Serious Emotional Disturbance Among Youths Exposed to Hurricane Katrina 2 Years Postdisaster

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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, sociodemographics, and family factors 18 to 27 months after the hurricane. **Method:** A probability sample of prehurricane 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 to 17 years. 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, 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 the youths were estimated to have SED that is directly attributable to Hurricane Katrina. Stress exposure was associated strongly with SED, and 20.3% of the youths with high stress exposure had hurricane-attributable SED. Death of a loved one had the strongest association with SED among prehurricane 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 youths exposed to Hurricane Katrina remains high 18 to 27 months after the storm, suggesting a substantial need for mental health treatment resources in the hurricane-affected areas. The youths 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. *J. Am. Acad. Child Adolesc. Psychiatry,* 2009; 48(11):1069–1078. **Key Words:** 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 1,000 people, displaced more than 500,000, and cost more than $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 because of forced relocation, difficulty obtaining housing, and prolonged community disruption.

In the first 3 to 6 months after 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. After Hurricanes Andrew and Hugo, the prevalence of PTSD among the youths living

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in hurricane areas, and who therefore experienced some exposure to hurricane-related stressors, was estimated at 3% to 9%.[6,7] Previous research has identified exposure to disaster-related stressors as an important predictor of psychiatric symptoms among youths after 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 the youths in affected areas to be high. Indeed, in a survey conducted 6 months after 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 after natural disasters are relatively short lived, with substantial decreases occurring during the first year postdisaster.[4] Nearly 30% of children exposed to Hurricane Andrew reported severe symptoms of PTSD, defined as 10 or more symptoms, 3 months after the storm.[9] At 7 months posthurricane the prevalence of such symptoms had dropped to 18%, and at 10 months posthurricane, 13% of the 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 postdisaster interventions. Previous research after other natural disasters has identified female sex, younger age, nonwhite race/ethnicity, parent psychopathology, and degree of stress exposure as predictors of long-term symptom elevation in youths.[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 after the storm have been reported,[14,15] but epidemiological data regarding the prevalence and severity of psychiatric symptoms among children at longer intervals posthurricane are lacking. The extent to which risk factors identified in previous 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 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 to 27 months after the storm. *Serious emotional disturbance* 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. Sociodemographic and family factors also are examined as predictors of SED.

METHOD

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 Federal Emergency Management Administration–defined disaster area or by a random selection of families applying for assistance from the American Red Cross's database. The baseline CAG was performed in three waves. The first wave was collected between January and March 2006, 5 to 7 months after the hurricane. Approximately 1,043 respondents completed the interview, representing an estimated 41.9% of the eligible households screened. The second wave was performed 7 to 10 months after the hurricane (between April and June 2006). Approximately 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 posthurricane), and the 1,322 completed interviews represented an estimated 32.3% of the eligible households screened. The three waves together resulted in 3,089 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 to participate in the baseline survey, as the goal of the CAG was to track the progress of recovery over time.

A nonresponse survey found that individuals who did not participate in the baseline CAG were similar to participants on sociodemographic 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 scale of 0–10 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 scale of 0–10). The median and interquartile range of hurricane-related stress exposure were 8.0 (6.0–10.0) among nonrespondents and 7.0 (5.0–9.0) among the first wave of baseline CAG members, and those of psychological distress were 2.9 (1.2–4.4) among nonrespondents 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 poststratification weight were used to adjust for residual discrepancies between the CAG and the 2000 census population on a range of sociodemographic and prehurricane housing variables. The consolidated CAG sample weight was trimmed to increase design efficiency.[17]

