Exposure to Hurricane-Related Stressors and Mental Illness After Hurricane Katrina

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Context: Uncertainty exists about the prevalence, severity, and correlates of mental disorders among people exposed to Hurricane Katrina.

Objective: To estimate the prevalence and associations between DSM-IV anxiety-mood disorders and hurricane-related stressors separately among prehurricane residents of the New Orleans metropolitan area and the remainder of the areas in Alabama, Louisiana, and Mississippi affected by Katrina.

Design: Community survey.

Setting and Participants: A probability sample of 1043 English-speaking prehurricane residents of the areas affected by Hurricane Katrina was administered via telephone survey between January 19 and March 31, 2006. The survey assessed hurricane-related stressors and screened for 30-day DSM-IV anxiety-mood disorders.

Main Outcome Measures: The K6 screening scale of anxiety-mood disorders and the Trauma Screening Questionnaire scale for posttraumatic stress disorder (PTSD), both calibrated against blinded structured clinical reappraisal interviews to approximate the 30-day prevalence of DSM-IV disorders.

Results: Prehurricane residents of the New Orleans metropolitan area were estimated to have a 49.1% 30-day prevalence of any DSM-IV anxiety-mood disorder (30.3% estimated prevalence of PTSD) compared with 26.4% (12.5% PTSD) in the remainder of the sample. The vast majority of respondents reported exposure to hurricane-related stressors. Extent of stressor exposure was more strongly related to the outcomes in the New Orleans metropolitan area subsample than the remainder of the sample. The stressors most strongly related to these outcomes were physical illness/injury and physical adversity in the New Orleans metropolitan area subsample and property loss in the remainder of the sample. Sociodemographic correlates were not explained either by differential exposure or reactivity to hurricane-related stressors.

Conclusions: The high prevalence of DSM-IV anxiety-mood disorders, the strong associations of hurricane-related stressors with these outcomes, and the independence of sociodemographics from stressors argue that the practical problems associated with ongoing stressors are widespread and must be addressed to reduce the prevalence of mental disorders in this population.

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It is well established that natural disasters lead to increased prevalence of mental illness in the range of 5% to 40%, although most increases are in the lower half of this range. Much of the between-disaster variation is likely due to differential disaster severity and exposure, as indicated by the fact that studies of people who experienced devastating loss in major natural disasters consistently document high prevalence of mental illness. Assessment of individual stressors in natural disasters is nonetheless challenging, and our understanding of their effects on postdisaster mental illness remains limited.

Hurricane Katrina was the worst natural disaster in the United States in the past 75 years, creating a disaster region as large as Great Britain, killing more than 1000 people, uprooting 500,000 others, and causing more than $100 billion in damage. This vast devastation would lead us to expect a high prevalence of mental illness among people who lived through Katrina. Available evidence is consistent with this expectation. However, no published research has yet considered the scope or variety of stressors experienced or the role played by disaster-related stressors in the mental illness of people who lived through Katrina. Such an investigation has the potential to be important in targeting intervention efforts, especially because Katrina exposed people to a wide variety of stressors, such as community disruption, job loss, and property loss, many of which still persist 2 years after the hurricane.

We examined the prevalence of hurricane-related stressors and their associations with screening measures of DSM-IV anxiety and mood disorders using data from
the Hurricane Katrina Community Advisory Group (CAG), a representative sample of 1043 prehurricane residents of the areas in Alabama, Louisiana, and Mississippi directly affected by Katrina who agreed to participate in a series of tracking surveys over several years to assess need for services and the pace of recovery efforts. Based on the much more devastating nature of the disaster in the 7 parishes defined by the Census Bureau as the New Orleans metropolitan area (henceforth New Orleans metro) than in the remainder of the hurricane area, we consider results separately in each of these 2 subsamples.

METHODS

SAMPLE

The CAG target population was English-speaking adult (aged ≥18 years) prehurricane residents of the counties (in Alabama and Mississippi) and parishes (in Louisiana) defined by the Federal Emergency Management Agency (FEMA) as directly affected by Hurricane Katrina.16 Prehurricane residents of these areas were eligible for the sample regardless of whether they were in these areas at the time of the hurricane and regardless of the extent to which they or their property were affected by the hurricane. Census data suggest that only about 1% of this population was unable to speak English,17 suggesting that the restriction of the sample to English speakers did not introduce major bias into the sample.

