

## Mental illness and suicidality after Hurricane Katrina

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**Objective** To estimate the impact of Hurricane Katrina on mental illness and suicidality by comparing results of a post-Katrina survey with those of an earlier survey.

**Methods** The National Comorbidity Survey-Replication, conducted between February 2001 and February 2003, interviewed 826 adults in the Census Divisions later affected by Hurricane Katrina. The post-Katrina survey interviewed a new sample of 1043 adults who lived in the same area before the hurricane. Identical questions were asked about mental illness and suicidality. The post-Katrina survey also assessed several dimensions of personal growth that resulted from the trauma (for example, increased closeness to a loved one, increased religiosity). Outcome measures used were the K6 screening scale of serious mental illness and mild–moderate mental illness and questions about suicidal ideation, plans and attempts.

**Findings** Respondents to the post-Katrina survey had a significantly higher estimated prevalence of serious mental illness than respondents to the earlier survey (11.3% after Katrina versus 6.1% before;  $\chi^2_1 = 10.9$ ;  $P < 0.001$ ) and mild–moderate mental illness (19.9% after Katrina versus 9.7% before;  $\chi^2_1 = 22.5$ ;  $P < 0.001$ ). Among respondents estimated to have mental illness, though, the prevalence of suicidal ideation and plans was significantly lower in the post-Katrina survey (suicidal ideation 0.7% after Katrina versus 8.4% before;  $\chi^2_1 = 13.1$ ;  $P < 0.001$ ; plans for suicide 0.4% after Katrina versus 3.6% before;  $\chi^2_1 = 6.0$ ;  $P = 0.014$ ). This lower conditional prevalence of suicidality was strongly related to two dimensions of personal growth after the trauma (faith in one's own ability to rebuild one's life, and realization of inner strength), without which between-survey differences in suicidality were insignificant.

**Conclusion** Despite the estimated prevalence of mental illness doubling after Hurricane Katrina, the prevalence of suicidality was unexpectedly low. The role of post-traumatic personal growth in ameliorating the effects of trauma-related mental illness on suicidality warrants further investigation.

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### Introduction

Hurricane Katrina was the deadliest hurricane in the United States in seven decades and the most expensive natural disaster in American history. More than 500 000 people were evacuated. Nearly 90 000 square miles were declared a disaster area (roughly equal to the land mass of the United Kingdom).<sup>1</sup> More than 1600 confirmed deaths occurred and more than 1000 people remain missing.<sup>2</sup> The destruction caused by Hurricane Katrina has lingered much longer than that occurring after previous hurricanes.<sup>3</sup>

An extensive literature documents the adverse mental health effects of

natural disasters.<sup>4,5</sup> Although these effects vary greatly, the effects of catastrophic disasters are consistently large.<sup>6,7</sup> For example, studies after Hurricane Andrew, which occurred in Louisiana in 1992, found that 25–50% of respondents were affected by disaster-related mental disorders.<sup>8,9</sup> Based on these results, and given the extraordinary array of stressors that occurred in conjunction with Hurricane Katrina (for example, bereavement, exposure to the dead and dying, personal threats to life, and the massive destruction),<sup>10–12</sup> we would expect Hurricane Katrina's effects on mental health to be at the upper end of the range of previous disasters.

Due to the wide geographical dispersion of the displaced population, a comprehensive assessment of the mental health of survivors of Hurricane Katrina is nonexistent. The Louisiana Department of Public Health documented substantial psychopathology among the 50 000 survivors cared for in evacuation centres shortly after the hurricane,<sup>13</sup> but these individuals represented less than 1% of survivors. Seven weeks after the hurricane, the United States Centers for Disease Control and Prevention (CDC) carried out a survey to assess household needs and found that half of the adults surveyed who were still living in New Orleans had clinically significant

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psychological distress;<sup>14</sup> no information was obtained on the much larger number of residents who had lived in New Orleans before the hurricane but who no longer live there. Two public opinion polls — one carried out jointly by Gallup, CNN and USA Today in a sample of people who sought assistance from the American Red Cross<sup>15</sup> and the other carried out by the New York Times among a sample from the American Red Cross' "safe list" (a list posted on the Internet with the names and contact information of survivors who were displaced by the hurricane and separated from relatives and friends)<sup>16</sup> — asked a handful of questions about mental health but did not attempt to assess clinical significance. A probability survey of families with children still residing in trailers (caravans) supplied by the United States Federal Emergency Management Agency (FEMA) or hotel rooms sponsored by FEMA in Louisiana as of mid-February 2006 found that 44% of adult caregivers had clinically significant psychological distress.<sup>17</sup> As with the earlier CDC survey of evacuation centres, though, the sampling frame represented less than 1% of the pre-hurricane residents of the affected areas.

Public health decisions cannot be based on such a narrow empirical foundation. This report presents the initial results of an ongoing tracking survey designed to provide broader coverage of the population affected by Hurricane Katrina. The first phase of the study aimed to enrol and carry out a baseline

survey of mental health needs among a representative sample of adults (aged  $\geq 18$ ) who, before the hurricane, were resident in the FEMA-defined impact areas in Alabama, Louisiana and Mississippi.<sup>18–20</sup> Subsequent phases of the study will monitor the evolving needs of this sample in follow-up surveys. The focus of this report is on the effects of the hurricane on the prevalence and correlates of mental illness and suicidality. Before and after comparisons are approximated by using baseline data from a 2001–03 national survey that included a probability sub-sample of respondents in the two Census Divisions subsequently affected by Katrina.<sup>21</sup> The questions used to assess mental illness and suicidality were identical in the two surveys.

