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Serious Emotion Disturbance among Youth Exposed to Hurricane Katrina Two Years Post-Disaster

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Abstract

Objective—To estimate the prevalence of serious emotional disturbance (SED) among children and adolescents exposed to Hurricane Katrina along with the associations of SED with hurricane-related stressors, socio-demographics, and family factors 18–27 months following the hurricane.

Method—A probability sample of pre-hurricane residents of areas affected by Hurricane Katrina was administered a telephone survey. Respondents provided information on up to two of their children (n=797) aged 4–17. The survey assessed hurricane-related stressors and lifetime history of psychopathology in respondents, screened for 12-month SED in respondents' children using the Strengths and Difficulties Questionnaire (SDQ), and determined whether children's emotional and behavioral problems were attributable to Hurricane Katrina.

Results—The estimated prevalence of SED was 14.9%, and 9.3% of youth were estimated to have SED that is directly attributable to Hurricane Katrina. Stress exposure was associated strongly with SED, and 20.3% of youth with high stress exposure had hurricane-attributable SED. Death of a loved one had the strongest association with SED among pre-hurricane residents of New Orleans, whereas exposure to physical adversity had the strongest association in the remainder of the sample. Among children with stress exposure, parental psychopathology and poverty were associated with SED.

Conclusions—The prevalence of SED among youth exposed to Hurricane Katrina remains high 18–27 months after the storm, suggesting a substantial need for mental health treatment resources in the hurricane-affected areas. Youth who were exposed to hurricane-related stressors, have a family history of psychopathology, and have lower family incomes are at greatest risk for long-term psychiatric impairment.

Keywords

Hurricane Katrina; SED; natural disaster; child mental health

Hurricane Katrina was the most devastating natural disaster in the United States in the past half-century. The effects of the hurricane on New Orleans and affected Gulf Coast areas were unprecedented. The hurricane killed more than 1000 people, displaced more than 500,000, and cost over \$100 billion.¹ Individuals in hurricane-affected areas were exposed to a wide range of stressors including serious risk of death, property loss, difficulty obtaining food and clothing, and exposure to violence after the storm.² Elevated stress exposure persisted for many individuals due to forced relocation, difficulty obtaining housing, and prolonged community disruption.

In the first three to six months following a hurricane, more than 50% of children exposed to the disaster exhibit symptoms of posttraumatic stress disorder (PTSD), disruptive behaviors, or other manifestations of psychological distress.^{3–5} The prevalence of psychiatric disorders is lower, but still elevated. Following Hurricanes Andrew and Hugo, the prevalence of PTSD among youth living in hurricane areas, and who therefore experienced some exposure to hurricane-related stressors, was estimated at 3–9%.^{6, 7} Prior research has identified exposure to disaster-related stressors as an important predictor of psychiatric symptoms among youth following natural disasters.^{5, 8, 9} Given the scope of Hurricane Katrina and the magnitude of stress exposure, one would expect the prevalence of mental health problems among youth in affected areas to be high. Indeed, in a survey conducted 6 months following the hurricane approximately 50% of parents in hurricane-affected areas reported emotional or behavioral problems in their children that were not present before the disaster.¹⁰

For many children symptom elevations following natural disasters are relatively short-lived, with substantial decreases occurring during the first year post-disaster.⁴ Nearly 30% of children exposed to Hurricane Andrew reported severe symptoms of PTSD, defined as 10 or more symptoms, 3 months following the storm.⁹ At 7-months post-hurricane the prevalence of such symptoms had dropped to 18%, and at 10-months post-hurricane 13% of children still reported severe symptoms.⁹ Identification of factors that distinguish children who experience chronic symptoms from those whose distress is more transient represents an

important goal given its implications for targeting post-disaster interventions. Prior research following other natural disasters has identified female gender, younger age, non-White race/ethnicity, parent psychopathology, and degree of stress exposure as predictors of long-term symptom elevation in youth.^{7, 9, 11–13}

To date, there have been few published reports examining the long-term effects of Hurricane Katrina on child mental health. Elevations in PTSD symptoms and aggressive behavior in the year following the storm have been reported,^{14, 15} but epidemiologic data regarding the prevalence and severity of psychiatric symptoms among children at longer intervals post-hurricane are lacking. The extent to which risk factors identified in prior disasters are associated with long-term symptoms also remains to be determined.