Respondents were selected from 3 sampling frames: the telephone numbers (land lines and cell phones) of the roughly 1.4 million families that applied for assistance from the American Red Cross (ARC); a random-digit dial (RDD) telephone frame of households in the areas affected by the hurricane; and a supplemental sample of hotels that housed FEMA-supported evacuees. Surveying was carried out between January 19 and March 31, 2006, 5 to 7 months after the hurricane. As noted earlier, prehurricane residents of New Orleans metro were oversampled.

Although the use of RDD might seem impractical in a population where many people evacuated, evacuation was much more common in the New Orleans metro than the remainder of the affected areas. Furthermore, many evacuees had returned as of the time of the survey. Random-digit dial was useful in contacting these nonevacuees and returned evacuees. The vast majority of evacuees, in comparison, applied to the ARC for assistance and could be traced through contact information provided in the ARC application for assistance. Other evacuees could be traced in the RDD sample through a call-forwarding service set up by Bell South in the wake of the hurricane, which forwarded calls to phone numbers anywhere in the country as requested by the person in whose name the prehurricane phone was registered. More details on sampling and adjustment for overlap of the frames are reported elsewhere.18

The sample of potential respondents we were able to contact and screen for eligibility represented 64.9% of those we attempted to reach. This low contact-screening rate reflects the special difficulties locating people after the massive disruption caused by Katrina. Screening-survey respondents were informed that joining the CAG required a commitment to participate in a number of follow-up surveys over several years and to provide tracing information if they moved. Screening-survey respondents were asked to consider these requirements carefully before agreeing because we wanted all respondents to participate in subsequent surveys. The 1043 respondents who agreed were administered the baseline CAG survey, the results of which are presented here. These respondents represented 41.9% of those we attempted to reach. This could have been increased up as much as 64.9% (ie, all the screening-survey respondents) if we had not required a commitment for long-term involvement in the CAG, but we felt that this commitment was needed because a central aim of the CAG was to track changes in adjustment over time.

Screening questionnaires administered to the full screening sample showed that those who did not join the CAG were similar to respondents on all sociodemographic variables but had a somewhat higher level of self-reported hurricane-related stress exposure than CAG members (assessed by asking respondents to rate their hurricane-related stress exposure on a 0-10 scale where 0 meant “no stress at all” and 10 meant “the most stress you can imagine a person having”) and more psychological distress than CAG members (assessed with a short series of questions about frequency of common anxiety-mood symptoms, responses to which were summed and normed to a 0-10 theoretical range). The median and interquartile range (IQR) (25th-75th percentiles) of reported hurricane-related stress exposure were 8.0 (IQR, 6.0-10.0) among nonrespondents and 7.0 (IQR, 5.0-9.0) among CAG members. The median and IQR of reported psychological distress were 2.9 (IQR, 1.2-4.4) among nonrespondents and 1.7 (IQR, 0.6-3.5) among CAG members. A weight was applied to the CAG data to adjust for these response biases. A within-household probability of selection weight was also used along with a poststratification weight to adjust for residual discrepancies between the CAG and the 2000 census population on a range of social, demographic, and prehurricane housing variables. The consolidated CAG sample weight, finally, was trimmed to increase design efficiency based on evidence that trimming did not significantly affect the estimated prevalence of anxiety-mood disorders.

MEASURES

Hurricane-Related Stressors

The survey included 29 structured questions developed based on pilot interviews about hurricane-related stressors. In addition, we asked an open-ended question—"What would you say are your most serious practical problems caused by Katrina?"—in an effort to discover any common stressors not covered in the structured questions. It should be noted that some respondents, especially evacuees to South Texas, were subsequently exposed to Hurricane Rita. To capture information about these experiences, we asked all respondents whether they were exposed to Rita, and if so, we asked about stressors experienced in either hurricane. The full text of the interview schedule that includes the complete set of stressor questions is available elsewhere.18

Ten stressors emerged as sufficiently common to be considered in this analysis. Four were traumatic stressors in the sense specified in the DSM-IV for a diagnosis of posttraumatic stress disorder (PTSD): experiences that involved serious risk of death, death of a loved one (family member or close friend), victimization (burglary, robbery, physical assault, or sexual assault) due to lawlessness after the storm, and victimization of a loved one. The other 6 were for the most part nontraumatic stressors: physical illness or injury caused or exacerbated by the storm, extreme physical adversity (eg, sleeping in a church basement, difficulty obtaining adequate food or clothing), extreme psychological adversity (eg, living in circumstances where the respondent had to use the toilet or change clothes without adequate privacy, exposure to threats of violence), major property loss, income loss, and ongoing difficulties associated with housing (multiple moves or living in substantially worse posthurricane than prehurricane housing). Some cases of the latter 6 stressors were described by respondents in ways that implied that the stressors might have been traumatic (eg, a life-
threatening injury, a threat of fatal violence), but no attempt was made to distinguish these cases from nontraumatic stressors because the open-ended reports of these events were often too imprecise to make this distinction clearly.