Detailed personal contact 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 posthurricane). Of the 1,043 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 with the baseline sample in sociodemographic characteristics, traumatic stress exposure, and mental health were adjusted for by using a propensity score adjustment weight[18] applied to the consolidated baseline weight. A probability subsample of respondents from the second and third waves of baseline interviews was selected for the second interview to be performed approximately 24 months after the hurricane. These interviews were completed from August until November 2007 (24–27 months posthurricane). All second- and third-wave CAG members with PTSD or moderate-to-serious psychological distress at baseline[19] were selected for follow-up along with a probability subsample of the remaining respondents, resulting in 1,195 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 oversampling 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 to 17 years living with the respondent at the time of the interview. We completed interviews on 254 (91.4%) of the 278 eligible children in households with only one child. In the 202 households with exactly two children, we completed 378 (93.6%) of 404 interviews, and in the 99 households with three or more children, we completed 165 (83.3%) of 198 interviews attempted, for a total of 797 child interviews of the 880 children screened for a 90.6% cooperation rate. A child weight was assigned by adjusting the household reinterview weight for the probability of selection of male and female children in the household and by including a poststratification adjustment by sex and age. Institutional review board approval from Harvard Medical School and informed consent were obtained.

Measures

Serious Emotional Disturbance. An abbreviated six-item version of the Strength and Difficulties Questionnaire (SDQ)[20] was used to screen for SED in the 12 months before the interview in children of the respondents. The brief SDQ includes five 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 to 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 to 3. The respondents were asked to rate how much they believed their child's difficulties were caused by the hurricane on a scale of 0 to 3.

In a previous validation study, the six-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-Age Children (K-SADS)[23] and the Children's Global Assessment of Functioning (C-GAF) scale.[24] The six-item SDQ was completed by each respondent's parent or guardian. The respondents who received a C-GAF score of 50 or lower 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 used only the five symptom-focused items. Using a cutoff 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 on 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]

The 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. The 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 the 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, 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 posthurricane than prehurricane housing).[2] We examined the associations between SDQ approximations of SED and each of these stress domains.

Sociodemographic 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 nonwhite. Family income was coded in tertiles where low/low-average was defined as less than or equal to 0.5 to 1.0 of the population median on the ratio of pretax income to number of family members, high-average was defined as 1.0 to 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 prehurricane area or living in a different area, and parent psychopathology. The 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 prehurricane residents of the New Orleans metro area (New Orleans) from the remainder of the sample. The independent and joint effects of sociodemographic 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. The Taylor series linearization method was used to calculate design-based significance tests because the data were weighted. Statistical significance was evaluated using two-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 prehurricane 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 prehurricane 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).

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		

Note: H-SED = hurricane-attributable SED; Metro = metropolitan area; NH-SED = SED unrelated to hurricane; SDQ = Strengths and Difficulties Questionnaire; SED = serious emotional disturbance.

[a]Estimates of SED were based on the SDQ. See the "Method" section for details.

Associations of Sociodemographic 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 A can be found in the supplemental digital content (online only) materials at *http://links.lww.com/CHI/A119*. The estimated prevalence of NH-SED was higher among white respondents than nonwhite respondents in New Orleans (OR 0.2, $\chi^2_1 = 4.0$, $p = .046$), but NH-SED was more common among nonwhite 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 the youths 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 the youths in both samples. Hurricane-related stressors were highly co-occurring, with more than one third of the 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, seven of the stressors

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[a]	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[a]	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[a]	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
No. 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[a]	86.8	1.6	80.9	2.2	83.0	1.6

Note: Metro = metropolitan area.

[a]Significant difference at the .05 level, two-sided test in the prevalence of exposure between prehurricane respondents of the New Orleans metro and the remainder of the hurricane area.

were positively and significantly associated with estimated H-SED (70.0%, ORs range from 2.3 to 50.7), whereas only two stressors were positively and significantly associated with NH-SED (20.0%, ORs range from 2.2 to 2.6). Appendix Table A can be found in the supplemental digital content (online only) materials at *http://links.lww.com/CHI/A119*. 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, three specific hurricane-related stressors (i.e., death or victimization of a loved one, physical adversity) were positively and significantly associated with estimated H-SED (30.0%, ORs range from 2.3 to 3.1). In the remainder of the sample, five stressors (i.e., 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 to 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 because of the small number of youths 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 with youths with no stressors) to 37.3–99.7 for four and five 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 sociodemographic factors and type and number of hurricane-related stressors. The best-fitting model included dummy variables representing exactly two, three, four, five, or more hurricane-related stressors (detailed results available on request). After controlling for the number of stressors to which the youths 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

