis. Ongoing surveillance involves a regular search for recurring or newly emerging causal risk factors and related threats to public safety and well-being (e.g., supply shortages, disease outbreaks, and people moving back into condemned/unsafe housing) that can exacerbate or prolong the short-term effects of hurricane exposure. Fourth, *ongoing assessment of client well-being* occurs in conjunction with intervention and involves monitoring client response over the course of intervention and assessing outcomes at follow-up (Kaplow et al., 2018).

Typically, following a disaster, situation analyses are conducted by staff members or providers who (a) have prior relationships with affected youth and families, or (b) are embedded in community agencies within the disaster-affected region. In particular, school personnel and medical professionals are often families’ first points of contact and are thus frequently called upon to carry out a situation analysis. One of the greatest challenges in conducting a situation analysis in the aftermath of a disaster is the need for both rapid and efficient information gathering. Post-disaster settings that serve youth, such as schools or hospitals, require developmentally and culturally informed self-report tools that can be easily completed by children or adolescents with minimal assistance from

teachers or health care providers (Kaplow et al., 2018). Further, because situation analysis focuses on rates of exposure to specific types of hurricane-related events (rather than resulting psychological symptoms—the province of needs assessment), hurricane exposure screening tools are ideally suited for medical practitioners and school personnel, who may have only limited training in psychological assessment. Making a clear distinction between situation analysis, which focuses on disaster exposure, and mental health needs assessment, which focuses on distress reactions and problems consequent to those exposures, is critical to developing effective methods for allocating scarce mental health resources in the aftermath of a hurricane.

Because most children naturally exhibit expectable temporary increases in psychological distress following natural disasters, the first line of care for hurricane-affected youth and families should be non-intensive trauma-informed programs that can be widely disseminated among staff in settings such as schools, shelters, and hospitals. For example, Psychological First Aid (PFA; Brymer et al., 2006) is an exemplary program that takes care to equip providers with adequate support strategies, while at the same time providing caution about interfering with families' existing coping reactions and support structures. A similar consideration related to the use of hurricane-related exposure tools is that the early assessment of mental health variables (e.g., posttraumatic stress symptoms) can lead to high rates of “false positives” if used in the short-term aftermath of a disaster. For example, La Greca and colleagues (1996) found that 29.1% of youth exposed to Hurricane Andrew ($N = 442$) exhibited “severe” or “very severe” PTSS within the first three months of the storm; in contrast, only 12.7% exhibited severe or very severe symptoms ten months post-Andrew. By this line of reasoning, to be accurate and clinically actionable, situation analysis conducted in the short-term aftermath of a disaster should focus on *exposure* rather than the presence of acute stress reactions or mental health symptoms.

Accurate situation analysis is necessary to ensure that children receive appropriate referrals for mental health needs assessments. To do this most efficiently, situation analyses should seek to include and emphasize the most potent risk factors for negative outcomes following exposure to a natural disaster while remaining flexible to the specific ways in which they were manifest within a given population and setting (Layne et al., 2010). For example, a meta-analysis of 96 studies examining post-disaster risk factors for PTSD identified as the most robust predictors three peri-traumatic factors that can be readily assessed as part of situation analysis in the short-term aftermath of the disaster: *child distress*

at the time of the event, the child's perceptions of danger during the disaster, child proximity to the disaster, and loss of a loved one during the event (Furr, Comer, Edmunds, & Kendall, 2010). In addition, broad psychosocial risk factors (e.g., prior trauma, psychopathology) may contribute to trauma responses in complex and dynamic ways following exposure to natural disasters (Masten & Narayan, 2012). Given that exposure-related risk factors are often specific to the community in which the disaster occurred, tools designed for situation analysis must consider the specific needs, strengths, prior history, and general ecology of the community itself.

To this end, this study presents preliminary data from a child self-report risk screening measure designed to assist with situation analysis in the aftermath of a hurricane. Specifically, we set out to construct and examine the clinical utility and criterion-referenced validity of a culturally informed, developmentally appropriate measure to assess the prevalence of hurricane exposure-related events, predisposing risk factors (e.g., prior trauma or loss), and ongoing adversities (e.g., food insecurity) in the aftermath of Hurricane Harvey.

Review of Post-Hurricane Risk Screening Tools

To date, few hurricane-specific measures designed to assess exposure-related risks have been developed (for a more detailed review of existing measures, see Kaplow et al., 2018). One of the most widely used measures of hurricane-related risk exposure (Brown, Mellman, Alfano, & Weems, 2011; Terranova, Boxer, & Morris, 2009; Weems et al., 2010) is the *Hurricane-Related Traumatic Experiences* Questionnaire (HURTE; Vernberg et al., 1996). The development of this measure was aided by clinical experience gained from interviews of children and adults following Hurricane Andrew in 1992, and from inspection of a post-disaster supplement to the Diagnostic Interview Schedule (Robins & Smith, 1983). The HURTE, which was recently updated with additional items and is now referred to as the HURTE-II, is designed to be administered to school-age children and assesses exposure-related risk factors across four domains: *Before the Hurricane* (17 items), *During the Hurricane* (16 items), *After the Hurricane* (17 items), and *Current Functioning* (4 items). Research findings support the reliability and predictive validity of the original HURTE for assessing children's hurricane-related exposure and associated stressors (La Greca, Silverman, & Wasserstein, 1998; Weems et al., 2010; Yelland et al., 2010).