**Mental Illness**

The K6 scale of nonspecific psychological distress\(^{19}\) was used to screen for DSM-IV anxiety disorders within 30 days of the interview.\(^{30}\) Scores range from 0 to 24. Two independent validation studies found the K6 to have an area under the receiver operating characteristic curve between 0.86\(^{19}\) and 0.89\(^{11,12}\) in predicting diagnoses of mental illness based on comprehensive diagnostic interviews. Based on previous K6 validation and using the definition of the terms from SAMHSA (Substance Abuse and Mental Health Services Administration), scores of 13 to 24 were classified probable serious mental illness (SMI) while scores of 8 to 12 were classified probable mild/moderate mental illness (MMI) and scores of 0 to 7 were classified probable noncases. The designation of MMI represents respondents who were estimated to meet criteria for a DSM-IV anxiety-mood disorder but not SMI. Previous research has shown that MMI is of considerable public health importance because of its high prevalence, burden, and risk of transition to SMI.\(^{21}\) A small clinical reappraisal study of 5 respondents selected randomly from each of these 3 K6 categories (SMI, MMI, noncase) with the Structured Clinical Interview for DSM-IV (SCID)\(^{14}\) confirmed K6 classifications for 14 of 15 respondents. The exception was a respondent classified as having SMI by the K6 but MMI by the SCID based on a global assessment of functioning (GAF) score of 65 (a GAF score of 0-60 is required to diagnose SMI). These results, although based on only a small sample, suggest that the K6 has excellent psychometric properties (estimated in the SCID sample weighted to adjust for the sample-wide K6 distribution), including sensitivity (1.0 for SMI, 0.90 for MMI, and 1.0 for either SMI to MMI) and specificity (1.0).

Given the special importance of PTSD in trauma situations, a separate PTSD screen was included based on the 12-item Trauma Screening Questionnaire (TSQ),\(^{25}\) a validated screen for PTSD.\(^{26}\) Our version differed from the original TSQ in using dimensional response options rather than a simple yes-no response format to assess 30-day symptom frequency (never, less than once a week, about once a week, 2 to 4 days a week, and most every day). A clinical reappraisal study was carried out to calibrate TSQ responses to DSM-IV PTSD with 30 respondents judged possible cases and 10 randomly selected others. A cutoff on the factor-based 0-to-42 scale of TSQ responses (12 items, each scored 0-4) was used to approximate the SCID PTSD prevalence in the weighted (to adjust for oversampling of screened positives) clinical reappraisal sample. Sensitivity (0.89), specificity (0.93), and area under the receiver operating characteristic curve (0.91) were all excellent for this dichotomous screen.

**Sociodemographic Controls**

We examined associations of K6 and TSQ approximations of DSM-IV diagnoses with several sociodemographic variables: age, sex, race/ethnicity, family income in the year before the hurricane, education, prehurricane marital status, and prehurricane employment status. Age was coded 18 to 39 years, 40 to 59 years, and 60 years or older. Race/ethnicity was coded non-Hispanic white, non-Hispanic black, and other (largely Hispanic and Asian). Family income was coded in quartiles where low was defined as less than or equal to 0.5 of the population median on the ratio of per-tax income to number of family members while low-average was defined 0.5+ through 1.0 on the same ratio; high-average, 1.0+ through 3; and high, 3+ on this ratio. Years of education were coded in 4 categories: 0 to 11, 12 (high school graduate), 13 to 15, and 16+ (college graduate). Marital status was coded married (including cohabiting, excluding separated), never married, and previously married (separated, widowed, divorced). Employment status, finally, was coded employed (including self-employed and full-time students), homemaker, retired, and other (largely unemployed and disabled).

**ANALYSIS METHODS**

Estimated prevalence of DSM-IV disorders and hurricane-related stressors were examined with cross-tabulations that distinguished prehurricane residents of the New Orleans metro from the remainder of the sample. The effects of sociodemographic variables, hurricane-related stressors, and their interactions in predicting the estimates of DSM-IV disorders were examined using logistic regression analysis.\(^{27}\) Logistic regression coefficients and their standard errors were exponentiated to create odds ratios (ORs) and 95% confidence intervals (95% CIs) for ease of interpretation. Because the data were weighted, the Taylor series linearization method\(^{28}\) was used to calculate design-based significance tests. Multivariate significance was calculated using Wald $\chi^2$ tests based on design-corrected coefficient variance-covariance matrices. Statistical significance was evaluated using 2-sided .05-level tests.