TABLE 3
Associations Between Number of Hurricane-Related Stressors and 12-Month H-SED and NH-SED[a,b]

No. of stressors	H-SED				NH-SED			
	OR	95% CI	χ^2_1	p	OR	95% CI	χ^2_1	p
0	1.0	—			1.0	—		
1	14.5[c]	1.7–122.7	6.1	.014	1.2	0.3–4.4	0.1	.820
2	51.9[c]	6.7–404.3	14.3	<.001	1.9	0.4–8.6	0.7	.390
3	51.3[c]	6.4–413.1	13.7	<.001	1.9	0.5–6.9	0.9	.350
4	37.3[c]	4.4–317.9	11.0	<.001	3.2	0.8–12.8	2.6	.110
5	99.7[c]	12.6–787.5	19.1	<.001	3.0	0.8–12.2	2.4	.120

Note: CI = confidence interval; H-SED = hurricane-attributable SED; NH-SED = SED unrelated to hurricane; OR = odds ratio; SDQ = Strengths and Difficulties Questionnaire; SED = serious emotional disturbance.

[a]Estimates of SED were based on the SDQ. See the "Method" section for details.

[b]Respondents in New Orleans metro and other areas were combined because of the small sample size associated with exposure to 0 stressors; model controls for prehurricane location.

[c]Significant at the .05 level, two-sided test.

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 the youths 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 Sociodemographics With Hurricane-Related Stressors

Because virtually all estimated cases of H-SED occurred in the youths with exposure to hurricane-related stressors, we examined the effects of sociodemographic and family factors on estimated SED among the youths 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). The youths in the lowest income tertile were more likely to have H-SED than those in the highest income tertile (p = .051), and the youths living in the same prehurricane 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.

TABLE 5
Predictors of 12-Month H-SED Among Respondents With Exposure to Hurricane-Related Stressors[a,b]

Effect	New Orleans Metro (n = 367) OR (95% CI)		Other Areas (n = 271) OR (95% CI)	
Income				
Low/low–middle	6.0[c]	(1.2–30.7)		
Middle–high	3.4	(0.6–19.3)		
High	1.0	—		
χ^2_2 (p)	6.0	(.051)		
Current living				
Same town	3.7[c]	(1.3–10.9)		
Different town	1.0	—		
χ^2_1 (p)	5.7[c]	(.017)		
Group (stress)[b]				
High	3.5[c]	(1.6–7.7)	4.0[c]	(1.7–9.1)
Intermediate	1.0	—	1.0	—
χ^2_1 (p)	9.4[c]	(.002)	10.8[c]	(.001)
Parent pathology[d]				
1+ lifetime diagnoses	3.1[c]	(1.4–6.8)	2.0	(0.8–4.7)
0 lifetime diagnoses	1.0	—	1.0	—
χ^2_1 (p)	7.6[c]	(.006)	2.4	(.120)

Note: CI = confidence interval; H-SED = hurricane-attributable SED; metro = metropolitan area; OR = odds ratio; SDQ = Strengths and Difficulties Questionnaire; SED = serious emotional disturbance.

[a]Estimates of SED were based on the SDQ. See the "Method" section for details.

[b]Individuals with no exposure to hurricane-related stressors are not included in this analysis.

[c]Significant at the .05 level, two-sided test.

[d]Lifetime anxiety, mood, and substance disorders, as well as intermittent explosive disorder, were assessed in adult respondents.

TABLE 4
Weighted Distribution and Conditional Probabilities of 12-Month SED as a Function of Stress Exposure[a]

	New Orleans Metro (n = 444)						Remainder of Hurricane Area (n = 353)					
	Total		H-SED		NH-SED		Total		H-SED		NH-SED	
Group[b]	%	SE	%	SE	%	SE	%	SE	%	SE	%	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

Note: H-SED = hurricane-attributable SED; metro = metropolitan area; NH-SED = SED unrelated to hurricane; SDQ = Strengths and Difficulties Questionnaire; SED = serious emotional disturbance.