The National Child Traumatic Stress Network (NCTSN) *Hurricane Assessment and Referral Tool for Children and Adolescents* was created

to assess both hurricane-related exposure and associated symptoms of PTSD and depression (Hansel, Osofsky, & Osofsky, 2015; National Child Traumatic Stress Network, 2005), thereby collecting information relevant to both situation analysis and mental health needs assessment. This measure can be completed by caregivers or children and adolescents, although assistance may be needed if the measure is to be completed by younger school-aged children (Kronenberg et al., 2010). The measure assesses demographic information, 18 hurricane-related exposure items, and 6 items assessing for a history of psychological or psychiatric problems and treatment. This measure also includes a section designed to assess 22 symptoms of PTSD (derived from the UCLA PTSD Reaction Index, DSM-5 version; Kaplow et al., 2019) and depression, as well as 7 additional parent-report symptoms for young children.

Many of the items of the *Hurricane Assessment and Referral Tool for Children and Adolescents* have been shown to differentiate between children whose scores lie above versus below the clinical cutoff on the instrument's posttraumatic stress symptom scale (H. J. Osofsky, Osofsky, Kronenberg, Brennan, & Hansel, 2009). Additionally, several adaptations to the instrument have been created to meet the needs of different settings and populations. For example, an adaptation by Kronenberg and colleagues (2010), simplified the language of the measure to make it easier for school-aged students (9 to 18 years old) to complete individually. Similarly, the *Louisiana State Health Sciences Center Katrina Inspired Disaster Screenings* model (Hansel et al., 2015) utilized the NCTSN screening tool as part of a larger screening effort post-Katrina. A parent report version of the NCTSN tool has also been developed to aid in the screening of children aged 3 to 5 years (J. D. Osofsky et al., 2015).

Finally, the *Hurricane Exposure Questionnaire for Caretakers and Youth* (aged 11 to 17 years) was adapted from adult measures of hurricane-related exposure (Bravo, Rubio-Stipec, Canino, Woodbury, & Ribera, 1990; Norris & Kaniasty, 1992) as well as the HURTE. Items assess the child's and family's exposure to the hurricane, perceived safety, loss or damage to their home, life threat/loss (i.e., physical injury to the child or a significant other, loss of a family member or a person close to him/her), loss of material objects, and child's disruption of everyday life (i.e., separation from family, still living out of home at time of interview). This measure has been used in multiple studies to examine risk factors associated with hurricane-related exposure (Felix et al., 2011; Felix, Kaniasty, You, & Canino, 2016; Felix, You, Vernberg, & Canino, 2013; Rubens et al., 2013); however, to our knowledge, a formal psychometric study has not yet been conducted.

Development of the Hurricane Exposure, Adversity, and Recovery Tool (HEART)

As previously discussed, one of the greatest challenges in conducting a situation analysis in the aftermath of a disaster is the need for rapid, efficient, and accurate information gathering, while taking into account that most children exhibit expectable short-term increases in psychological distress immediately following the disaster (Kaplow et al., 2018). Although PTSD can be diagnosed as early as one month post-event, additional time may be needed to discriminate between individuals with more protracted recovery trajectories versus youth at risk for severe persisting distress, functional impairment, and developmental disruption, who may be in need of specialized psychosocial intervention (Kaplow et al., 2018). It is thus important to avoid conflating the tasks of situation analysis with those of needs assessment (especially in the short-term aftermath of disasters) by combining hurricane exposure-related risk factors with symptoms of psychological distress and treating both sets of items as equally informative and actionable (Layne et al., 2009; Layne, Kaplow, & Youngstrom, 2017). In other words, temporary increases in distress reactions exhibited by many residents shortly after the disaster can impede accurate discrimination between residents at risk for severe persisting distress and those at risk for resilient recovery, thereby undermining the accuracy of needs assessment by increasing false positive classification errors. Disaster risk screening tools should also be constructed or adapted to capture issues specific to the local disaster setting and culture, recognizing that broadly studied types of causal risk factors (e.g., life threat, physical harm, material loss, and threat to loved ones) can manifest in ways idiosyncratic to the specific disaster and location (Layne et al., 2010). Finally, using lengthy measures in the short-term aftermath of a disaster can impede quick and efficient screening by practitioners and/or school personnel who lack the time needed for a more thorough situation analysis.