## Methods

### The samples

The baseline survey was the National Comorbidity Survey-Replication (NCS-R),<sup>21</sup> a face-to-face survey of English-speaking adults aged  $\geq 18$  administered between February 2001 and February 2003. The NCS-R interviewed 826 people in the two Census Divisions later affected by Hurricane Katrina. The response rate in the total sample ( $n = 9282$ ) was 70.9% but a response rate was not calculated separately for the subsample of respondents interviewed in the two Census Divisions subsequently affected by Hurricane Katrina. The NCS-R data were weighted to adjust for differential probabilities of selection and for residual discrepancies between the sample and

the 2000 Census on a series of social, demographic and geographical variables. The NCS-R design is discussed in more detail elsewhere.<sup>22</sup>

The post-Katrina survey acted as the baseline data collection for the Hurricane Katrina Community Advisory Group. The advisory group is a representative sample of 1043 survivors of Hurricane Katrina who agreed to participate in a series of surveys over a period of several years; these surveys will track the speed and effectiveness of hurricane recovery efforts. The target population for the advisory group was English-speaking adults (aged  $\geq 18$ ) who before the hurricane had lived in the areas subsequently defined by FEMA as having been affected by Hurricane Katrina (a total of 4 137 000 adult residents in the 2000 Census spread across parts of Alabama, Louisiana and Mississippi) in either of two sampling frames: a random-digit dial telephone frame that included telephone banks working in the eligible counties (in Alabama and Mississippi) and parishes (in Louisiana) in the affected areas before the hurricane and a frame that included the telephone numbers of the roughly 1.4 million families from these same areas who had applied to the American Red Cross for assistance after the hurricane. Pre-hurricane residents of the New Orleans metropolitan area were over-sampled in both frames. Many displaced people were traced in the random-digit dial sample because telephone calls were forwarded to new addresses. The American Red Cross

Table 1. Estimated prevalence of mental illness within the past 30 days as classified by the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition, and prevalence of suicidality within the past 12 months in the National Comorbidity Survey-Replication (NCS-R), February 2001–February 2003, and the post-Katrina survey, 19 January–31 March 2006

	Survey				Odds ratio post-Katrina survey vs NCS-R <sup>b</sup>	$\chi^2_1$	P value
	NCS-R <sup>a</sup>		Post-Katrina <sup>a</sup>				
Mental illness (30-day prevalence) <sup>c</sup>							
Serious mental illness	6.1 (91)	(0.7)	11.3 <sup>d</sup> (113)	(1.7)	2.0 <sup>d</sup> (1.3–3.0)	10.9 <sup>d</sup>	0.001
Mild–moderate mental illness	9.7 (131)	(1.0)	19.9 <sup>d</sup> (206)	(2.1)	2.3 <sup>d</sup> (1.6–3.3)	22.5 <sup>d</sup>	< 0.001
Any mental illness	15.7 (222)	(1.2)	31.2 <sup>d</sup> (319)	(2.4)	2.4 <sup>d</sup> (1.8–3.2)	35.9 <sup>d</sup>	< 0.001
Suicidality (12-month prevalence)							
Ideation	2.8 (45)	(0.4)	2.9 (30)	(0.9)	1.0 (0.5–2.1)	0.0	0.96
Plan	1.1 (19)	(0.3)	0.7 (4)	(0.5)	0.6 (0.1–2.9)	0.4	0.54
Attempt	0.6 (10)	(0.2)	0.7 (5)	(0.5)	1.1 (0.2–5.3)	0.0	0.88
Total	826		1043		1869		

<sup>a</sup> Values are the percentage (number) (standard error) of respondents who met criteria for the outcome. All percentages and standard errors are based on weighted data; numbers are based on unweighted data. The number in the last row is the denominator for all calculations of percentage.

<sup>b</sup> Values are the odds ratio (95% confidence interval) of the outcome in the post-Katrina survey (numerator) versus the NCS-R survey (denominator).

<sup>c</sup> Prevalence of mental illness is estimated using scores from the K6 screening scale. See text for details.

<sup>d</sup> Difference between the two surveys is significant at the 0.05 level with a two-sided test.

Table 2. Prevalence of first onset of suicidality during the past year among respondents with probable mental illness during the past 30 days as classified by the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition, in the National Comorbidity Survey-Replication (NCS-R), February 2001–February 2003, and the post-Katrina survey, 19 January–31 March 2006<sup>a</sup>

Suicidality	Survey		Odds ratio post-Katrina survey vs NCS-R <sup>c</sup>	$\chi^2_1$	P value
	NCS-R <sup>b</sup>	Post-Katrina <sup>b</sup>			
Ideation	8.4 (15/147) (2.3)	0.7 <sup>d</sup> (4/255) (0.4)	0.1 <sup>d</sup> (0.0–0.3)	13.1	< 0.001
Plan	3.6 (9/191) (1.3)	0.4 <sup>d</sup> (2/287) (0.3)	0.1 <sup>d</sup> (0.0–0.6)	6.0	0.014
Attempt	2.3 (5/183) (1.2)	0.8 (4/285) (0.5)	0.3 (0.1–1.6)	1.9	0.17

<sup>a</sup> Prevalence of mental illness is estimated using scores from the K6 screening scale. See text for details.

<sup>b</sup> Values are the percentage (numerator/denominator) (standard error) of respondents who met criteria for the outcome described in the row among those with probable mental illness and no past history of the outcome. All percentages and standard errors are based on weighted data. The numerator and denominator are based on unweighted data.

<sup>c</sup> Values are the odds ratio (95% confidence interval) of the estimated outcome in the post-Katrina survey (numerator) versus the NCS-R survey (denominator).

<sup>d</sup> Difference between the two surveys is significant at the 0.05 level with a two-sided test.

sample also included cell phones (mobile phones). The small proportion of evacuees still living in hotels at the time of the survey was represented through a supplemental sample of hotels that housed evacuees supported by FEMA.