We use data from the Hurricane Katrina Community Advisory Group (CAG), a representative sample of pre-hurricane residents of the areas in Louisiana, Mississippi, and Alabama designated by the Federal Emergency Management Administration (FEMA) as the official disaster area, who participated in a series of surveys to provide estimates of serious emotional disturbance (SED) among children exposed to Hurricane Katrina 18–27 months following the storm. SED is a term that refers to children and adolescents who have a diagnosable mental disorder that results in significant impairment or decreased role functioning in family, school, or community activities.¹⁶ We were interested in examining the prevalence of youth mental health problems sufficiently severe to warrant public health attention because of the large magnitude of the likely problem and the lack of treatment resources in the hurricane area. We examine the distribution of exposure to a wide range of hurricane-related stressors and evaluate whether such exposure is associated with SED. Socio-demographic and family factors also are examined as predictors of SED.

Methods

Sample

We recruited English-speaking adults (≥ 18 years of age) for the baseline survey either by random-digit-dial telephone calls of households in the FEMA-defined disaster area or from a random selection of families applying for assistance from the American Red Cross's database. The baseline CAG was carried out in three waves. The first wave was collected between January and March, 2006, 5–7 months after the hurricane. 1043 respondents completed the interview, representing an estimated 41.9% of eligible households screened. The second wave was carried out 7–10 months after the hurricane (between April and June, 2006). 724 subjects completed the interview representing an estimated 33.1% of eligible households screened. The third wave of data collection occurred between December, 2006 and April, 2007 (15–19 months post-hurricane) and the 1322 completed interviews represented an estimated 32.3% of eligible households screened. The three waves together resulted in 3089 completed baseline CAG interviews with an estimated response rate of 35.2%. This low cooperation rate is due in part to our requirement that respondents make a long-term commitment to involvement in the CAG in order to participate in the baseline survey, as the goal of the CAG was to track the progress of recovery over time.

A non-response survey found that individuals who did not participate in the baseline CAG were similar to participants on socio-demographic variables, but had a somewhat higher level of hurricane-related stress exposure (assessed by asking respondents to rate their hurricane-related stress exposure on a 0–10 scale where 0 meant ‘no stress at all’ and 10 meant ‘the most stress you can imagine a person having’) and more psychological distress (assessed with a short series of questions about frequency of common anxiety-mood symptoms, scored on a 0–10 scale). The median and inter-quartile range (IQR) of hurricane-related stress exposure were 8.0 (6.0–10.0) among non-respondents and 7.0 (5.0–9.0) among the first wave of baseline CAG members, and of psychological distress were 2.9 (1.2–4.4) among non-respondents and 1.7 (0.6–3.5) among CAG members. A weight was applied to the baseline CAG data to adjust for these response biases. A within-household probability of selection weight and a post-stratification weight were used to adjust for residual discrepancies between the CAG and the 2000 Census population on a range of socio-demographic and pre-hurricane housing variables. The consolidated CAG sample weight was trimmed to increase design efficiency.¹⁷

Detailed personal contact information and tracing information was obtained for all baseline CAG respondents. This information was used to find baseline respondents for a 12-month follow-up interview (18–22 months post-hurricane). Of the 1043 wave 1 respondents, 815 were successfully traced (including 13 deceased) and interviewed (78.7% of the baseline sample) between March and June, 2007. Minor differences in the composition of the follow-up sample compared to the baseline sample in socio-demographic characteristics, traumatic stress exposure, and mental health were adjusted for by using a propensity score adjustment weight¹⁸ applied to the consolidated baseline weight. A probability sub-sample of respondents from the second and third waves of baseline interviews was selected for the second interview to be carried out approximately 24 months after the hurricane. These interviews were completed from August until November, 2007 (24–27 months post-hurricane). All 2nd and 3rd wave CAG members with PTSD or moderate to serious psychological distress at baseline¹⁹ were selected for follow-up along with a probability sub-sample of the remaining respondents, resulting in 1195 baseline respondents traced (including 16 deceased) for follow-up. Of these, 902 interviews were completed for a conditional response rate of 76.5%. This 24-month follow-up was weighted to adjust for over-sampling of respondents with psychological distress and differences between the baseline and follow-up samples. The final adjustment weight was applied to the consolidated baseline weight.