### Table 1. Estimated 30-Day Prevalence of DSM-IV Anxiety-Mood Disorders

<table>
<thead>
<tr>
<th>Disorder</th>
<th>New Orleans Metro (n=594)</th>
<th>Remainder of Sample (n=449)</th>
<th>Total (N=1043)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any anxiety-mood disorder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMI</td>
<td>32.0 (3.7)</td>
<td>16.6 (2.4)</td>
<td>19.9 (2.1)</td>
</tr>
<tr>
<td>SMI</td>
<td>17.0 (2.6)</td>
<td>9.8 (2.1)</td>
<td>11.3 (1.8)</td>
</tr>
<tr>
<td>Any (MMI or SMI)</td>
<td>49.1 (3.3)</td>
<td>26.4 (3.1)</td>
<td>31.2 (2.6)</td>
</tr>
<tr>
<td>PTSD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD given MMI</td>
<td>42.5 (8.9)</td>
<td>24.8 (7.0)</td>
<td>30.9 (5.8)</td>
</tr>
<tr>
<td>PTSD given SMI</td>
<td>98.1 (1.0)</td>
<td>85.8 (7.6)</td>
<td>89.7 (5.4)</td>
</tr>
<tr>
<td>PTSD total</td>
<td>30.3 (3.7)</td>
<td>12.5 (2.2)</td>
<td>16.3 (2.0)</td>
</tr>
</tbody>
</table>

Abbreviations: Metro, metropolitan area; MMI, mild/moderate mental illness; PTSD, posttraumatic stress disorder; SMI, serious mental illness. *Estimates of anxiety-mood disorders were based on the K6 and Trauma Screen Questionnaire scales. See the “Methods” section for details.

**RESULTS**

The estimated prevalence of any 30-day DSM-IV anxiety-mood disorder based on the K6 was 31.2% in the total sample (Table 1) and significantly higher among prehurricane residents of the New Orleans metro (49.1%) than the remainder of the sample (26.4%; $z=5.0, P<.001$). Approximately one-third of respondents who screened positive for a DSM-IV anxiety-mood disorder were classified as having probable SMI (11.3%) and the other two-thirds as having probable MMI (19.9%). The ratio of prob-
We examined sociodemographic correlates of estimated PTSD, of other estimated DSM-IV anxiety-mood disorders exclusive of PTSD, and of probable SMI or MMI separately in the New Orleans metro subsample and the remainder of the sample (Table 2). Estimated prevalence of any DSM-IV anxiety-mood disorder was consistently associated with age less than 60 years, female sex, education less than college graduation, low family income, “other” prehurricane employment status (largely unemployed and disabled), and being unmarried. In addition, Hispanic individuals and people of other racial/ethnic minorities exclusive of non-Hispanic black had