The overlap of the two sampling frames was handled in two ways: by confining numbers from the American Red Cross frame to those not in the random-digit dial frame (for example, cell phones and exchanges outside the hurricane area) and by down-weighting those respondents selected by the random-digit dial frame who reported receiving assistance from the American Red Cross and had additional phone numbers outside the random-digit dial frame. Respondents from the two frames were combined by weighting the participating households in the American Red Cross sample to their estimated population proportion based on estimates of the proportion of Red Cross numbers outside the random-digit dial frame and the proportion of random-digit dial respondents who asked for assistance from the American Red Cross. Respondents in the hotel sample were included without a household weight because they were selected proportionally.

The final sample of 1043 advisory group members was recruited from an initial sample that we estimate to have included 3835 eligible households living in the area before the hurricane and selected across the two frames. We were able to contact and determine to be eligible 2489 of these households. The estimate of 3835 eligible households in the sample is nothing more than an estimate because we were unable to contact a large proportion of this number even

after many attempts, leading us to subsample hard-to-reach cases for especially intensive tracing efforts and to estimate rather than to confirm the proportion of eligible households. If the estimate of 3835 is correct, the 2489 households that we contacted and determined to be eligible represent a 64.9% screening response rate. This response rate is lower than that found in typical household surveys because of the geographical dislocation of the population after Hurricane Katrina and the attendant difficulties in tracing and contacting people in this population. For example, some of the phone numbers in the American Red Cross frame were for rooms in hotels where a family was living temporarily at the time they sought assistance. We were able to trace some of these households when they left forwarding information, but often it was not possible to trace households, and this led to a low screening response rate.

A short screening questionnaire was administered to a randomly selected respondent in each of the households contacted for the screening sample; this questionnaire was used to determine eligibility for the advisory group. It included questions about the location of the respondent's residence before the hurricane, the extent of the respondent's exposure to the hurricane, the respondent's current mental health status and basic demographic information. Once these screening questions were answered, respondents who were determined to be eligible to participate by virtue of the location of their residence before the hurricane were introduced to the purposes and goals of the advisory group. They were also informed that agreeing

to join the advisory group required making a commitment to participate in a number of follow-up surveys over a period of several years and providing information that would allow us to contact them if they moved house during the study period. We asked respondents to consider these requirements carefully before agreeing to participate because we wanted the advisory group to include only those respondents who would continue to participate in the repeated tracking surveys.

The baseline advisory group survey was administered to the 1043 respondents who agreed to join the group: the results of the survey are presented in this report. These respondents represent 41.9% (1043/2489) of those who participated in the screening questionnaire survey. Although this is a relatively low response rate in comparison to typical one-shot telephone surveys, it is considerably higher than the response rates obtained in more conventional consumer panel surveys. It is noteworthy that responses to the screening questionnaire were quite similar among those who agreed to join the advisory group and those who declined. A weight was nonetheless applied to the advisory group sample. This was done to adjust for observed differences between advisory group participants and non-participants in responses made to the screening questionnaire: there was a somewhat higher level of trauma exposure and a somewhat higher prevalence of hurricane-related psychological distress among non-participants. In addition, a within-household probability-of-selection weight was applied to the advisory group sample to adjust for the fact that in each eligible

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household only one member was invited to join the advisory group. In addition, a post-stratification weight was applied to the data to adjust for residual discrepancies between the advisory group and the 2000 Census population in the affected areas on a range of social, demographic and pre-hurricane housing variables. Finally, the consolidated advisory group sample weight was trimmed to increase design efficiency based on evidence that trimming did not significantly affect prevalence estimates of outcome variables.

## Measures

The K6 scale of non-specific psychological distress<sup>23,24</sup> was used to screen for anxiety and mood disorders occurring within 30 days of the interview as defined by the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV). The K6 is the most widely used mental health screening scale in the United States.<sup>25,26</sup> Scores on the scale range from 0 to 24. Based on previous K6 validation,<sup>24</sup> scores in the range of 13–24 were classified probable serious mental illness, those in the range 8–12 were classified probable mild–moderate mental illness, and those in the range 0–7 were classified as probable non-cases. A small clinical reappraisal study was carried out with five respondents selected randomly from each of the three categories (serious mental illness, mild–moderate mental illness, non-case). A trained clinical interviewer administered the non-patient version of the Structured Clinical Interview for DSM-IV,<sup>27</sup> blinded to the category of each of the 15 respondents. The syndromes assessed were DSM-IV major depressive episode, panic disorder, generalized anxiety disorder, post-traumatic stress disorder, agoraphobia, social phobia and specific phobia. Serious mental illness was defined as a DSM-IV diagnosis with a global assessment of functioning<sup>28</sup> score of 0–60 and mild–moderate mental illness as a DSM-IV diagnosis with a global assessment of functioning of  $\geq 61$ . K6 classifications were confirmed for 14 of 15 respondents, the exception being a respondent classified as having severe mental illness by the K6 but mild–moderate mental illness by the structured interview (based on a global assessment of functioning score of 65). Suicidality was assessed by questions about lifetime occurrence of suicidal thoughts, plans and attempts; age at first occurrence of

each of these outcomes; and recency of each outcome. Respondents were classified as first-onset cases in respect of each of these outcomes if they reported that the outcome occurred for the first time in their life within the past 12 months (the most recent time frame assessed in the NCS-R).

Sociodemographic correlates assessed included age, sex, and ethnicity, family income, education, marital status and employment status. Income was coded into a dichotomy of either below the population median for the income-per-family-member ratio versus at or above the median for that ratio.