We created the HEART to support post-hurricane situation analyses among youth aged 8 to 18 years in healthcare and school-based settings. Our aim was to construct a measure that allowed for child self-report, could be easily utilized by a wide range of healthcare and school personnel with minimal prior training in mental health services, and could be utilized to refer “at-risk” youth for a more thorough mental health needs assessment. Based on the extant literature, we also aimed to capture a broad range of indicators of risk for longer-term maladaptive outcomes. Consistent with guidelines for best practice test construction (DeVellis,

2016; Haynes, Smith, & Hunsley, 2011), test construction for the HEART began by first reviewing the literature to identify relevant disaster-related experiences and associated distress reactions and generating a pool of candidate test items. Given that we conceptualized disaster exposure using a formative composite with causal indicators model, we sought to develop a pool of exposure items that were sufficiently prevalent and causally potent to merit risk screening, non-redundant with other items, and clinically actionable. We also prioritized content validity over brevity to ensure that critical parts of victims' potential disaster-related experiences were not excluded (Layne et al., 2010). A second step focused on enhancing the developmental appropriateness and cultural sensitivity of candidate items by recruiting a panel of trauma-informed clinicians and other community stakeholders (e.g., school personnel, medical providers) to review the item pool and provide verbal feedback about the developmental appropriateness, clarity, and relevance of each item to the Hurricane Harvey post-disaster setting. In a third step, we recruited clinical child therapists to field-test the item pool with hurricane-exposed youth and ask the youth to provide their verbal feedback about the comprehensibility and acceptability of the candidate items. In a fourth step, we modified several of the items based on the feedback, focusing primarily on using developmentally appropriate language.

The resulting HEART item pool comprised 29 items describing specific events (e.g., "During the storm or floods, I got hurt") and discrete reactions to events (e.g., "...I thought that my family and I might get badly hurt or die"). The items are presented in a binary, Yes/No response format to reduce administration time and because severity ratings (e.g., a Likert-type format) would have not been applicable for items assessing the occurrence of disaster-specific events (e.g., "...someone rescued me or my family"). Caregiver and youth self-report versions of the HEART were created in parallel. Both versions have been piloted with stand-alone and clinician-read administration types, and the administration time was typically between five and ten minutes in both cases.

The first 22 items on the HEART assess hurricane-specific disaster-related experiences derived from the extant empirical literature, broadly partitioned into experiences *During the Storm or Floods*, and *After the Storm or Floods*. During the Storm or Floods items include perceived threat to self or others, separation from caregivers, and injury to self or others, (La Greca et al., 1996; Lai, La Greca, Auslander, & Short, 2013; Lonigan, Shannon, Finch, Daugherty, & Taylor, 1991). In addition, to address a known barrier to service use among undocumented and immigrant families (Hacker, Anies, Folb, & Zallman, 2015), we included an

item addressing fear of help-seeking (“...*my family was afraid to be rescued or ask for help because we thought we might get in trouble*”). Similarly, *After the Storm or Floods* items capture post-hurricane disruptions in daily life functioning (e.g., relocation to a shelter, moving out of one’s house, witnessing damage or destruction, changing schools; H. J. Osofsky et al., 2009).

The remaining seven items assess pre-existing indicators of risk (four items) and ongoing adversity (three items). Pre-existing indicators of risk were drawn from research identifying factors that incrementally increase risk for PTSD following natural disasters (Hensley & Varela, 2008; La Greca et al., 1996; Lonigan, Shannon, Taylor, Finch, & Sallee, 1994; H. J. Osofsky et al., 2009) and included prior disaster exposure, other trauma exposure, bereavement, and impairing emotional problems. Ongoing adversity was tapped by three items inquiring about difficulty meeting basic needs, emotional problems, and perceived social difficulties.

The Present Study

The aim of the current study was to evaluate, during the post-acute hurricane recovery period, the criterion-referenced validity of a measure containing hurricane exposure-related risk factors in relation to established measures of posttraumatic stress and depressive symptoms during the post-acute recovery period 3 to 17 months after Hurricane Harvey. Our intent was to answer the following questions: (a) *Which specific types of exposure were most commonly reported among youth in the aftermath of Hurricane Harvey?* And (b) *which exposure items, pre-existing indicators of risk, and ongoing adversities were most strongly associated with posttraumatic stress and depressive symptoms during the post-acute hurricane recovery period?* To examine these questions, we first present HEART item endorsement frequencies in an ethno-racially diverse sample of hurricane-exposed youth from the greater Houston metropolitan area. We then evaluate associations between HEART responses and posttraumatic stress and depressive symptoms assessed during the post-acute hurricane recovery period.

Method

Participants

Participants were 107 ethnically diverse youth ages 7 to 17 years ($M_{\text{age}} = 12.29$, $SD = 3.09$, 52.3% female, $n = 1$ youth did not report demographics) who presented at an outpatient mental health clinic specializing in the

assessment and treatment of childhood trauma and loss. Referrals to the clinic came from a variety of sources including primary care providers, school personnel, and other mental health providers in the region. Data for the present study were gathered between November 2017 and January 2019, approximately 3 to 17 months following Hurricane Harvey. Participants predominantly self-identified as White or Caucasian (37.4%, $N = 40$), followed by Black or African-American (16.8%, $N = 18$), Native American (3.7%, $N = 4$), Asian-American or Pacific Islander (1.9%, $N = 2$) and Other Race/Ethnicity (9.3%, $N = 10$). Nearly half of the sample identified ethnically as Hispanic or Latino (46.7%, $N = 50$).

Procedure

Youth were referred for a standardized clinic intake assessment, which was conducted in an outpatient therapy clinic by staff including social workers, psychologists, and postdoctoral clinical psychology fellows. This assessment was conducted at each youth's first appointment; participating youth had not previously received services from the clinic. The clinician began by providing families with a description of services provided by the clinic and an overview of the research study. Parents or legal guardians provided written consent for each youth's participation. Each youth also assented to the research protocol. The clinician then administered all instruments using a semi-structured individual interview format in which the clinician read each item aloud, then queried the youth for a response. Youth were compensated for their participation, and all study procedures were approved by an Institutional Review Board.