Both the 12- and 24-month follow-up surveys, but not the baseline surveys, included interviews with the parent or legal guardian of up to two children aged 4–17 living with the respondent at the time of the interview. We completed interviews on 254 of the 278 eligible children in households with only one child, or 91.4%. In the 202 households with exactly 2 children we completed 378 of 404 interviews (93.6%), and in the 99 households with 3 or more children we completed 165 out of 198 interviews attempted (83.3%), for a total of 797 child interviews out of 880 children screened for a 90.6% cooperation rate. A child weight was assigned by adjusting the household re-interview weight for the probability of selection of male and female children in the household and by including a post-stratification

adjustment by sex and age. Institutional Review Board approval from Harvard Medical School and informed consent were obtained.

Measures

SED

An abbreviated 6-item version of the Strength and Difficulties Questionnaire (SDQ)²⁰ was used to screen for SED in the 12 months prior to the interview in children of respondents. The brief SDQ includes 5 items that assess conduct problems, hyperactivity-inattention, emotional symptoms, and peer problems. These domains are combined to generate a total difficulties score, which ranges from 0–10. An additional item assessing impairment asks respondents to rate the degree of youth’s difficulties with emotions, concentration, behavior, or ability to get along with people, with scores ranging from 0–3. Respondents were asked to rate how much they believed their child’s difficulties were caused by the hurricane on a 0–3 scale.

In a previous validation study, the 6-item SDQ was found to have good psychometric properties in predicting SED based on comprehensive diagnostic interviews.²¹ In this study, a sample of 178 adolescent participants in the National Comorbidity Survey-Adolescent Supplement (NCS-A)²² were administered the 12-month version of the Schedule for Affective Disorders and Schizophrenia for School-aged Children (K-SADS)²³ and the Child Global Assessment of Functioning (C-GAF) scale.²⁴ The 6-item SDQ was completed by each respondent’s parent or guardian. Respondents who received a C-GAF score of 50 or less and who were diagnosed with a DSM-IV/K-SADS Axis I mental disorder (not including substance disorders) were classified as having SED. A number of methods for scoring the brief SDQ were examined to investigate the strength of associations of the brief SDQ with K-SADS diagnoses and C-GAF scores. The scoring method that resulted in the greatest concordance with the K-SADS utilized only the five symptom-focused items. Using a cut-off of 6 or more, the brief SDQ had an area under the receiver operating curve (AUC) of 0.85 in predicting SED based on the K-SADS and C-GAF in this study (detailed results available upon request). The SDQ has been found to have adequate psychometric properties in differentiating children with and without a psychiatric disorder in a number of other validation studies.^{20, 25}

Respondents whose children were classified as having SED and who indicated that their child’s difficulties were caused by the hurricane either “some” or “a lot” were classified as having SED attributable to Hurricane Katrina (H-SED). The remaining SED cases were classified as unrelated to the hurricane (NH-SED).

Hurricane-related stressors

Respondents were asked 30 questions regarding exposure to hurricane-related stressors, including an open-ended question regarding the most serious practical problems they experienced as a result of Hurricane Katrina, during the initial wave of data collection. Ten categories of stressors were sufficiently common to be included in analysis: experiences that involved serious risk of death, death of a family member or close friend, victimization due to lawlessness after the storm (e.g., robbery and physical assault), victimization of a loved one,

physical illness or injury caused or exacerbated by the storm, extreme physical adversity (e.g., sleeping in a church basement, difficulty obtaining food or clothing), extreme psychological adversity (e.g., living in circumstances in which the respondent had to use the toilet or change clothes without adequate privacy), major property loss, income loss, and ongoing difficulties associated with housing (e.g., experiencing multiple moves or living in substantially worse post-hurricane than pre-hurricane housing).² We examined the associations between SDQ approximations of SED and each of these stress domains.

Socio-demographic and family factors

We examined the associations between SED and age, sex, race/ethnicity, family income in the year before the hurricane, and health insurance status at the time of interview. Age was examined as a continuous measure. Race/ethnicity was coded as non-Hispanic White versus non-White. Family income was coded in tertiles where low/low-average was defined as less than or equal to 0.5–1.0 of the population median on the ratio of pre-tax income to number of family members; high-average was defined as 1.0–3; and high was defined as 3+ on this ratio. Health insurance status was coded as insured versus uninsured.