We also included measures of several dimensions of personal growth occurring after the hurricane (post-traumatic personal growth) that have been found in previous research to occur after exposure to trauma and to facilitate psychological adjustment by making sense of the trauma or finding some positive aspect to the trauma.<sup>29,30</sup> We focus on five such dimensions based on their presence in the two most commonly used inventories of post-traumatic personal growth:<sup>31,32</sup> post-traumatic increases in emotional closeness to loved ones, faith in the ability to rebuild one's life, spirituality or religiosity, meaning or purpose in life, and recognition of inner strength or competence.

## Analysis

Differences in the estimated prevalence of mental illness and suicidality were compared between the NCS-R and the post-Katrina baseline advisory group survey. Sociodemographic variation in between-survey differences was assessed using pooled logistic regression equations predicting outcomes from a 0–1 variable for survey (0 = NCS-R, 1 = post-Katrina survey), the sociodemographic variables, and interactions between the survey and sociodemographic variables. Logistic regression coefficients and their standard errors were exponentiated to create odds ratios (ORs) and their 95% confidence intervals. The role of post-traumatic growth was examined in a subgroup analysis. Because both surveys featured weighting and geographical clustering (NCS-R), analyses used the Taylor series linearization method.<sup>33</sup> Multivariate significance was calculated using Wald  $\chi^2$  tests based on design-corrected coefficient variance–covariance matrices. Statistical significance was evaluated using two-sided 0.05 level tests.

## Findings

### Prevalence of mental illness and suicidality

The proportion of respondents estimated to have serious mental illness is significantly higher among those in the post-Katrina sample than the NCS-R (11.3% after Katrina versus 6.1% before;  $\chi^2_1 = 10.9$ ;  $P = 0.001$ ). The same is true for the proportion estimated to have mild–moderate mental illness (19.9% after Katrina versus 9.7% before;  $\chi^2_1 = 22.5$ ;  $P < 0.001$ ) and those estimated to have any mental illness (31.2% after Katrina versus 15.7% before;  $\chi^2_1 = 35.9$ ;  $P < 0.001$ ), with ORs in the range 2.0–2.4 (Table 1). The difference between the surveys in suicidality is not significant either for ideation (2.9% after Katrina versus 2.8% before;  $\chi^2_1 = 0.0$ ;  $P = 0.96$ ), plans (0.7% after Katrina versus 1.1% before;  $\chi^2_1 = 0.4$   $P = 0.54$ ) or attempts (0.7% after Katrina versus 0.6% before;  $\chi^2_1 = 0.0$ ;  $P = 0.88$ ).

Suicidal ideation, plans and attempts during the 12 months before the interview were reported in both samples almost entirely by people estimated to have mental illness (results available on request). As a result, the higher estimated prevalence of mental illness but not suicidality in the post-Katrina sample implies that the conditional prevalence of suicidality given probable mental illness is lower among those in the post-Katrina sample than among those sampled before the hurricane. More detailed analysis found that this was especially true for the first onset of suicidality during the past year among respondents with probable mental illness (Table 2). These differences are significant for ideation (0.7% after Katrina versus 8.4% before;  $\chi^2_1 = 13.1$ ;  $P < 0.001$ ) and plans (0.4% after Katrina versus 3.6% before;  $\chi^2_1 = 6.0$ ;  $P < 0.014$ ) but not for attempts (0.8% after Katrina versus 2.3% before;  $\chi^2_1 = 1.9$ ;  $P = 0.17$ ).

### Sociodemographic correlates of mental illness and suicidality

Significant sociodemographic correlates of serious mental illness among those in the post-Katrina sample included being non-Hispanic white, not being married before the hurricane, and being classified as having “other” employment status before the hurricane (this mainly included unemployed or disabled people) (Table 3).



Table 3. Sociodemographic predictors of probable serious mental illness during the past 30 days as classified by the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition, and of suicidal ideation among people with probable mental illness in the National Comorbidity Survey-Replication (NCS-R), February 2001–February 2003, and the post-Katrina survey, 19 January–31 March 2006<sup>a</sup>