Measures

Hurricane Exposure, Adversity, and Recovery Tool (HEART). The HEART item pool (Harvey Resiliency and Recovery Program, 2017; see Appendix) consists of 29 items rated in "Yes/No" format. Items assess content along four conceptual domains: Hurricane Exposure (e.g., "*During the storm or floods, someone in my family or a close friend got hurt*"), Post-Hurricane Adversity (e.g., "*After the storm or floods, some or all of my things [like toys, clothes, books] were ruined*"), Pre-Existing Risk Factors (i.e., trauma history, bereavement, and emotional problems), and Ongoing Adversities (i.e., socioeconomic problems, social support, and current emotional problems). A summary score of the 22 disaster-related exposure items was calculated by summing the number of yes responses.

Posttraumatic stress symptoms. The 31-item UCLA PTSD Reaction Index for DSM-5 (RI-5; Kaplow et al., 2019) was used to assess child

posttraumatic stress symptoms secondary to the hurricane. Symptoms (e.g., “I have upsetting thoughts, pictures, or sounds of what happened come into my mind when I do not want them to”) are rated on a 5-point scale ranging from 0 (*never happens*) to 4 (*most of the time*). A total score is created by summing ratings across all 20 symptom items (range = 0–80). A score ≥ 35 denotes significant risk for PTSD with good sensitivity and specificity (Kaplow et al., 2019). Present study $\alpha = .92$.

Depressive symptoms. The 13-item Short Mood and Feelings Questionnaire (SMFQ; Angold, Costello, Messer, & Pickles, 1995) was used to assess child depressive symptoms. Frequency of symptoms (e.g., “I felt miserable or unhappy”) experienced during the last two weeks is rated on a 3-point scale (0 = *not true*, 1 = *sometimes true*, 2 = *true*). Responses are summed to create a total score (range = 0–26). Although several cut scores have been examined (Rhew et al., 2010; Thapar & McGuffin, 1998; Turner, Joinson, Peters, Wiles, & Lewis, 2014), a score ≥ 8 was used in the current study to indicate clinically significant risk for a depressive disorder (Angold et al., 1995). Present study $\alpha = .82$.

Analyses

All analyses were conducted using SPSS Version 25. Endorsement rates for the HEART items represent percentages of participants who endorsed each item. Given our interest in examining associations between binary (exposure) variables and continuous (distress) variables, we used point-biserial correlations to examine the degree of association between individual HEART items and posttraumatic stress and depressive symptoms. To further explore these relationships, we calculated summary scores for five groups of HEART items by totaling all ‘yes’ responses: the *total number of disaster experiences* (items 1–22), *during the storm or floods experiences* (items 1–14), *after the storm or floods experiences* (items 15–22), *pre-existing indicators of risk* (items 23–26), and *ongoing adversities* (items 27–29). Pearson correlations were calculated to examine the degree of association among these summary scores and posttraumatic stress and depressive symptoms. Complete HEART and SMFQ data were available for all $N = 107$ youth; complete RI-5 data were available for $n = 100$ youth.

Results

Question 1: Which Hurricane-Specific Disaster Exposure Items Were Most Commonly Reported Among Youth in the Aftermath of Hurricane Harvey?

Disaster-Specific Items. Overall, youth endorsed an average of 3.49 ($SD = 3.25$, range = 0–20) of 22 HEART disaster-related experience items. Table 1 lists the percentage of youth endorsing each HEART item. Endorsement rates ranged from 2.8% to 38.3% across disaster-related experience items. Youth endorsed an average of 2.05 ($SD = 1.89$, range = 0–12) of 14 items assessing experiences *during the storm or floods*. The most frequently endorsed items were observation of caregiver distress (38.3%, $n = 41$), perceived danger to self or other family members (34.6%, $n = 37$), being trapped in their home (26.2%, $n = 28$), and having to leave their house quickly during the storm (26.2%, $n = 28$). Few youth endorsed bodily harm to self (2.8%, $n = 3$), harm to a loved one (5.6%, $n = 6$), or death of a family member or friend (1.9%, $n = 2$).

Youth endorsed an average of 1.44 ($SD = 1.79$, range = 0–8) of the eight items assessing experiences *after the storm or floods*. The most frequently endorsed items were damage to the home (30.8%, $n = 33$), neighborhood (29.9%, $n = 32$), and personal items (23.4%, $n = 25$). Although 20.6% of youth ($n = 22$) endorsed being displaced from their homes, few reported having to stay in a shelter (5.6%, $n = 6$) or moving to a new school (5.7%, $n = 6$).

Pre-existing Indicators of Risk and Ongoing Adversities. Youth endorsed an average of 1.02 ($SD = 1.12$, range = 0–4) of four *pre-existing indicators of risk*. Most commonly endorsed was history of bereavement (38.3%, $n = 41$), followed by history of exposure to other potentially traumatic events (31.8%, $n = 34$), prior exposure to a natural disaster (19.6%, $n = 21$) and history of emotional problems (12.1%, $n = 13$). Youth endorsed, on average, 0.89 ($SD = 0.93$, range = 0–3) of three items assessing *current problems*. Most commonly endorsed was having difficulty sharing their feelings with family or friends (40.2%, $n = 43$), followed by feeling upset a lot of the time (36.4%, $n = 39$), and family difficulty meeting basic needs (12.1%, $n = 13$).