### Table 2. Bivariate Associations of Sociodemographic Variables With Estimated 30-Day DSM-IV Anxiety-Mood Disorders

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>PTSD</th>
<th>Other MMI or SMI</th>
<th>Any MMI or SMI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New Orleans Metro (n=594)</td>
<td>Remainder of Sample (n=449)</td>
<td>New Orleans Metro (n=594)</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-39</td>
<td>2.9 (0.7-12.6)</td>
<td>1.8 (0.5-5.6)</td>
<td>1.3 (0.4-5.0)</td>
</tr>
<tr>
<td>40-59</td>
<td>2.0 (0.6-6.9)</td>
<td>1.3 (0.4-4.3)</td>
<td>1.5 (0.7-3.6)</td>
</tr>
<tr>
<td>≥60</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
</tr>
<tr>
<td>chi²</td>
<td>2.2</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>2.7 (1.3-5.9)</td>
<td>2.7 (1.1-6.3)</td>
<td>1.3 (0.6-2.9)</td>
</tr>
<tr>
<td>Male</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
</tr>
<tr>
<td>chi²</td>
<td>6.4</td>
<td>5.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
</tr>
<tr>
<td>Non-Hispanic black</td>
<td>1.9 (0.8-4.8)</td>
<td>1.0 (0.4-2.3)</td>
<td>0.5 (0.2-1.2)</td>
</tr>
<tr>
<td>Hispanic or other</td>
<td>0.5 (0.1-1.6)</td>
<td>0.0 (0.0-0.1)</td>
<td>0.3 (0.1-0.9)</td>
</tr>
<tr>
<td>chi²</td>
<td>4.0</td>
<td>15.7</td>
<td>5.6</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>3.9 (1.3-11.7)</td>
<td>7.9 (1.5-40.6)</td>
<td>0.7 (0.3-1.9)</td>
</tr>
<tr>
<td>High school</td>
<td>1.8 (0.5-5.9)</td>
<td>3.2 (0.7-15.2)</td>
<td>0.9 (0.3-2.1)</td>
</tr>
<tr>
<td>Some college</td>
<td>2.9 (1.0-8.3)</td>
<td>4.0 (0.8-18.7)</td>
<td>1.7 (0.8-3.9)</td>
</tr>
<tr>
<td>College graduate</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
</tr>
<tr>
<td>chi²</td>
<td>7.3</td>
<td>6.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Family income (prehurricane)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>4.1 (1.3-12.6)</td>
<td>17.7 (2.1-145.6)</td>
<td>0.8 (0.3-2.1)</td>
</tr>
<tr>
<td>Low-average</td>
<td>4.0 (1.5-10.6)</td>
<td>6.2 (0.6-61.7)</td>
<td>0.7 (0.3-1.7)</td>
</tr>
<tr>
<td>High-average</td>
<td>2.0 (0.8-5.5)</td>
<td>4.3 (0.4-43.8)</td>
<td>0.9 (0.3-2.5)</td>
</tr>
<tr>
<td>High</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
</tr>
<tr>
<td>chi²</td>
<td>10.5</td>
<td>12.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Occupational status (prehurricane)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
</tr>
<tr>
<td>Housewife</td>
<td>1.1 (0.3-4.3)</td>
<td>1.0 (0.2-5.7)</td>
<td>0.2 (0.0-0.8)</td>
</tr>
<tr>
<td>Retired</td>
<td>1.4 (0.3-7.9)</td>
<td>1.4 (0.4-5.1)</td>
<td>1.0 (0.4-2.7)</td>
</tr>
<tr>
<td>Other</td>
<td>5.3 (2.3-12.4)</td>
<td>4.7 (1.8-12.0)</td>
<td>1.0 (0.4-2.5)</td>
</tr>
<tr>
<td>chi²</td>
<td>15.0</td>
<td>12.2</td>
<td>5.5</td>
</tr>
<tr>
<td>Marital status (prehurricane)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or cohabiting</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
<td>1.0 (Reference)</td>
</tr>
<tr>
<td>Previously married</td>
<td>2.3 (1.0-5.0)</td>
<td>8.0 (3.2-20.0)</td>
<td>0.8 (0.3-1.9)</td>
</tr>
<tr>
<td>Never married</td>
<td>2.1 (0.7-6.5)</td>
<td>5.1 (1.8-15.0)</td>
<td>0.8 (0.3-2.2)</td>
</tr>
<tr>
<td>chi²</td>
<td>4.9</td>
<td>21.1</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Abbreviations: Metro, metropolitan area; MMI, mild/moderate mental illness; PTSD, posttraumatic stress disorder; SMI, serious mental illness.

* Estimates of anxiety-mood disorders were based on the K6 and Trauma Screening Questionnaire scales. See the “Methods” section for details.

* Values are given as odds ratio (95% confidence interval).

* Significantly at the .05 level, 2-sided test.
significantly lower estimated prevalence of any disorder than non-Hispanic white individuals in the New Orleans metro as well as a significantly lower estimated prevalence of PTSD in the remainder of the sample. The strongest ORs in the New Orleans metro were for low income and other employment status with PTSD (4.0-5.3), whereas the strongest ORs in the remainder of the sample were for low education, low income, other employment status, and being unmarried with PTSD (4.7-17.7). Although some of the significant sociodemographic predictors of estimated SMI or MBI had different associations with estimated PTSD than with other estimated anxiety-mood disorders, these associations were inconsistent across geographic subsamples.

### PREVALENCE OF HURRICANE-RELATED STRESSORS

The vast majority of respondents both in the New Orleans metro (91.9%) and in the remainder of the sample (81.7%) reported experiencing at least 1 of the 10 categories of hurricane-related stressors (Table 3). New Orleans metro respondents reported a higher prevalence of each stressor than respondents in the remainder of the sample. The 2 most frequently reported stressors were housing adversity (71.7%) in the New Orleans metro; 34.1% in the remainder of the sample; \( z=8.6, P<.001 \) and property loss (70.2% vs 47.8%; \( z=4.9, P<.001 \). Other stressors occurred to between 33.6% and 46.3% (physical adversity) and 0.9% and 1.1% (life-threatening experience) of respondents.