Variable	Category			
	Serious mental illness <sup>b,c</sup>		Suicidal ideation <sup>b,c</sup>	
	Main effects	Interaction with Hurricane Katrina	Main effects	Interaction with Hurricane Katrina
Age				
18–39	1.4 (0.4–4.7)	0.4 (0.1–1.9)	11.4 (2.5–52.4)	4.5 (0.8–26.3)
40–59	2.2 (0.8–6.5)	0.3 (0.1–1.7)	– <sup>d</sup>	– <sup>d</sup>
≥ 60	1.0	1.0	1.0	1.0
$\chi^2_{2/1}$ (P value)	2.7 (0.26)	1.7 (0.42)	9.7 <sup>e</sup> (0.002)	2.8 (0.09)
Sex				
Female	1.9 (0.9–4.1)	0.9 (0.3–2.7)	1.4 (0.3–7.5)	0.8 (0.1–5.8)
Male	1.0	1.0	1.0	1.0
$\chi^2_1$ (P value)	2.6 <sup>e</sup> (0.11)	0.0 (0.90)	0.2 (0.66)	0.0 (0.86)
Race				
Non-Hispanic white	1.0	1.0	1.0	1.0
Non-Hispanic black	0.5 <sup>e</sup> (0.2–0.9)	1.8 (0.7–5.0)	0.2 <sup>e</sup> (0.0–0.9)	0.2 (0.0–1.0)
Hispanic or other	0.1 <sup>e</sup> (0.0–0.5)	0.4 (0.8–2.4)	0.0 <sup>e</sup> (0.0–0.4)	0.0 <sup>e</sup> (0.0–0.5)
$\chi^2_2$ (P value)	10.3 <sup>e</sup> (0.006)	2.7 (0.26)	8.5 <sup>e</sup> (0.014)	7.8 <sup>e</sup> (0.20)
Pre-hurricane income				
Low or low-average	1.6 (0.6–4.5)	1.6 (0.6–4.4)	1.6 (0.2–10.6)	4.6 (0.7–31.2)
High-average or high	1.0	1.0	1.0	1.0
$\chi^2_1$ (P value)	0.9 (0.35)	0.8 (0.36)	0.2 (0.64)	2.4 (0.12)
No. of years of education				
0–11 (less than high school)	4.1 (0.9–18.2)	2.6 (0.6–11.7)	1.4 (0.1–13.4)	6.7 (0.6–70.5)
12 (high school)	1.9 (0.5–7.2)	1.0 (0.2–4.6)	0.6 (0.1–3.8)	1.5 (0.2–14.5)
13–15 (some university)	2.4 (0.7–8.4)	1.1 (0.2–4.8)	1.6 (0.3–7.8)	2.1 (0.2–17.6)
≥ 16 (university graduate)	1.0	1.0	1.0	1.0
$\chi^2_3$ (P value)	4.2 (0.24)	3.5 (0.32)	1.6 (0.67)	2.8 (0.43)
Pre-hurricane marital status				
Previously married	7.4 <sup>e</sup> (3.6–15.1)	3.7 <sup>e</sup> (1.4–9.5)	1.8 (0.4–8.7)	1.1 (0.2–7.8)
Never married	8.8 <sup>e</sup> (3.3–23.7)	6.5 <sup>e</sup> (2.1–19.8)	1.3 (0.3–6.4)	0.7 (0.1–5.6)
Married or cohabiting	1.0	1.0	1.0	1.0
$\chi^2_2$ (P value)	33.7 <sup>e</sup> (<.001)	13.4 <sup>e</sup> (0.001)	0.5 (0.77)	0.1 (0.94)
Pre-hurricane employment status				
Employed	1.0	1.0	1.0	1.0
Retired	0.9 (0.2–3.5)	1.3 (0.2–9.4)	– <sup>f</sup>	– <sup>f</sup>
Student	0.4 (0.0–4.5)	0.5 (0.0–8.4)	– <sup>f</sup>	– <sup>f</sup>
Homemaker	1.3 (0.4–4.7)	0.7 (0.1–3.3)	2.8 (0.3–25.9)	0.5 (0.0–5.9)
Other	3.3 <sup>e</sup> (1.6–6.6)	0.9 (0.4–2.4)	2.6 (0.6–11.4)	0.8 (0.1–4.3)
$\chi^2_{4/2}$ (P value)	14.4 <sup>e</sup> (0.006)	0.6 (0.97)	1.6 (0.46)	0.3 (0.85)
Total <sup>g</sup>	1043	1869	286	479

<sup>a</sup> Prevalences of serious mental illness within the past 30 days and any mental illness were estimated using scores on the K6 screening scale. See text for details.

<sup>b</sup> The main effects model is based on a single logistic regression equation that includes all sociodemographic data and is estimated only in the post-Katrina sample (1043 respondents in the total sample used to predict serious mental illness and 286 with any mental illness to predict suicidal ideation). The interaction model is estimated in the two samples combined (1043 plus the 826 NCS-R respondents, for a total of 1869 to predict serious mental illness; 286 plus the 193 NCS-R respondents, for a total of 479 to predict suicidal ideation), with a dummy predictor variable for sample (post-Katrina or NCS-R), all sociodemographic data, and interactions between the dummy variable (post-Katrina coded as 1 and NCS-R coded as 0) and sociodemographic data. Sample sizes reported here are unweighted.

<sup>c</sup> Values are odds ratio (95% confidence interval) of the estimated outcome in the post-Katrina survey (numerator) versus the NCS-R survey (denominator). These values are based on weighted data.

<sup>d</sup> Age categories were collapsed to 18–39 and ≥ 40 owing to sparse data for estimating the relatively rare outcome.

<sup>e</sup> Significant at the 0.05 level with a two-sided test.

<sup>f</sup> In the subsample of respondents estimated to have a mental illness, no student or retired person reported suicidal ideation in either survey.

<sup>g</sup> Unweighted sample size.

Table 4. Proportion of participants in post-Katrina survey, 19 January–31 March 2006, who reported post-traumatic personal growth in five domains as a function of probable mental illness during the past 30 days as classified by the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition. (See text for further details.)

Domain <sup>a</sup>	Total <sup>b</sup>	Subsamples as function of mental illness <sup>c</sup>				$\chi^2_2$	P value
		Serious mental illness	Mild–moderate mental illness	Any mental illness	No mental illness		
Became closer to loved ones	81.6 (824) (2.1)	69.3 (83) (8.6)	83.0 (160) (4.3)	78.0 (243) (4.3)	83.2 (581) (2.2)	2.2	0.34
Developed faith in ability to rebuild life	95.6 (984) (1.0)	85.5 (97) (5.2)	96.7 (189) (1.2)	92.6 (286) (2.0)	97.0 (698) (1.1)	4.6	0.10
Became more spiritual or religious	66.8 (655) (2.5)	72.7 (88) (6.5)	72.1 (141) (5.6)	72.3 (229) (4.4)	64.3 (426) (3.0)	2.4	0.31
Found deeper meaning and purpose in life	75.2 (752) (2.3)	82.1 (90) (5.6)	84.0 (163) (4.2)	83.3 (253) (3.4)	71.6 (499) (2.9)	6.7 <sup>d</sup>	0.037
Discovered inner strength	69.5 (707) (2.5)	71.2 (81) (8.2)	86.9 (162) (3.6)	81.2 (243) (4.0)	64.2 (464) (3.0)	18.3 <sup>d</sup>	<0.001
Total	1043	113	206	319	724		

<sup>a</sup> Participants were asked the extent to which their experiences in the hurricane led them to changes in each domain. Response options were “a lot”, “some”, “a little” and “not at all.”