[a]Estimates of SED were based on the SDQ. See the "Method" 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.

DISCUSSION

The estimated prevalence of SED among children and adolescents exposed to Hurricane Katrina 18 to 27 months after the storm is approximately 15%. Nearly 10% of the youths 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% to 9% prevalence of SED reported in epidemiological studies.[26–28] The prevalence of SED has not typically been reported after natural disasters; however, the prevalence of PTSD among youths was estimated at 3% to 9% 6 months after Hurricane Andrew[6] and at 5% after 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 the youths 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 sociodemographic factors typically associated with psychopathological reactions to other natural disasters, such as age and sex,[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 youths 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 the youths with high stress exposure are estimated to have H-SED. These findings are not surprising because 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, represents a marker for 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 after other natural disasters[12,15,30] and may predispose youths to the development of psychiatric symptoms after disasters through pathways involving psychological predispositions, such as trait anxiety and neuroticism.[29] Postdisaster parental symptoms may also 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 posthurricane food, shelter, and employment. Consistent with this interpretation, the youths who remained in their prehurricane 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 predisaster communities relative to those who moved postdisaster.[32] The magnitude and

duration of community disruption after Hurricane Katrina were substantial, and resource depletion after the storm may have directly affected children's ability to recover from the disaster.[33] Extensive property damage and poor access to basic necessities after the storm led to high levels of posthurricane migration, resulting in the dissolution of social support networks. This breakdown of the social fabric posthurricane likely affected child mental health because poor social support is associated with psychiatric symptoms in the youths exposed to the hurricane.[34]

Our results demonstrate that mental health problems among the youths 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 after Hurricane Katrina,[35,36] which has contributed to low rates of treatment seeking among those who developed mental health problems after the storm.[37] Thus, increasing the availability of child mental health services in hurricane-affected areas remains a goal of critical public health importance. A recent cost analysis suggests that providing posthurricane 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 epidemiological 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 nondifferential, 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, the parent's determinations of whether their child's emotional and behavioral problems were attributable to the hurricane were subjective and susceptible to bias. The parents who experienced mental health problems after 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 National Health Interview Survey,[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 underrepresentation 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 posthurricane psychopathology are responsible for the reported associations. For example, individuals living in communities with low levels of social cohesion likely experienced greater risk for both violence exposure after the storm and of mental disorders because of 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 to 27 months after the storm. Serious emotional disturbance is prevalent among the youths 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 sociodemographic 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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REFERENCES