We also examined the associations between SED and current living status, defined as living in the same pre-hurricane area or living in a different area, and parent psychopathology. Respondents completed screening scales assessing their lifetime history of mood, anxiety, and substance disorders as well as intermittent explosive disorder.¹⁹ Parent psychopathology was coded as present if respondents endorsed a lifetime history of one or more disorders versus absent if respondents reported no disorders.

Data Analysis

The prevalence of SED (both H-SED and NH-SED) was examined in a cross-tabulation that distinguished pre-hurricane residents of the New Orleans metro area (New Orleans) from the remainder of the sample. The independent and joint effects of socio-demographic factors and hurricane-related stressors in predicting SED were examined in logistic regression analysis. Logistic regression coefficients and their standard errors were exponentiated to create odds ratios (ORs) and 95% confidence intervals (95% CIs). The Taylor series linearization method was used to calculate design-based significance tests because the data were weighted. Statistical significance was evaluated using 2-sided .05-level tests.

Results

The estimated prevalence of SED

The estimated prevalence of SED based on the SDQ in the total sample was 14.9% and did not differ among pre-hurricane residents of New Orleans (12.2%) and the remainder of the sample (16.3%; $\chi^2_1 = 2.4$, $p = .12$). (Table 1) The estimated prevalence of NH-SED (5.5%) is similar to the SED prevalence reported in the 2006 National Health Interview Survey (4.2%),²⁶ and is considerably lower than the prevalence of H-SED (9.3%). The estimated prevalence of both H-SED and NH-SED was similar among pre-hurricane residents of New Orleans and the remainder of the sample. Approximately two-thirds of cases that screened

positive for SED were H-SED, and this ratio did not meaningfully differ among residents of New Orleans (0.68) and the remainder of the sample (0.63).

Associations of socio-demographic and family factors with SED

Estimated prevalence of H-SED was associated with low family income in New Orleans (OR=5.8, $\chi^2_2=8.2$, $p=.016$) but not in the remainder of the sample. Family income was unrelated to the estimated prevalence of NH-SED. (Appendix Table 1) The estimated prevalence of NH-SED was higher among White respondents than non-White respondents in New Orleans (OR=0.2, $\chi^2_1=4.0$, $p=.046$), but NH-SED was more common among non-White respondents in the remainder of the sample (OR=3.1, $\chi^2_1=5.5$, $p=.02$). The estimated prevalence of H-SED was unrelated to race/ethnicity. Age, sex, health insurance status, and current living situation were unrelated to the estimated prevalence of H-SED and NH-SED both in New Orleans and the remainder of the sample. In New Orleans, parent psychopathology was associated with H-SED (OR = 3.1, $\chi^2_1=7.9$, $p=.005$) and NH-SED (OR=13.6, $\chi^2_1=6.3$, $p=.012$). In the remainder of the sample, parent psychopathology was related only to H-SED (OR=2.6, $\chi^2_1=5.0$, $p=.026$).

Associations of hurricane-related stressors with SED

More than 80% of youth in the CAG sample were exposed to at least one hurricane-related stressor. (Table 2) Property loss was the most common stressor in both New Orleans (60.4%) and the remainder of the sample (48.1%). Housing adversity and physical adversity were experienced by more than 30% of youth in both samples. Hurricane-related stressors were highly co-occurring, with more than one-third of respondents in New Orleans (44.6%) and the remainder of the sample (34.6%) experiencing three or more stressors. Exposure to property loss, housing adversity, and death of a loved one was more common in New Orleans than in the remainder of the sample.

We examined the associations between the 10 domains of hurricane-related stressors and the estimated prevalence of SED. Hurricane-related stressors had consistently stronger associations with H-SED than NH-SED. In the total sample, 7 of the stressors were positively and significantly associated with estimated H-SED (70.0%, ORs range from 2.3–50.7), whereas only 2 stressors were positively and significantly associated with NH-SED (20.0%, ORs range from 2.2–2.6). (Appendix Table 1) The overall pattern of associations did not differ meaningfully in New Orleans and the remainder of the sample, but the types of stressors that had the strongest associations with SED differed. In New Orleans, 3 specific hurricane-related stressors (death or victimization of a loved one and physical adversity) were positively and significantly associated with estimated H-SED (30.0%, ORs range from 2.3–3.1). In the remainder of the sample, 5 stressors (death or victimization of a loved one, property loss, physical and psychological adversity) were positively and significantly associated with estimated H-SED (50.0%, ORs range from 2.5–6.0). None of the stressors were positively associated with NH-SED in either sample.