<sup>b</sup> Values are percentage (number) (standard error). The percentage and standard error are based on weighted data and the number on unweighted data.

<sup>c</sup> Prevalence of mental illness is estimated using scores from the K6 screening scale. See text for details.

<sup>d</sup> Significant at the 0.05 level with a two-sided test.

The only one of these associations that differs significantly when the post-Katrina sample was compared with the NCS-R is a higher prevalence of serious mental illness among people who were not married after Katrina than those who were married before. Suicidal ideation was the focus of a subsequent analysis of suicidality because suicide plans and attempts were too uncommon to be studied with adequate statistical power. The only statistically significant sociodemographic correlates of ideation were being 18–39 years of age and non-Hispanic white (Table 3). The second of these two associations is significantly stronger among those in the post-Katrina sample than those in the NCS-R.

### Post-traumatic growth and suicidal ideation

Most respondents to the post-Katrina survey reported the following types of post-traumatic growth: becoming closer to their loved ones (81.6%; 824/1043 in the unweighted data), developing faith in one's own abilities to rebuild one's life (95.6%; 984/1043 in the unweighted data), becoming more spiritual or religious (66.8%; 655/1043 in the unweighted data), finding deeper meaning and purpose in life (75.2%; 752/1043 in the unweighted data) and discovering inner strength (69.5%; 707/1043 in the unweighted data) (Table 4). The probabilities of two of these five vary significantly with mental illness: there is

a comparatively low probability of finding deeper meaning and purpose in life among people estimated to have mental illness and there is a comparatively high probability of discovering inner strength among people estimated to have mild–moderate mental illness.

Two of the five dimensions of post-traumatic growth are significantly related to a low prevalence of suicidal ideation among people thought to have mental illness: belief in their own ability to recover and discovery of inner strength (Table 5). The lower prevalence of suicidal ideation in the post-Katrina sample than the NCS-R is limited to those who reported these two aspects of post-traumatic growth, among whom the OR compared with the NCS-R is a statistically significant 0.2. In comparison, the prevalence of suicidal ideation among mentally ill respondents to the post-Katrina survey who had neither of these cognitions does not differ significantly from the prevalence among comparable respondents in the NCS-R, with a statistically insignificant OR of 1.1.

### Conclusion

The two-survey comparison method is an inexact way to estimate the effects of Hurricane Katrina because the surveys differed in their sampling frames (all households in two Census Divisions in the NCS-R versus households contactable by telephone in areas within

these divisions affected by the hurricane in the post-Katrina survey), mode of data collection (face-to-face versus telephone interviews) and response rates. An additional limitation concerns the K6. Although good concordance with clinical interviews has been consistently documented in published reports,<sup>23,24</sup> the K6 is merely a screening tool and not a clinical interview.

Notwithstanding these limitations, the fact that the estimated prevalence of serious mental illness and mild–moderate mental illness doubled after Hurricane Katrina is consistent with other evidence of the adverse effects on mental health of major disasters.<sup>34,35</sup> The sociodemographic correlates are also largely consistent with previous research.<sup>36,37</sup> That the associations among sociodemographic correlates were largely the same across the samples suggests that the adverse mental health effects of Hurricane Katrina were equally distributed across broad segments of the population. Although an analysis of treatment patterns goes well beyond the scope of this report, these results document a high and widely dispersed need for mental health treatment.

Our most striking finding is the lower conditional likelihood of suicidality among people believed to have mental illness after Hurricane Katrina compared with people surveyed before. This finding is not unprecedented. A cross-national epidemiological survey

Table 5. Comparison of prevalence of suicidal ideation during the past year among those with probable mental illness during the past 30 days and post-traumatic increase in faith in own ability to rebuild one's life and discovery of inner strength compared with those without post-traumatic increase, post-Katrina survey, 19 January–31 March 2006, in relation to prevalence of suicidal ideation among those with probable mental illness during the past 30 days in the National Comorbidity Survey-Replication (NCS-R), February 2001–February 2003<sup>a</sup>

Faith in own ability and discovery of inner strength	Survey		Odds ratio post-Katrina survey vs NCS-R <sup>c</sup>	$\chi^2_1$	P value
	NCS-R <sup>b</sup>	Post-Katrina <sup>b</sup>			
Yes	14.7 (38/222) (2.4)	2.9 (13/199) (1.0)	0.2 (0.1–0.4)	18.9 <sup>d</sup>	< 0.001
No	14.7 (38/222) (2.4)	16.5 (14/120) (6.8)	1.1 (0.4–3.2)	0.1	0.80
Combined	14.7 (38/222) (2.4)	7.0 (27/319) (2.3)	0.4 (0.2–1.0)	4.2 <sup>d</sup>	0.040

<sup>a</sup> Prevalence estimated using scores from the K6 screening scale. See text for details.

<sup>b</sup> Values are percentage (numerator/denominator) (standard error). The percentage and standard error are based on weighted data. The numerator and denominator are based on unweighted data.

<sup>c</sup> Values are odds ratio (95% confidence interval) of the estimated outcome in the post-Katrina survey (numerator) versus the NCS-R survey (denominator).