1. Rosenbaum S. US health policy in the aftermath of Hurricane Katrina. *JAMA*. 2006;295:437–440.
2. Galea S, Brewin CR, Gruber M et al. Exposure to hurricane-related stressors and mental illness after Hurricane Katrina. *Arch Gen Psychiatry*. 2007;64:1427–1434.
3. Russoniello CV, Skalko TK, O'Brien K, McGhee SA, Bingham-Alexander D, Beatley J. Childhood posttraumatic stress disorder and efforts to cope after Hurricane Floyd. *Behav Med*. 2002;28:61–71.
4. Shaw JA, Applegate B, Tanner S et al. Psychological effects of Hurricane Andrew on an elementary school population. *J Am Acad Child Adolesc Psychiatry*. 1995;34:1185–1192.
5. Vernberg EM, LaGreca AM, Silverman WK, Prinstein MJ. Prediction of posttraumatic stress symptoms in children after Hurricane Andrew. *J Abnorm Psychol*. 1996;105:237–248.
6. Garrison CZ, Bryant ES, Addy CL, Spurrier PG. Posttraumatic stress disorder in adolescents after Hurricane Andrew. *J Am Acad Child Adolesc Psychiatry*. 1995;34:1193–1201.
7. Shannon MP, Lonigan CJ, Finch AJ, Taylor CM. Children exposed to disaster: epidemiology of post-traumatic symptoms and symptom profile. *J Am Acad Child Adolesc Psychiatry*. 1994;33:80–93.
8. Eksi A, Braun K, Ertem-Vehid H et al. Risk factors for the development of PTSD and depression among child and adolescent victims following of a 7.4 magnitude earthquake. *Int J Psychiatry Clin Pract*. 2007;11:190–199.
9. LaGreca AM, Silverman WK, Vernberg EM, Prinstein MJ. Symptoms of posttraumatic stress in children after Hurricane Andrew: a prospective study. *J Consult Clin Psychol*. 1996;64:712–723.
10. Abramson D, Garfield R. *On the Edge: Children and Families Displaced by Hurricanes Katrina and Rita Face a Looming Medical and Mental Health Crisis*. New York: Columbia University Mailman School of Public Health. *http://www.ncdp.mailman.columbia.edu/files/On%20the%20Edge%20L-CAFH%20Final%20Report_Columbia%20University.pdf*. Accessed December 16, 2008.
11. Bokszczanin A. PTSD symptoms in children and adolescents 28 months after a flood: age and gender differences. *J Trauma Stress*. 2007;20:347–351.
12. Green BL, Korol M, Grace MC et al. Children and disaster: age, gender, and parental effects on PTSD symptoms. *J Am Acad Child Adolesc Psychiatry*. 1991;30:945–951.
13. Pynoos RS, Goenjian A, Tashjian M et al. Post-traumatic stress reactions in children after the 1988 Armenian earthquake. *Br J Psychiatry*. 1993;163:239–247.
14. Marsee MA. Reactive aggression and posttraumatic stress in adolescents affected by Hurricane Katrina. *J Clin Child Adolesc Psychol*. 2008;37:519–529.
15. Scheeringa MS, Zeanah CH. Reconsideration of harm's way: onsets and comorbidity patterns of disorders in preschool children and their caregivers following Hurricane Katrina. *J Clin Child Adolesc Psychol*. 2008;37:508–518.
16. Substance Abuse and Mental Health Services Administration. *Psychiatric Epidemiology: Recent Advances and Future Directions*. Rockville, MD: Center for Mental Health Services; 1999.
17. Heeringa SG, Wells JE, Hubbard F, Mneimneh Z, Chiu WT, Sampson N. Sample designs and sampling procedures. In: Kessler RC, Üstün TB, eds. *The WHO World Mental Health Surveys: Global Perspectives on the Epidemiology of Mental Disorders*. New York: Cambridge University Press; 2008.
18. Mansson R, Joffe MM, Sun W, Hennessy S. On the estimation and use of propensity scores in case-control and case-cohort studies. *Am J Epidemiol*. 2007;166:332–339.
19. Kessler RC, Galea S, Gruber MJ, Sampson NA, Ursano RJ, Wessely S. Trends in mental illness and suicidality after Hurricane Katrina. *Mol Psychiatry*. 2008;13:374–384.
20. Goodman R. The extended version of the Strengths and Difficulties Questionnaire as a guide to child psychiatric caseness and consequent burden. *J Child Psychol Psychiatry*. 1999;40:791–799.
21. Kessler RC, Gruber M, Sampson NA. *Validation Studies of Mental Health Indices in the National Health Interview Survey*. Boston: Harvard; 2006.
22. Kessler RC, Avenevoli S, Costello EJ et al. Design and Field Procedures in the US National Comorbidity Survey Replication Adolescent (NCS-A) Supplement. *Int J Methods Psychiatr Res*. 2009;18:69–83.
23. Puig-Antich J, Chambers W. *Schedule for Affective Disorders and Schizophrenia for School-Age Children (Kiddie-SADS)*. New York: State Psychiatric Institute; 1978.
24. Shaffer D, Gould MS, Brasic J et al. A Children's Global Assessment Scale (C-GAS). *Arch Gen Psychiatry*. 1983;40:1228–1231.
25. Goodman R. Psychometric properties of the Strength and Difficulties Questionnaire. *J Am Acad Child Adolesc Psychiatry*. 2001;40:1337–1345.
26. Bloom B, Cohen RA. Summary Health Statistics for U.S. Children: National Health Interview Survey, 2006. National Center for Health Statistics. *Vital Health Stat 10*. 2007;234:1–79.
27. Costello EJ, Angold A, Burns BJ, Erkanli A, Stangl DK, Tweed DL. The Great Smoky Mountains Study of Youth. Functional impairment and serious emotional disturbance. *Arch Gen Psychiatry*. 1996;53:1137–1143.
28. Costello EJ, Messer SC, Bird HR, Cohen P, Reinherz HZ. The prevalence of serious emotional disturbance: a re-analysis of community studies. *J Child Fam Stud*. 1998;7:411–432.
29. Weems CF, Pina AA, Costa NM, Watts SE, Taylor LK, Cannon MF. Predisaster trait anxiety and negative affect predict posttraumatic stress in youths after Hurricane Katrina. *J Consult Clin Psychol*. 2007;75:154–159.
30. Laor N, Wolmer L, Mayes LC, Gershon A, Weizman R, Cohen DJ. Israeli preschool children under Scuds: a 30-month follow-up. *J Am Acad Child Adolesc Psychiatry*. 1997;36:349–356.
31. Scaramella LV, Sohr-Preston SL, Callahan KL, Mirabile SP. A test of the family stress model on toddler-age children's adjustment among Hurricane Katrina impacted and nonimpacted low-income families. *J Clin Child Adolesc Psychol*. 2008;37:530–541.
32. Najarian LM, Goenjian AK, Pelcovitz D, Mandel F. Relocation after a disaster: posttraumatic stress disorder in Armenia after the earthquake. *J Am Acad Child Adolesc Psychiatry*. 1996;35:374–383.
33. Hobfoll SE. Conservation of resources: a new attempt at conceptualizing stress. *Am Psychologist*. 1989;44:513–524.
34. Pina AA, Villalta IK, Ortiz CD, Gottschall AC, Costa NM, Weems CF. Social support, discrimination, and coping as predictors of posttraumatic stress reactions in youth survivors of Hurricane Katrina. *J Clin Child Adolesc Psychol*. 2008;37:564–574.
35. Berggren RE, Curiel TJ. After the storm–health care infrastructure in post-Katrina New Orleans. *N Engl J Med*. 2006;354:1549–1552.
36. Zwillich T. Health care remains basic in New Orleans. *Lancet*. 2006;367:637–638.