We next examined the association between number of hurricane-related stressors and SED in a logistic regression model that included dummy variables for exposure to exactly two, three, four, and five stressors. This model was estimated in the total sample due to the small

number of youth who were exposed to 0 stressors. The model for H-SED shows generally increasing ORs with number of stressors, from 14.5 for exactly one stressor (compared to youth with no stressors) to 37.3–99.7 for 4 and 5 stressors. (Table 3) Number of stressors was not associated with NH-SED.

We estimated a series of multivariate logistic regression models predicting H-SED using socio-demographic factors, type and number of hurricane-related stressors. The best-fitting model included dummy variables representing exactly two, three, four, and five or more hurricane-related stressors (detailed results available upon request). After controlling for the number of stressors to which youth were exposed, death of a loved one was significantly associated with H-SED in New Orleans (OR=3.9), whereas physical adversity was significant in the remainder of the sample (OR=3.8).

We created a stress exposure index based on this model. In New Orleans, death of a loved one plus at least one other stressor was coded high exposure, death of a loved one only or at least one hurricane-related stressor without death of a loved one was coded moderate exposure, and no stressors was considered low exposure. In the remainder of the sample, the coding for high, moderate, and low was identical with the exception that physical adversity, instead of death of a loved one, was required for high exposure.

In both New Orleans and the remainder of the sample, approximately 20% of youth with high stress exposure were estimated to have H-SED. The estimated prevalence of H-SED was virtually zero among respondents with low stress exposure. (Table 4)

Joint associations of socio-demographics with hurricane-related stressors

Because virtually all estimated cases of H-SED occurred in youth with exposure to hurricane-related stressors, we examined the effects of socio-demographic and family factors on estimated SED among youth with exposure to at least one stressor. A dummy variable representing high stress exposure was included in this model to account for differential stress exposure. In New Orleans, family income and current living situation were associated with estimated H-SED. (Table 5) Youth in the lowest income tertile were more likely to have H-SED than those in the highest income tertile (OR=6.0, $\chi^2_1=4.7$, $p=.03$), and youth living in the same pre-hurricane town were more likely to have H-SED than those who relocated after the hurricane (OR=3.7, $p=.017$). Parent psychopathology was associated with H-SED in New Orleans (OR=3.1, $p=.006$). None of these factors were associated with estimated H-SED in the remainder of the sample.

Discussion

The estimated prevalence of SED among children and adolescents exposed to Hurricane Katrina 18–27 months following the storm is approximately 15%. Nearly 10% of youth continue to experience emotional and behavioral problems that cause significant impairment in role functioning and are deemed by their parents to be directly attributable to the hurricane. This stands in contrast to the 4–9% prevalence of SED reported in epidemiologic studies.^{26–28} The prevalence of SED has not typically been reported following natural disasters; however, the prevalence of youth PTSD was estimated at 3%–9% 6-months

following Hurricane Andrew⁶ and at 5% following Hurricane Hugo.⁷ The estimated prevalence of SED in the CAG sample is considerably higher, but these estimates are difficult to compare because SED includes emotional and behavioral problems other than PTSD, including depression and aggressive behavior.^{14, 15, 29} Nonetheless, the high prevalence of SED among youth exposed to Hurricane Katrina suggests that the long-term impact of the hurricane on child mental health was at least equivalent, and most likely greater, than previous hurricanes and natural disasters.^{6, 7, 9} Moreover, we find that socio-demographic factors typically associated with psychopathological reactions to other natural disasters, such as age and gender,^{6, 7, 12} are largely unrelated to SED in children exposed to Hurricane Katrina. Why this is the case remains unclear, but it is likely that the magnitude and length of disruption associated with the hurricane increased risk for mental health problems in youth across many segments of society.