Table 1
HEART Percent Item Endorsement and Item-Level Validity Correlations

	%	RI-5	SMFQ
Disaster-Related Experiences			
<i>During the storm or floods...</i>			

	%	RI-5	SMFQ
1. I got hurt.	2.8	.17	.17
2. Someone in my family or a close friend got hurt.	5.6	.14	.06
3. Someone in my family or a close friend died.	1.9	.12	.00
4. I thought that my family and I might get badly hurt or die.	34.6	.40**	.32**
5. I saw someone who was badly hurt.	12.1	.10	.14
6. I saw one (or both) of my caregivers looking very upset, scared, or sad.	38.3	.17	.24*
7. I got separated from one (or both) of my caregivers.	8.4	.08	.14
8. My pet got badly hurt or died.	6.5	.20*	.27**
9. We had to leave my pet behind.	9.4	.10	.10
10. I had to leave my house very quickly.	26.2	-.07	-.17
11. I was trapped in my house.	26.2	.12	.14
12. Someone rescued me or my family (like by boat or helicopter).	7.5	-.07	-.04
13. My family was afraid to be rescued or ask for help because we thought we might get in trouble.	4.7	.34**	.09
14. Someone in my family was out helping other people (and not with us).	20.6	-.23*	.01
<i>After the storm or floods...</i>			
15. My house was damaged or ruined.	30.8	-.01	-.09
16. I had to move out of my house.	20.6	-.09	-.06
17. I had to stay in a shelter.	5.6	.14	.14
18. I had to move more than once.	12.1	.01	-.01
19. Some or all of my things (like toys, clothes, books) were ruined.	23.4	-.09	-.15
20. My neighborhood was badly damaged.	29.9	.02	.04
21. My school was badly damaged.	15.9	.18	.26**
22. I had to go to a new school.	5.7	.19	.04
Total ($M = 3.49$, $SD = 3.25$)	--	.16	.16
<i>Pre-Existing Indicators of Risk</i>			
23. Before the storm or floods, I was in another disaster, like a different hurricane, flood, or tornado.	19.6	-.04	.05
24. Before the storm or floods, other bad or scary things happened to me (like a car accident, seeing someone get beat up, people in my neighborhood getting in bad fights).	31.8	.33**	.24*
25. Before the storm happened, someone I really cared about died.	38.3	.28**	.31**
26. Before the storm or floods, I felt so sad, worried, or angry that it caused me problems at school or at home.	12.1	.39**	.40**
Total ($M = 1.02$, $SD = 1.12$)	--	.36**	.38**
<i>Ongoing Adversities</i>			
27. My family is having a hard time getting the things we need (like food, clothes, a car, medicine).	12.1	.28**	.20*
28. I have trouble talking to my family or friends about my feelings.	40.2	.39**	.45**
29. I have been feeling upset a lot of the time.	36.4	.47**	.51**
Total ($M = 0.89$, $SD = 0.93$)	--	.57**	.57**

Note. $N = 98$ to 107 with pairwise deletion. HEART = Hurricane Exposure, Adversity, and Recovery Tool. RI-5 = UCLA PTSD Reaction Index for the DSM-5. SMFQ = Short Mood and Feeling Questionnaire.

* $p < .05$. ** $p < .01$.

Question 2: Which Disaster Exposure Items, Pre-Existing Indicators of Risk, and Ongoing Adversities Are Associated With Posttraumatic Stress and Depressive Symptoms During the Post-Acute Hurricane Recovery Period?

Youth reported an average posttraumatic stress symptom score of 23.17 ($SD = 15.91$); 24% ($n = 24$ of 100) of the youth with RI-5 scores had clinically elevated scores (≥ 35 ; Kaplow et al., 2019). Youth reported an average depressive symptom score of 6.36 ($SD = 4.94$); 30.8% ($n = 33$ of 107) scored in the clinically elevated range (≥ 8 ; Angold et al., 1995). Table 1 presents correlations among HEART items, HEART summary scores, and posttraumatic stress and depressive symptom scores. Although the total number of disaster-related experiences was not significantly correlated with posttraumatic stress or depressive symptoms (both r 's = $.16$), the total number of *During the Storm or Floods* items was significantly and positively correlated with posttraumatic stress ($r = .25$) and depressive symptoms ($r = .26$).

At the individual-item level, of 14 *during the storm or floods* items, 4 reached statistical significance ($p < .05$) in correlating with either posttraumatic stress or depressive symptoms. Item 4, which assessed perceived threat during the storm ("*I thought that my family and I might get badly hurt or die*"), correlated positively with posttraumatic stress ($r = .40$) and depressive symptoms ($r = .32$). Similarly, Item 8, *my pet got badly hurt or died*, correlated positively with posttraumatic stress ($r = .20$) and depressive symptoms ($r = .27$). Item 13, *my family was afraid to be rescued or ask for help because we thought we might get in trouble*, correlated positively with posttraumatic stress symptoms ($r = .34$), but not significantly with depressive symptoms. In contrast, Item 14, *someone in my family was out helping other people (and not with us)*, correlated *inversely* with posttraumatic stress symptoms ($r = -.23$), but not significantly with depressive symptoms.