### ASSOCIATIONS OF HURRICANE-RELATED STRESSORS WITH ESTIMATED ANXIETY-MOOD DISORDERS

Because high intercorrelations among stressors made it difficult to assess the separate effects of individual stressors in predicting estimated mental disorders, we evaluated a series of logistic regression models that included additive and interactive effects of exposure to multiple stressors (Table 4). Model 1 included only sociodemographic predictors. Model 2 then added information about number of hurricane-related stressors, ignoring type of stressor. Information about number of stressors was significantly related to the outcomes in all but 1 instance (other probable anxiety-mood disorders in the subsample exclusive of the New Orleans metro; \( \chi^2=13.7, P=.06 \)). We then evaluated a series of 10 models, each adding 1 of the 10 stressors to model 2 to determine whether type of stressor predicted the outcomes net of number of stressors. (Detailed results are not reported but are available on request.) Three of these 10 were significant: physical illness/injury and physical adversity in the New Orleans metro and property loss in the remainder of the sample. When these significant adversities were added to model 2, the best-fitting specification included a single predictor to distinguish respondents exposed to 1 or more stressors vs none plus separate predictors for...
In hurricane-related stressors. They could not. (Detailed re-

Table 2 could be explained by differential exposure to

The ORs are consistently higher in the New Orleans me-

Orleans metro and 1.5-1.8 in the remainder of the sample.

The ORs for other stressors are 3.6-6.3 in the New Or-

creased odds of the outcomes in the New Orleans metro

injury and physical adversity are associated with in-

Pairs among the 10 stressors minus 1

tive pattern because the 44

count of stressors) might have failed to detect substan-

The best-fitting model 3 shows that physical illness/

The 2 (in the New Orleans metro) or 1 (in the remainder

creed significantly higher than the others. The latter model

remained significant at the .05 level after introducing con-

cter the results reported here on predictors to be conserva-

ged significantly on model 2. We next considered a model

Second, the survey response rate was low and the sam-

ing the results reported here. This imprecision will gen-

Five principal limitations need to be noted. First, mental

disorders were estimated with screening scales rather than

dependent events, and in the New Orleans metro area, the

test reliability and are relatively free from recall bias.30 In

addition, because our assessment was conducted only 5 to

months after the hurricane, many of the hurricane-related

stressors were still directly and immediately relevant to re-

In the New Orleans metro.

the 27 statistically significant ORs in Table 2

the 27 statistically significant ORs in Table 2 remained sig-

Five principal limitations need to be noted. First, mental dis-

orders were estimated with screening scales rather than clini-

cal interviews. Despite the fact that the K6 screening scale

has been used in national surveys20,29 and has been previ-

ously validated19,21,22 and the fact that the modified TSQ was

found to be valid in our clinical reappraisal study, screen-

ing scales are inevitably less precise than clinical inter-

views. This imprecision will generate attenuated associa-

tions, leading the results reported here on predictors to be conser-

spondents at the time of their interviews. Fifth, no attempt

was made to tease apart the effects of exposure to stressors

related to Hurricane Katrina vs Hurricane Rita even though

some of the respondents were exposed to Rita in the wake

of Katrina. As noted in the section on measures, we asked

respondents to include information about stressors related
to Rita in their reports. The effects of Rita are consequently

in the results reported here.

Within the context of these limitations, the estimated

prevalence of DSM-IV anxiety and mood disorders in the New

Orleans metro was substantially higher than typically found

in US population-based surveys of mental illness after natu-

ral disasters, while the estimated prevalence in the remain-

der of the sample was comparable with that in previous

studies.5,31 Previous reviews have noted that making com-

JOINT EFFECTS OF SOCIODEMOGRAPHICS

and hurricane-related stressors

Analyses were conducted to determine whether the sig-

nificant sociodemographic associations documented in

Table 2 could be explained by differential exposure to

hurricane-related stressors. They could not. (Detailed re-

sults are not reported but are available on request.) Inde-

eed, 22 of the 27 statistically significant ORs in Table 2

remained significant at the .05 level after introducing con-

controls for the stressors. The other previously significant

ORs only changed modestly in substantive terms.

We also evaluated the possibility that the adverse ef-

fects of the hurricane-related stressors vary across socio-

demographic subsamples. To increase statistical power, we

combined the significant stressors from Table 5 into a single

measure by generating individual-level predicted prob-

abilities of the outcomes based on the coefficients in model

3. This summary measure was used in interaction with the

sociodemographic variables. No more interactions were

found to be statistically significant at the .05 level in these

tests than would be expected by chance.