More than 80% of children in the sample were exposed to at least one hurricane-related stressor, and stress exposure is associated strongly with SED; nearly 20% of youth with high stress exposure are estimated to have H-SED. These findings are not surprising, as exposure to disaster-related stressors has been associated with child psychopathology in previous research.^{5, 9, 14} We also examined exposure to the various component traumas associated with Katrina, a topic that is seldom considered in studies of natural disasters, and find complex associations between hurricane-related stressors and the prevalence of SED. Death of a loved one is most strongly associated with H-SED in New Orleans, whereas physical adversity, such as sleeping in a church basement or having difficulty obtaining food, is most strongly associated with H-SED in the remainder of the sample. It is unclear why different events were associated with SED in New Orleans and the remainder of the sample. Because physical adversity was more common among residents of New Orleans,² it is possible that exposure to these events in the remainder of the sample occurred among families with the most serious property damage or loss, and as such, represent a marker of longer-term disruptions in the lives of these families. Hurricane Katrina was a complex disaster involving many different component stressors, and our analysis of the individual and joint effects of these stressors suggests that different aspects of hurricane exposure were associated with child psychopathology in different disaster areas. Identifying the psychological and social mechanisms that underlie this complex set of associations between hurricane-related stressors and SED is an important goal for future research.

Parent psychopathology was associated with H-SED in both samples and among New Orleans respondents with at least some exposure to hurricane-related stressors. Parent psychopathology has been associated with child psychopathology following other natural disasters,^{12, 15, 30} and may predispose youth to the development of psychiatric symptoms following disasters through pathways involving psychological predispositions, such as trait anxiety and neuroticism.²⁹ Post-disaster, parental symptomatology may increase risk for youth psychopathology through pathways involving ineffective parenting.³¹

Among New Orleans residents with exposure to hurricane-related stressors, social class is negatively associated with H-SED. Although SED is approximately twice as common among children living in poverty,²⁸ certain characteristics of Hurricane Katrina may also explain this association. Because hurricane damage was greatest in areas of the city with

high levels of poverty,¹⁰ exposure to hurricane-related stressors was likely higher among individuals with fewer economic resources. Families with fewer resources may have been unable to relocate after the hurricane, resulting in ongoing exposure to community stressors and difficulty obtaining post-hurricane food, shelter, and employment. Consistent with this interpretation, youth who remained in their pre-hurricane communities experienced higher rates of SED than those who relocated. This result contrasts with previous findings documenting equivalent mental health outcomes among children who continued to live in their pre-disaster communities relative to those who moved post-disaster.³² The magnitude and duration of community disruption following Hurricane Katrina were substantial, and resource depletion following the storm may have directly affected children's ability to recover from the disaster.³³ Extensive property damage and poor access to basic necessities following the storm led to high levels of post-hurricane migration, resulting in the dissolution of social support networks. This breakdown of the social fabric post-hurricane likely impacted child mental health, as poor social support is associated with psychiatric symptoms in youth exposed to the hurricane.³⁴

Our results demonstrate that mental health problems among youth exposed to Hurricane Katrina are common and widespread. The construct of SED was created as a severity threshold for judging need for mental health treatment. Our findings thus suggest a substantial need for treatment resources among hurricane-exposed children that is not concentrated in only one high-risk segment of the population. Marked declines in the availability of mental health treatment resources occurred following Hurricane Katrina,^{35, 36} which has contributed to low rates of treatment-seeking among those who developed mental health problems after the storm.³⁷ Increasing the availability of child mental health services in hurricane-affected areas thus remains a goal of critical public health importance. A recent cost analysis suggests that providing post-hurricane screening and mental health treatment to the Gulf Coast would have reduced storm-attributable mental health problems by 35% at a cost that is within the range of widely-used medical interventions.³⁸ Such work provides an important template for guiding the public health response to future disasters.

A number of limitations of the current study must be acknowledged. First, SED was estimated using a screening scale rather than a diagnostic interview. The SDQ has been previously validated and used in national epidemiologic surveys,³⁹ and in a clinical reappraisal study, the SDQ demonstrated good psychometric properties in estimating SED based on clinical diagnostic interviews.²¹ Nevertheless, screening scales are less precise than clinical interviews, leaving open the possibility that respondents were misclassified. Because misclassification was likely non-differential, any imprecision would have resulted in attenuation of the associations between risk factors and SED, making the reported associations conservative estimates of the true associations. Moreover, the SDQ did not include specific questions about PTSD symptoms, increasing the likelihood that our estimates of SED prevalence are conservative. Because we were unable to differentiate children with PTSD from those with SED related to other types of symptoms,^{14, 40} our results provide little guidance regarding the types of treatment that may be most beneficial to hurricane-exposed children. Second, parent's determinations of whether their child's emotional and behavioral problems were attributable to the hurricane were subjective and susceptible to bias. Parents who experienced mental health problems following the hurricane