The total number of *After the Storm or Floods* items did not significantly correlate with posttraumatic stress ($r = .04$) or depressive symptoms ($r = .01$). Of the eight of these items, one item correlated differentially with ($p < .05$) the symptom scores. Specifically, Item 21, *my school was badly damaged*, correlated positively with depressive ($r = .26$), but not posttraumatic stress, symptoms.

The total number of *Pre-Existing Indicators of Risk* correlated significantly with both posttraumatic stress ($r = .36$) and depressive symptoms ($r = .38$). Of these four items, three were significantly correlated with both posttraumatic stress and depressive symptoms: prior exposure to traumatic events ($r = .33$ and $.24$, respectively), bereavement ($r = .28$ and $.31$), and previous emotional problems ($r = .39$ and $.40$). Prior exposure to a natural disaster did not correlate significantly with posttraumatic stress ($r = -.04$) or depressive symptoms ($r = .05$).

The total number of *Ongoing Adversities* was significantly correlated with both posttraumatic stress ($r = .57$) and depressive symptoms ($r = .57$). At the item level, all three were also significantly correlated with current symptoms. Youth reports of family difficulty meeting basic needs correlated significantly with both posttraumatic stress ($r = .28$) and depressive symptoms ($r = .20$). Youth difficulty expressing their feelings toward family and friends correlated significantly with both posttraumatic stress ($r = .39$) and depressive symptoms ($r = .45$). Last, youths' emotional problems (i.e., currently feeling "upset") correlated significantly with both posttraumatic stress ($r = .47$) and depressive symptoms ($r = .51$).

Discussion

This study presents a preliminary examination of the Hurricane Exposure, Adversity, and Recovery Tool (HEART), a brief screening tool for use in post-hurricane situation analyses conducted with youth between the ages of 7 and 17. We first examined endorsement of hurricane-specific disaster exposure items among youth in the aftermath of Hurricane Harvey. The most commonly reported experiences for youth included observing caregivers in distress and perceived danger to self and family. This finding is consistent with prior research, in which perceived danger or threat is one of the most commonly endorsed experiences of hurricane-exposed youth (Vernberg et al., 1996). A substantial portion of youth also reported damage to their home or neighborhood, being trapped at home, and having to leave home very quickly. Much of the destruction caused by Harvey was due to flooding, with total rainfall records of three to four feet in the Houston metropolitan area (Blake & Zelinsky, 2018). High rates of reported displacement during the floods, and of resulting damages to property and infrastructure in its aftermath, thus serve as a validity check of the intended aim (situation analysis) of the screening tool by reflecting documented disaster-specific details of what happened to whom and how the crisis unfolded (Layne et al., 2009, 2010). In contrast, relatively few youth reported life-threatening experiences or actual physical harm—

results again consistent with previous findings (e.g., Hurricane Andrew; Vernberg et al., 1996).

We next examined which disaster exposure items, pre-existing indicators of risk, and ongoing adversities correlated with posttraumatic stress and depressive symptoms. Several individual disaster-related experiences correlated significantly with posttraumatic stress or depressive symptoms. One of the most commonly reported experiences (youths' perception that someone in their family might get hurt or die), was significantly associated with both posttraumatic stress and depressive symptoms and replicated prior findings with war-exposed youth (Layne et al., 2010). Although infrequently endorsed, having a pet get hurt or die also correlated with increased posttraumatic stress and depressive symptoms. Other commonly reported experiences (having to leave home very quickly, being trapped at home, having to move out of one's house, having one's house badly damaged) were not significantly associated with either posttraumatic stress or depressive symptoms. Taken together, these results indicate that perception of danger may be as potent, if not more potent, a predictor of persisting post-disaster distress than severity of actual disaster exposure (e.g., loss of housing, damage to possessions; Furr et al., 2010).

The item designed to assess fear of help-seeking ("*My family was afraid to be rescued or ask for help because we thought we might get in trouble*") was also positively associated with posttraumatic stress symptoms. Given that this item was endorsed infrequently, we interpret this result cautiously. Possible explanations for this finding include that participating immigrant families were afraid to seek help (a) given concerns about deportation, or (b) given their prior histories of trauma/posttraumatic stress, which may have been exacerbated by the storm (Cardoso, 2018). These families may also have lacked sufficient access to emergency disaster relief resources, resulting in prolonged exposure to privation or ongoing adversity.

In addition, having a family member out helping other people (e.g., emergency response workers) was associated with *fewer* posttraumatic stress symptoms ($r = -.23$). One possible explanation for this finding is that individual and community-level pride and gratitude toward family members who served as emergency response workers (or volunteered to help) served as a protective factor that buffered the harmful effects of hurricane-related hardships and distress. Alternatively, volunteering may have served as a marker of lower risk (i.e., being in less immediate danger enabled members to help others in need), which produced children with fewer reported posttraumatic stress symptoms.