37. Wang PS, Gruber MJ, Powers RE et al. Disruption of existing mental health treatments and failure to initiate new treatment after Hurricane Katrina. *Am J Psychiatry*. 2008;165:34–41.
38. Schoenbaum M, Buttler B, Kataoka S et al. Promoting mental health recovery after Hurricanes Katrina and Rita: what could we have done at what cost? *Arch Gen Psychiatry*. 2009;66:906–914.
39. Kessler RC, Avenevoli S, Green JG et al. National Comorbidity Survey Replication Adolescent Supplement (NCS-A): III. Concordance of DSM-IV/CIDI Diagnoses With Clinical Reassessments. *J Am Acad Child Adolesc Psychiatry*. 2009;48:386–399.
40. Hensley L, Varela RE. PTSD symptoms and somatic complaints following Hurricane Katrina: the roles of trait anxiety and anxiety sensitivity. *J Clin Child Adolesc Psychol*. 2008;37:542–552.
41. Dohrenwend BP, Turner JB, Turse NA, Adams BG, Koenen KC, Marchall R. The psychological risks of Vietnam for U.S. veterans: a revisit with new data and methods. *Science*. 2006;313:979–982.
42. Norris FH, Kanlasty KA. A longitudinal study of the effects of various crime prevention strategies on criminal victimization, fear of crime, and psychological distress. *Am J Commun Psychol*. 1992;20:207–239.
43. Kawachi I, Subramanian SV. Measuring and modeling the social and geographic context of trauma: a multilevel modeling approach. *J Trauma Stress*. 2006;19:195–203.