may have been more likely to report that their children's problems were caused by the hurricane, leading to an overestimation of the association between parental psychopathology and H-SED. However, the estimated prevalence of NH-SED is similar to the prevalence of SED reported the previous year in the NHIS,²⁶ and we find no association between hurricane-related stressors and NH-SED, suggesting that parents' determinations of whether their child's problems resulted from the storm are likely valid. Third, the response rate to the CAG survey was low, and the sampling frame excluded individuals who were unreachable by telephone, which likely resulted in under-representation of individuals with high levels of stress exposure and, potentially, high rates of mental illness. These sample limitations likely resulted in conservative estimates of the prevalence of SED. Fourth, assessment of hurricane-related stressors was retrospective and subject to recall bias. However, evidence from both retrospective and prospective studies suggests that reports of acute traumatic events are reliable and largely free of recall bias.^{41, 42} Finally, it is possible that unmeasured confounders associated with both stress exposure and post-hurricane psychopathology are responsible for the reported associations. For example, individuals living in communities with low levels of social cohesion likely experienced greater risk of both violence exposure following the storm and of mental disorders due to community disintegration and poor social support.^{34, 43} Caution is therefore warranted in interpreting the associations between stressors and SED as causal.

A considerable proportion of children exposed to Hurricane Katrina continue to experience mental health problems that cause significant functional impairment 18–27 months following the storm. SED is prevalent among youth who experienced high levels of stress exposure during the storm. Parental psychopathology and low family income are associated with SED, but we find no other socio-demographic differences in SED prevalence. These findings suggest substantial need for youth mental health services in New Orleans and other affected Gulf Coast areas.

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Table 1

Estimated prevalence of 12-month SED among children and adolescents exposed to Hurricane Katrina^a (weighted N=797)

	New Orleans Metro		Remainder of Hurricane Area		Total	
	(n)	% (se)	(n)	% (se)	(n)	% (se)
H-SED	39	8.5 (1.4)	36	9.8 (1.6)	75	9.3 (1.2)
NH-SED	18	3.7 (0.9)	21	6.5 (1.4)	39	5.5 (1.0)
SED-Total	57	12.2 (1.6)	57	16.3 (2.1)	114	14.9 (1.5)
No SED	387	87.8 (1.6)	296	83.7 (2.1)	683	85.1 (1.5)
Total		444		353		797

Abbreviations: Metro, metropolitan area; SED, serious emotional disturbance; H-SED, hurricane-attributable SED; NH-SED, SED unrelated to hurricane

^a Estimates of SED were based on the SDQ. See the "Methods" section for details.

Table 2

Distribution of exposure to hurricane-related stressors (weighted N=797)

	New Orleans Metro		Remainder of Hurricane Area		Total	
	%	(se)	%	(se)	%	(se)
Property Loss*	60.4	(2.4)	48.1	(2.8)	52.4	(2.0)
Physical Adversity	36.1	(2.4)	41.3	(2.7)	39.5	(2.0)
Housing Adversity*	46.6	(2.5)	31.2	(2.5)	36.5	(1.9)
Psychological Adversity	24.3	(2.2)	23.9	(2.4)	24.1	(1.7)
Income Loss	21.5	(2.0)	19.7	(2.2)	20.3	(1.6)
Loved One Victimized	17.7	(1.9)	13.8	(1.9)	15.2	(1.4)
Death of a Loved One*	18.3	(2.0)	12.6	(2.0)	14.6	(1.5)
Physical Illness or Injury	11.0	(1.6)	14.0	(1.9)	13.0	(1.4)
Victimization	10.5	(1.6)	7.9	(1.6)	8.8	(1.2)
Life-Threatening Experience	4.2	(1.1)	2.0	(0.8)	2.8	(0.6)
Number of Stressors						
1-2	42.2	(2.4)	46.3	(2.8)	44.9	(2.0)
3-4	29.1	(2.2)	23.0	(2.3)	25.1	(1.7)
5+	15.5	(1.9)	11.6	(1.7)	13.0	(1.3)
Any*	86.8	(1.6)	80.9	(2.2)	83.0	(1.6)

Abbreviations: Metro, metropolitan area

* Significant difference at the .05 level, 2-sided test in the prevalence of exposure between pre-hurricane respondents of the New Orleans metro and the remainder of the hurricane area