<sup>d</sup> Difference between the two surveys is significant at the 0.05 level with a two-sided test.

of suicidal ideation found that in Beirut during the first Lebanon–Israel war there was a lower prevalence of suicidal ideation than in any other country studied despite Beirut having a higher prevalence of depression than virtually any other study site.<sup>38</sup> While post-hoc methodological interpretations can be constructed (for example, that mental illness associated with exposure to trauma might have a lower intensity that is not detected by standard measures), they seem implausible in light of independent evidence that the severity and impairment of mental illness occurring after disasters are similar when compared with those occurring at other times.<sup>39,40</sup>

A more plausible explanation is that the effects of increased mental illness after Hurricane Katrina on suicidality were offset by protective factors activated by the hurricane. Although this possibility has not been studied in previous trauma studies, post-traumatic personal growth in areas such as self-efficacy,<sup>41</sup> optimism,<sup>30</sup> hope<sup>42</sup> and perceived social support<sup>43</sup> have been documented after disasters, and these changes have been linked to low levels of post-disaster distress.<sup>44</sup> Our findings go beyond these earlier results, though, to suggest that some dimensions of post-traumatic personal growth might be protective against suicidality among people with clinically significant mental illness. It is noteworthy that the indicators of post-traumatic growth were not strongly related to our estimates of mental illness, which means that a great many survivors of Katrina are, understandably, depressed by their losses and anxious about their future despite experiencing post-traumatic per-

sonal growth. However, the suicidality often associated with these syndromes in the general population is much lower among people in the post-Katrina sample who were able to develop a belief in their ability to rebuild their life and a perception of inner strength in the wake of the hurricane. The causal processes underlying this pattern presumably involve the creation of positive orientations towards the future that provide psychological scaffolding that protects against the suicidality often associated with extreme distress. Although processes of this sort have long been discussed in the psychoanalytic literature,<sup>45,46</sup> the current study is, to our knowledge, the first to provide quantitative evidence regarding such a pattern in an epidemiological sample of a population that has survived a disaster.

This finding suggests that further systematic investigation of post-traumatic personal growth might be useful in guiding public health efforts delivered through the mass media in the aftermath of disasters. Research has suggested that public health messages play an important part in affecting psychological reactions to disasters.<sup>47–49</sup> The promotion of positive cognitions might be an important pathway for these effects. Systematic research to explore this possibility is needed. In a more immediate way, this finding documents a psychological strength in the population affected by Hurricane Katrina that is, at least temporarily, linked to an unexpectedly low prevalence of suicidality. It is important for public health officials to recognize, though, that this low prevalence of suicidality might be temporary. For

example, if the feelings of inner strength reported by so many respondents are linked to an expectation that the practical problems of living created by the hurricane will soon be resolved, and if these expectations are not met as time goes on, one could imagine that the positive cognitions will erode and be replaced with a sense of hopelessness that, in the presence of the high estimated levels of mental illness found here, could lead to a substantial increase in suicidality. The finding of a low prevalence of suicidality, then, should be considered evidence of a short-term postponement rather than of a permanent absence of suicidality in this population. ■

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## Résumé

### Troubles mentaux et tendances suicidaires après le passage du cyclone Katrina

**Objectif** Estimer l'impact du cyclone Katrina sur la santé mentale et les tendances suicidaires par comparaison des résultats d'une enquête postérieure au passage de ce cyclone avec ceux d'une enquête réalisée auparavant.

**Méthodes** Dans le cadre de l'enquête National Comorbidity-Survey Replication, réalisée de février 2001 à février 2003, les enquêteurs ont interrogé 826 adultes vivant dans les divisions de recensement ultérieurement touchées par le cyclone. Dans l'enquête effectuée après le passage de Katrina, des entretiens ont été menés avec 1043 adultes constituant un nouvel échantillon de personnes vivant dans la même zone avant le désastre. Ces entretiens comprenaient des questions identiques au sujet des troubles mentaux et des tendances suicidaires. L'enquête post-Katrina a aussi permis d'évaluer plusieurs évolutions de la personnalité consécutives au traumatisme lié au cyclone (rapprochement avec une personne aimée, religiosité accrue, par exemple). L'échelle d'évaluation du degré de souffrance morale K6, permettant de détecter les maladies mentales graves et les troubles mentaux légers à modérés, ainsi que des questionnaires portant sur les idées, les projets et les tentatives de suicide, ont servi à mesurer les résultats.

**Résultats** Chez les personnes interrogées dans le cadre de l'enquête post-Katrina, la prévalence des troubles mentaux graves a été estimée à une valeur nettement plus élevée que chez les personnes interrogées dans l'enquête antérieure (11,3 % après Katrina contre 6,1 % avant le passage du cyclone;  $\chi^2_1 = 10,9$  ;

$p < 0,001$ ), tout comme celle des troubles mentaux légers à modérés (19,9 % après Katrina contre 9,7 % avant le passage du cyclone;  $\chi^2_1 = 22,5$  ;  $p < 0,001$ ). Néanmoins parmi les personnes évaluées comme atteintes d'un trouble mental, la prévalence des idées et des projets suicidaires s'est révélée notablement plus faible dans l'enquête post-Katrina que dans l'enquête antérieure (prévalence des idées suicidaires : 0,7 % après le passage de Katrina contre 8,4 % auparavant,  $\chi^2_1 = 13,1$  ;  $p < 0,001$  ; prévalence des projets de suicide : 0,4 % après Katrina contre 3,6 % auparavant ;  $\chi^2_1 = 6,0$  ;  $p < 0,014$ ). Une forte corrélation a été relevée entre cette baisse conjoncturelle de la prévalence des tendances suicidaires et deux facettes du développement personnel après le traumatisme (la foi en sa propre capacité à reconstruire sa vie et la prise de conscience de sa force interne), les différences relatives aux tendances suicidaires étant non significatives entre les deux enquêtes si l'on fait abstraction de l'influence de ces deux paramètres.

**Conclusion** Bien que la prévalence estimée des troubles mentaux ait doublé après le passage du cyclone Katrina, celle des tendances suicidaires s'est avérée étonnamment faible. Le rôle du développement personnel post-traumatique dans l'amélioration de l'impact des troubles mentaux d'origine traumatique en termes de tendances suicidaires mérite une étude plus approfondie.