Regarding pre-existing indicators of risk, prior exposure to traumatic stressors, bereavement, and emotional difficulties were all significantly associated with increased posttraumatic stress and depressive symptoms during the post-acute disaster recovery period. These results are consistent with previous literature indicating that pre-disaster factors such as loss and trauma increase risk for child PTSD and other negative outcomes in the aftermath of a disaster (Bonanno, Brewin, Kaniasty, & Greca, 2010) and also replicate prior findings with war-exposed youth (Layne et al., 2010). It is especially noteworthy that bereavement appears to be one of the most common forms of trauma among hurricane-exposed youth. For example, the most common potentially traumatic event reported in the aftermath of Hurricane Katrina was “death or serious injury of a loved one” prior to the hurricane, endorsed by 70% of the sample (Jaycox et al., 2010). Elevated prevalence rates of trauma and bereavement reported by underserved populations (who are often most affected by hurricane-related adversities) call for the systematic assessment of both trauma exposure and bereavement (in situation analysis) as well as common psychological consequences including PTSD and maladaptive grief (in needs assessment; Breslau, Peterson, Poisson, Schultz, & Lucia, 2004; Kaplow, Saunders, Angold, & Costello, 2010; Layne, Kaplow, Oosterhoff, Hill, & S. Pynoos, 2018). Only prior exposure to a natural disaster was not significantly associated with post-traumatic stress or depressive symptoms. This finding is consistent with the hypothesis that prior disaster exposures inoculate youth against posttraumatic stress responses after subsequent disaster disasters—a proposition that has received mixed empirical support (Masten & Narayan, 2012).

Regarding ongoing adversities: difficulty meeting basic needs, social support difficulties, and emotional difficulties were all positively and significantly correlated with posttraumatic stress and depressive symptoms. These three items straddle the line between situation analysis (which focuses on adverse life events and circumstances) and needs assessment (which focuses on the consequences of those exposures and associated needs for intervention; Layne et al., 2009). The role played by these factors is consistent with that of a *mediating secondary adversity*—that is, social and physical adversities set in motion by, or exacerbated by, the hurricane that assume a life of their own, and can prolong and worsen the course of recovery and complicate survivors’ clinical presentation and needs profiles (Layne et al., 2006). Our results indicate that a brief assessment of ongoing adversity may be sufficient in an initial screening

tool to indicate a need for a more in-depth mental health needs assessment.

Implications for Situation Analysis in the Aftermath of Hurricanes

The results of this study are consistent with the broader literature indicating that disaster-related exposure, pre-existing indicators of risk, and ongoing adversities are key temporal periods that are useful in screening for risk for serious persisting distress following hurricane-related disasters. Given that most children demonstrate expected short-term increases in psychological distress following natural disasters, we advocate that situation analysis (especially in the short-term aftermath of the disaster) focus primarily on exposure rather than the presence of mental disorders. These results provide support for post-hurricane risk screening/assessment models emphasizing hurricane exposure and pre-existing risk, while taking care not to inappropriately pathologize naturally occurring stress responses in the months after the disaster (Kaplow et al., 2018).

Results from this study support the proposition that pre-existing indicators of risk are significantly associated with child functioning in the post-acute disaster recovery period. Future studies can profitably evaluate whether other pre-existing vulnerabilities increase the clinical utility of the HEART for situation analysis and needs assessment following natural disasters and the predictive validity of the HEART in relation to indicators of severe persisting distress and functional impairment. Beyond the youth self-report version, evaluating the psychometric properties and clinical utility of the parent-report version carries promise for improving the standard of care for disaster-exposed younger children. Future studies can also focus on the incremental utility pre-, peri-, and post-disaster factors in stratifying different subgroups, given their exposure profiles, according to their levels and types of needs, and establishing multi-tiered systems of care that straddle community providers, schools, and mental health clinics (Saltzman, Layne, Steinberg, Arslanagic, & Pynoos, 2003).

Study Strengths and Limitations

This study examined the utility and criterion-referenced validity of a developmentally informed child self-report measure of hurricane-related risk. This study is unique in that it is the first, to our knowledge, to document the prevalence of hurricane-related risk factors among a diverse group of children exposed to Hurricane Harvey and their associations with posttraumatic stress and depression symptoms. The study was also conducted in a clinic that was actively providing direct therapeutic services

to disaster-exposed youth and families, which helped to bridge the science-to-service gap and focus attention on establishing continuity of care across risk screening, referral, clinical assessment, and therapeutic treatment stages of intervention.

Regarding study limitations, the use of a clinic-based sample limits the generalizability of the results to a more general, non-treatment seeking population of hurricane-exposed youth. Further, the small sample size limited power to evaluate the incremental contributions of item level disaster exposure, risk, and adversities. Additionally, data collection ranged from 3 to 17 months post-Harvey—a data collection window that was sensible given the clinic's mission and setting but may also have captured naturally occurring trends in the trajectories of distress-related variables over time beyond resilient recovery (e.g., protracted recovery; Layne et al., 2009). Trauma exposure subsequent to or unrelated to the hurricane may also have influenced current symptom reports. Finally, because the HEART was designed to be a brief, broadly applicable screening measure, item content differed from traditional norms of psychological test development in some respects (e.g., use of double-barreling to reduce the occurrence of low base rate items). This may have limited the clarity of those items, thereby reducing their utility for informing certain clinical decisions (e.g., using the item assessing harm to or death of a loved one to initiate referral to bereavement services).