Table 3Associations between number of hurricane-related stressors and 12-month H-SED and NH-SED^{a,b}

	H-SED			NH-SED		
	OR	(95% CI)	χ^2_1 (p-value)	OR	(95% CI)	χ^2_1 (p-value)
0 Stressors	1.0	--		1.0	--	
1 Stressor	14.5*	(1.7–122.7)	6.1 (.014)	1.2	(0.3–4.4)	0.1 (.820)
2 Stressors	51.9*	(6.7–404.3)	14.3 (<.001)	1.9	(0.4–8.6)	0.7 (.390)
3 Stressors	51.3*	(6.4–413.1)	13.7 (<.001)	1.9	(0.5–6.9)	0.9 (.350)
4 Stressors	37.3*	(4.4–317.9)	11.0 (<.001)	3.2	(0.8–12.8)	2.6 (.110)
5 Stressors	99.7*	(12.6–787.5)	19.1 (<.001)	3.0	(0.8–12.2)	2.4 (.120)

Abbreviations: H-SED, hurricane-attributable SED; NH-SED, SED unrelated to hurricane

^a Estimates of SED were based on the SDQ. See the “Methods” section for details.^b Respondents in New Orleans metro and other areas were combined due to the small sample size associated with exposure to 0 stressors; model controls for pre-hurricane location.

* Significant at the .05 level, two-sided test.

Table 4

Weighted distribution and conditional probabilities of 12-month SED as a function of stress exposure^a

Group ^b	New Orleans Metro (n=444)			Remainder of Hurricane Area (n=353)		
	Total % (se)	H-SED % (se)	NH-SED % (se)	Total % (se)	H-SED % (se)	NH-SED % (se)
High	15.7 (1.8)	20.7 (5.2)	3.5 (2.0)	34.7 (2.6)	20.3 (3.7)	8.0 (2.5)
Moderate	71.1 (2.2)	7.2 (1.5)	3.5 (1.0)	46.2 (2.8)	5.9 (1.9)	6.7 (2.3)
Low	13.2 (1.6)	1.2 (1.2)	4.8 (2.7)	19.1 (2.2)	0.0 --	3.4 (2.5)

Abbreviations: Metro, metropolitan area; SED, serious emotional disturbance; H-SED, hurricane-attributable SED; NH-SED, SED unrelated to hurricane

^a Estimates of SED were based on the SDQ. See the "Methods" section for details.

^b New Orleans metro: High=death of a loved one and at least one other stressor; Moderate=no death of a loved one and at least one other stressor OR only death of a loved one; Low=no stressors; Remainder of Hurricane Area: High=Physical adversity and at least one other stressor; Moderate=no physical adversity and at least one other stressor OR only physical adversity; Low=no stressors

Table 5Predictors of 12-month H-SED among respondents with exposure to hurricane-related stressors^{a,b}

Effect	New Orleans Metro (n=367)		Other Areas (n=271)	
	OR	(95% CI)	OR	(95% CI)
Income				
Low/Low-Middle	6.0*	(1.2–30.7)		
Middle-High	3.4	(0.6–19.3)		
High	1.0	--		
χ^2_2 (p-value)	6.0	(.051)		
Current Living				
Same town	3.7*	(1.3–10.9)		
Different town	1.0	--		
χ^2_1 (p-value)	5.7*	(.017)		
Group (Stress)^b				
High	3.5*	(1.6–7.7)	4.0*	(1.7–9.1)
Intermediate	1.0	--	1.0	--
χ^2_1 (p-value)	9.4*	(.002)	10.8*	(.001)
Adult Pathology^c				
1+ Lifetime Diagnoses	3.1*	(1.4–6.8)	2.0	(0.8–4.7)
0 Lifetime Diagnoses	1.0	--	1.0	--
χ^2_1 (p-value)	7.6*	(.006)	2.4	(.120)

Abbreviations: Metro, metropolitan area; SED, serious emotional disturbance/H-SED, hurricane-attributable SED

^aEstimates of SED were based on the SDQ. See the "Methods" section for details.^bIndividuals with no exposure to hurricane-related stressors are not included in this analysis^cLifetime anxiety, mood, and substance disorders, as well as intermittent explosive disorder, were assessed in adult respondents

* Significant at the .05 level, two-sided test.