COMMENT

Abbreviations: CI, confidence interval; metro, metropolitan area;

MMI, mild/moderate mental illness; PTSD, posttraumatic stress disorder;

SMI, serious mental illness.

Estimates of anxiety-mood disorders were based on the K6 and Trauma

Screening Questionnaire scales. See the “Methods” section for details.

Coefficient estimates are based on M3 in Table 4.

a Significant at the .05 level, 2-sided test.

b Each predictor is a dichotomy coded 1 for respondents who experienced

the stressor and 0 for respondents who did not experience the stressor. The

dichotomy defining any other stressor includes all stressors other than

physical illness/injury and physical adversity in the New Orleans metro

subsample and all stressors other than property loss in the remainder of

the sample.

Table 5. Multivariate Associations of Hurricane-Related

Stressors With Estimated 30-Day DSM-IV Anxiety-Mood

Disorders

<table>
<thead>
<tr>
<th>Stressor</th>
<th>PTSD</th>
<th>Other MMI or SMI</th>
<th>Any MMI or SMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Orleans Metro</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical injury/illness</td>
<td>2.8 (1.2-6.6) b</td>
<td>7.4 (2.8-19.5) b</td>
<td>6.5 (2.9-14.6) b</td>
</tr>
<tr>
<td>Physical adversity</td>
<td>7.9 (3.2-19.7) b</td>
<td>3.2 (1.4-7.2) b</td>
<td>6.0 (2.9-12.3) b</td>
</tr>
<tr>
<td>Any other stressor c</td>
<td>3.6 (0.7-20.2)</td>
<td>6.3 (1.8-21.4)</td>
<td>5.5 (2.0-15.0) b</td>
</tr>
<tr>
<td>Remains of Sample</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property loss</td>
<td>5.6 (1.8-17.8) b</td>
<td>2.8 (1.3-6.3) b</td>
<td>4.2 (2.0-8.9) b</td>
</tr>
<tr>
<td>Any other stressor c</td>
<td>1.8 (0.6-5.2)</td>
<td>1.5 (0.5-4.3)</td>
<td>1.7 (0.7-4.0)</td>
</tr>
</tbody>
</table>

a Estimates of anxiety-mood disorders were based on the K6 and Trauma

Screening Questionnaire scales. See the “Methods” section for details.

b Significant at the .05 level, 2-sided test.

c Each predictor is a dichotomy coded 1 for respondents who experienced

the stressor and 0 for respondents who did not experience the stressor. The

dichotomy defining any other stressor includes all stressors other than

physical illness/injury and physical adversity in the New Orleans metro

subsample and all stressors other than property loss in the remainder of

the sample.

The 2 (in the New Orleans metro) or 1 (in the remainder

creed significantly higher than the others. The latter model

improved significantly on model 2. We next

considered a model that allowed for interactions among

pairs of stressors (model 4). No significant interactions

of this type were found. We also examined the ORs in

model 4 for evidence of a consistently strong substantive

pattern because the 44 df test (all logically possible

pairs among the 10 stressors minus 1 df for the global

count of stressors) might have failed to detect substanci-

tively important patterns in a small number of pairs. No

such evidence was found.

The best-fitting model 3 shows that physical illness/

injury and physical adversity are associated with in-

creased odds of the outcomes in the New Orleans metro

(2.8-7.9) while financial loss is associated with increased

 odds in the remainder of the sample (2.8-5.6) (Table 5). The

ORs for other stressors are 3.6-6.3 in the New Or-

leans metro and 1.5-1.8 in the remainder of the sample.

The ORs are consistently higher in the New Orleans me-

tro than the remainder of the sample with the exception

of a higher OR associated with property loss in predicting

estimated PTSD in the remainder of the sample.
parisons of prevalence estimates across disasters is challeng-
ing because of the wide range of disaster experiences to which people in disasters are exposed. However, broadly speak-
ing, the high estimated prevalence of anxiety-mood disor-
ders in the New Orleans metro is consistent with the results
of studies that considered persons in highly disaster affected
areas,11,10 while the lower estimated prevalence in the remain-
der of the sample is consistent with the results of previous
studies in areas with lower disaster impact.13 We found that
the vast majority of respondents estimated to have SMI (98.1%
in the New Orleans metro and 85.8% in the remainder of
the sample) also screened positive for PTSD, reinforcing the
notion that PTSD is the central form of psychopathology
associated with natural disasters.32