Conclusion

In response to the increasing frequency and severity of hurricanes, we developed the Hurricane Exposure, Adversity, and Recovery Tool (HEART) – a brief measure for screening exposure to disaster-related experiences, pre-existing indicators of risk, and current functioning difficulties, for use in a wide range of settings. Development of the HEART followed best practices in test construction. Among youth affected by Hurricane Harvey, there was substantial endorsement of several hurricane-specific experiences, pre-existing risk factors, and ongoing problems in the 17 months after the hurricane. Of the disaster-specific experiences, perceived danger to self or family members during the storm was among the items with the highest endorsement rates and largest associations with posttraumatic stress and depressive symptoms. Nearly all items assessing pre-existing indicators of risk (e.g., prior trauma, loss, or emotional problems) and ongoing adversities (e.g., difficulty getting basic needs met, barriers to social support, and current emotional problems) had substantial endorsement rates and associations with current symptoms. These results provide preliminary support for use of the

HEART in identifying youth in need of further needs assessments and potential treatment after exposure to a hurricane.

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Appendix

Hurricane Exposure, Adversity, and Recovery Tool (HEART)

Child's Initials: _____ Date of Birth: _____ Age: _____	
Zip Code: _____ Gender: girl___ boy___ another gender_____	
Ethnicity: Hispanic/Latino (Yes / No)	
Race: American Indian/Alaska Native___ Asian___ White___	
Native Hawaiian or Other Pacific Islander___ Black/African American___	
More than one race___ Another race_____	
Name of School_____ Grade in school_____	
Today's Date (month/day/year): _____	
If child's sibling also completed the HEART, please include initials and DOB of sibling: Initials: _____ Date of Birth: _____	
The sentences below describe things that might have happened to you or your family <u>before, during, or after the storm or floods</u> . If the sentence is true about you, circle YES. If it is not true about you, circle NO.	
<i>Here is a list of things that might have happened to you or your family <u>during</u> the storm or floods.</i>	
1. During the storm or floods, I got hurt.	Yes No
2. During the storm or floods, someone in my family or a close friend got hurt.	Yes No
2a. If yes, who got hurt? _____	Yes No
3. During the storm or floods, someone in my family or a close friend died.	Yes No
3a. If yes, who died? _____	
4. During the storm or floods, I thought that my family and I might get badly hurt or die.	Yes No
5. During the storm or floods, I saw someone who was badly hurt.	Yes No
6. During the storm or floods, I saw one (or both) of my caregivers looking very upset, scared, or sad.	Yes No
7. During the storm or floods, I got separated from one (or both) of my caregivers.	Yes No
7a. If yes, are you still living apart from each other?	Yes No
8. During the storm or floods, my pet got badly hurt or died.	Yes No
9. During the storm or floods, we had to leave my pet behind.	Yes No
10. During the storm or floods, I had to leave my house very quickly.	Yes No
11. During the storm or floods, I was trapped in my house.	Yes No
12. During the storm or floods, someone rescued me or my family (like by boat or helicopter).	Yes No
13. During the storm or floods, my family was afraid to be rescued or ask	Yes No

for help because we thought we might get in trouble.	
14. During the storm or floods, someone in my family was out helping other people (and not with us).	Yes No
14a. If yes, who went to help? _____	
<i>Next are some things that might have happened to you or your family after the storm or floods.</i>	
15. After the storm or floods, my house was damaged or ruined.	Yes No
16. After the storm or floods, I had to move out of my house.	Yes No
16a. If yes, are you still living somewhere else? _____	
17. After the storm or floods, I had to stay in a shelter.	Yes No
17a. If yes, how long did you stay in the shelter (in days)? _____	
18. After the storm or floods, I had to move more than once.	Yes No
18a. If yes, how many times did you move? _____	
19. After the storm or floods, some or all of my things (like toys, clothes, books) were ruined.	Yes No
20. After the storm or floods, my neighborhood was badly damaged.	Yes No
21. After the storm or floods, my school was badly damaged.	Yes No
22. After the storm or floods, I had to go to a new school.	Yes No
<i>Next are some things that might have happened to you or your family before the storm or floods.</i>	
23. Before the storm or floods, I was in another disaster, like a different hurricane, flood, or tornado.	Yes No
24. Before the storm or floods, other bad or scary things happened to me (like a car accident, seeing someone get beat up, people in my neighborhood getting in bad fights).	Yes No
25. Before the storm happened, someone I really cared about died.	Yes No
25a. If yes, who was that person? _____	
26. Before the storm or floods, I felt so sad, worried, or angry that it caused me problems at school or at home.	Yes No
<i>Finally, here are some things that might be happening to you or your family right now.</i>	
27. My family is having a hard time getting the things we need (like food, clothes, a car, medicine).	Yes No
28. I have trouble talking to my family or friends about my feelings.	Yes No
29. I have been feeling upset a lot of the time.	Yes No
29a. If yes, would you like to talk to someone about it, like a counselor or therapist? _____	

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