## Resumen

### Enfermedades mentales y tendencias suicidas tras el huracán Katrina

**Objetivo** Estimar el impacto del huracán Katrina en las enfermedades mentales y las tendencias suicidas comparando los resultados de dos encuestas realizadas antes y después del huracán.

**Métodos** En el marco del National Comorbidity Survey-Replication, realizado entre febrero de 2001 y febrero de 2003, se entrevistó a 826 adultos de las Divisiones del Censo que luego se verían afectadas por el Katrina. En la encuesta realizada tras el huracán se entrevistó a una nueva muestra de 1043 adultos que vivían en la misma zona afectada. Se formularon las mismas preguntas sobre las enfermedades mentales y las tendencias suicidas. En la encuesta realizada tras el Katrina se evaluaron también varias dimensiones del desarrollo personal relacionadas con el trauma sufrido (por ejemplo una relación más estrecha con un ser querido, o una mayor religiosidad). Los indicadores de resultados empleados fueron la escala de cribado K6 de enfermedades mentales graves y enfermedades mentales leves/moderadas y diversas preguntas sobre los pensamientos, planes e intentos de suicidio.

**Resultados** Entre las personas encuestadas tras el paso del Katrina se observó una prevalencia estimada significativamente mayor de enfermedades mentales graves (11,3% después del

Katrina, frente a 6,1% antes de la catástrofe,  $\chi^2_1 = 10,9$ ;  $P < 0,001$ ) y enfermedades mentales leves/moderadas (19,9% después del huracán, frente al 9,7% anterior;  $\chi^2_1 = 22,5$ ;  $P < 0,001$ ). Entre los encuestados que se estimó que tenían enfermedades mentales, sin embargo, la prevalencia de ideas y planes suicidas fue significativamente menor en la encuesta realizada tras el Katrina (pensamientos suicidas: 0,7% después, frente a 8,4% antes;  $\chi^2_1 = 13,1$ ;  $P < 0,001$ ; planes de suicidio: 0,4% después, frente a 3,6% antes;  $\chi^2_1 = 6,0$ ;  $P = 0,014$ ). Esta menor prevalencia condicional de las tendencias suicidas estaba fuertemente relacionada con dos dimensiones del desarrollo personal tras el trauma: la confianza en la propia capacidad para reconstruir la vida, y una sensación de fortaleza interior; sin dichos factores las diferencias entre las dos encuestas serían desdeñables.

**Conclusión** Aunque la prevalencia estimada de enfermedades mentales se duplicó tras el huracán Katrina, la prevalencia de tendencias suicidas fue inesperadamente baja. La contribución del desarrollo personal postraumático a la mejora de los efectos de las enfermedades mentales relacionadas con el trauma en las tendencias suicidas debería ser objeto de nuevas investigaciones.



## ملخص

## المرض النفسي والانتحار بعد إعصار كاترينا

**الهدف:** تقييم تأثير إعصار كاترينا على المرض النفسي والانتحار، وذلك بمقارنة نتائج المسح تلو إعصار كاترينا مع نتائجه قبل ذلك.

**الطريقة:** في سياق نتائج المسح الوطني للمراضة المشتركة، والذي أجري بين شباط/فبراير 2001 وشباط/فبراير 2003، استجوبنا 826 بالغاً في أقسام تعداد السكان، ممن أصيبوا بوقت لاحق بإعصار كاترينا، ثم استجوبنا في المسح التالي لإعصار كاترينا عينة جديدة تتألف من 1043 بالغاً ممن عاشوا في نفس المنطقة قبل الإعصار. وقد سئلت في كلا المسحين أسئلة متماثلة حول المرض النفسي والانتحار. وقيّمنا في المسح التالي للإعصار أيضاً أبعاداً مختلفة للنماء الشخصي الذي نتج عن الرضح (منها على سبيل المثال ازدياد التقارب مع شخص محبوب، وازدياد الميل للتدين)، أما الحصائل المقاسة التي استخدمت فقد كانت سلم قياس لمسح الأمراض النفسية والأمراض النفسية الخفيفة والمتوسطة يتألف من 6 درجات مع أسئلة حول أفكار الانتحار والتخطيط له ومحاولة إقترافه.

**الموجودات:** لقد كان للمستجيبين للمسح الذي أجري بعد إعصار كاترينا معدلات ذات تقديرات أعلى لانتشار الأمراض النفسية الوخيمة أكثر مما لدى المستجيبين للمسح الذي أجري قبل إعصار كاترينا (فقد كان معدل الانتشار قبل إعصار كاترينا 6.1% وأصبح بعده 11.3%، وكان خي مربع

10.9 وكانت قوة الاحتمال تزيد عن 0.001) وينطبق ذلك أيضاً على الأمراض النفسية الخفيفة والمتوسطة (فقد كانت قبل إعصار كاترينا 9.7% وأصبحت بعده 19.9%، وكان خي مربع 22.5، وقوة الاحتمال تزيد عن 0.001). وقد كان من بين المستجيبين ممن يقدر بإصابته بمرض نفسي، من كانت لديه أفكار وخطط الانتحار أخفض بشكل ملحوظ بعد إعصار كاترينا (فقد بلغت أفكار الانتحار 0.7% وخطط الانتحار 0.4%) مما كانت عليه قبله (حين كانت أفكار الانتحار 8.4% وخي مربع 13.1%، وقوة احتمال أقل من 0.001، وبلغت خطط الانتحار 0.4% وخي مربع 6.0، وقوة الاحتمال 0.014). وقد كان هذا الانخفاض المشروط بمعدلات الانتحار مرتبطاً ببُعْدَيْنِ من أبعاد النماء الشخصي التالي للرضح (وهما الاعتقاد بالقدرة الذاتية للشخص على بناء حياته الشخصية، والتحقق من قواه الداخلية)، ودون هذين البعدين لم يكن هناك اختلاف ملحوظ بين المسحين.

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