Nearly one-fourth of New Orleans metro respond-
ents and one-sixth of other respondents were exposed to
traumatic hurricane-related stressors, while the vast
majority of respondents (79%-90%) were exposed to oth-
er hurricane-related stressors. Comparing these estimates
with other postdisaster samples is challenging because
few previous studies either attempted to sample com-
plete populations affected by large disasters or compre-
hensively assessed disaster-related stressors. However, to
the extent that comparisons allow, it appears that the pro-
portion of people experiencing hurricane-related stress-
ors after Katrina was substantially higher than after other
recent hurricanes, such as Hurricane Andrew in 199333
and Hurricanes Charley/Frances/Ivan/Jeanne in 2004.34

Although the hurricane-related stressors assessed here
were significant predictors of estimated anxiety-mood dis-
orders, the stressors with the highest ORs were different
in the New Orleans metro (physical illness/injury and
physical adversity) than the remainder of the sample
(property loss). It is especially striking that the impact
of property loss was less in the New Orleans metro than
the remainder of the hurricane area even though prop-
erty loss was much more commonly experienced in the
New Orleans metro than the remainder of the hurricane
area. One possible explanation for this difference is that
personal property loss might have been experienced as
less stressful in a situation where, in the New Orleans
metro, property loss was the norm in the population. Or
it might be that evacuation and physical displacement,
which occurred to the vast majority of prehurricane resi-
dents of the New Orleans metro, created a context in
which property loss had much less of an emotional effect
than in the rest of the hurricane area. It is also possible
that the subjective stressfulness of property loss was less-
ened in the context of the situation in the New Orleans
metro, where many people were exposed to even worse
stressors, such as death and injury and extreme physi-
cal adversity. But these are merely speculations. The only
certain conclusion that can be drawn from the results reg-
arding variation in the relative effects of specific stress-
ors in New Orleans and the remainder of the hurricane
area is that we have much more to learn about the ways
in which multiple exposures and disaster context influ-
ence the effects of individual disaster-related stressors.

The findings that women, young people, and people with
low socioeconomic status were at comparatively high risk
of anxiety-mood disorders are consistent with previously
documented correlates of mental illness after disasters.31

and other traumas.33 Importantly, though, these same
associations are found in community epidemiological sur-
vays in the absence of disasters, suggesting that these
associations might be related to preexisting mental disorders.14
Consistent with this possibility, these sociodemographic
associations were not explained by exposure to hurricane-
related stressors. Nor did we find evidence that the asso-
ciations of hurricane-related stressors with estimated anxi-
eity-mood disorders differ meaningfully in subsamples
defined by these sociodemographic factors.

The finding that Hispanic individuals and people of
other minorities exclusive of non-Hispanic black had sig-
nificantly lower estimated prevalence of anxiety-mood
disorders than non-Hispanic white individuals is diffi-
cult to interpret. Previous research has found elevated
prevalence of postdisaster mental illness among His-
panic people,36 although this was largely Puerto Rican and
Dominican individuals whereas the prehurricane His-
panic people in the Katrina area were largely Mexican-
American. However, caution is needed in interpreting this
finding, because the number of respondents in our mi-
nority subsample is quite small (35 respondents) and in-
cludes Asian as well as Hispanic individuals. Future re-
search will need much larger samples to investigate ethnic
differences in disaster response, noting that elevated preva-
ience among Hispanic people could well vary substan-
tially among Mexican-American people compared with
other segments of the Hispanic population.

The results lead to 4 conclusions. First, the stressors
considered here appear to have played a critical role in
the high prevalence of hurricane-related anxiety-mood
disorders. Second, the fact that the associations be-
 tween hurricane-related stressors and estimated anxiety-
mood disorders were stronger in the New Orleans me-
tro than the remainder of the hurricane area suggests that
undetermined vulnerability or contextual factors were
present in the New Orleans metro that remain under-
stood. Third, the observation that hurricane-related stressor exposure was widespread and comparable across sociodemographic subsamples means that the impact of the hurricane on mental health was widespread rather
than concentrated in any one particular segment of the
population. This, in turn, suggests that efforts to ad-
dress the problem of increased mental illness in the wake
of the hurricane must address the needs of persons in all
segments of society rather than target specific popula-
tion segments. This may be particularly challenging for
prehurricane residents of the New Orleans metro, many
of whom are now living throughout the country. Fourth,
evidence that avoidable stressors associated with the slow
government response to Hurricane Katrina (eg, physi-
cal adversity) had important implications for the men-
tal health of people who lived through Katrina argues
strongly for the importance of efficient provision of prac-
tical and logistical assistance in future disasters, not only
on humanitarian grounds, but also as a way to minimize
the adverse mental health effects of disasters.

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