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Mental Health and General Wellness in the Aftermath of Hurricane Ike

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Abstract

Exposure to natural disasters has been linked to a range of adverse outcomes, including mental health problems (e.g., posttraumatic stress symptoms [PTSS], depression), declines in role functioning (e.g., occupational difficulties), and physical health problems (e.g., somatic complaints). However, prior research and theory suggest that the modal postdisaster response in each of these domains is *resilience*, defined as low levels of symptoms or problems in a given outcome over time, with minimal elevations that are limited to the time period during the disaster and its immediate aftermath. However, the extent to which disaster survivors exhibit *mental health wellness* (resilience across multiple mental health conditions) or *general wellness* (resilience across mental health, physical health, and role functioning domains) remains unexplored. The purpose of this study was to quantify mental health and general wellness, and to examine predictors of each form of wellness, in a three-wave population-based study of Hurricane Ike survivors (N = 658). Latent class growth analysis was used to determine the frequency of resilience on four outcomes (PTSS: 74.9%; depression: 57.9%; functional impairment: 45.1%; days of poor health: 52.6%), and cross-tabulations were used to determine the frequency of mental health wellness (51.2%) and general wellness (26.1%). Significant predictors of both mental health and general wellness included lower perievent emotional reactions and higher community-level collective efficacy; loss of sentimental possessions or pets and disaster-related financial loss were negative predictors of mental health wellness, and loss of personal property was a negative predictor of general wellness. The results suggest that studies focusing on a single postdisaster outcome may have overestimated the prevalence of mental health and general wellness, and that

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peri-event responses, personal property loss and collective efficacy have a cross-cutting influence across multiple domains of postdisaster functioning.

Keywords

Wellness; resilience; mental health; physical health; role functioning; natural disasters

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It has been amply demonstrated that disasters are accompanied by increased rates of psychopathology and disability (Galea, Nandi, & Vlahov, 2005; Norris et al., 2002). The range of adverse outcomes experienced by disaster survivors extends across multiple domains of functioning, including *mental health*, such as posttraumatic stress symptoms (PTSS) and depression; *role functioning*, such as *functional impairment*, including difficulties in social, educational, and occupational roles; and *physical health*, such as somatic complaints and impaired immune function (Norris et al., 2002). Although overall rates of adverse outcomes in these three domains tend to increase in the aftermath of disaster, the modal response to disaster exposure is thought to be *resilience*, defined as a trajectory of low levels of symptoms or problems in a given outcome over time, with minimal elevations that are limited to the time period during the disaster and its immediate aftermath (Bonanno, 2004; Bonanno & Diminich, 2013). Aligning with this expectation, several longitudinal studies of mental health in the aftermath of disasters have shown that the largest proportion of participants exhibits a trajectory of stably low symptoms (e.g., Lowe & Rhodes, 2013; Nandi, Tracy, Beard, Vlahov, & Galea, 2009; Norris, Tracy & Galea, 2009). The broader concept of *wellness* has been defined as resilience across domains, that is, low levels of mental health problems, functional impairment, and physical health problems over time in the aftermath of a traumatic event (Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008). In the current study, we differentiate between this general definition of wellness, which we label *general wellness*, and *mental health wellness*, which we define as resilience across various conditions within the mental health domain (e.g., PTSS and depression) specifically.

Research to date has provided limited evidence on the rates of mental health and general wellness in the aftermath of disasters. First, studies on postdisaster mental health have generally focused on resilience, documenting rates of a stably low trajectory of symptoms of a single disorder, such as PTSD (e.g., Norris et al., 2009). No study in a disaster context to our knowledge has attempted to identify individuals who experienced resilience across multiple mental health conditions, which would determine rates of mental health wellness. A study of traumatic injury survivors recruited from a large medical center examined mental health wellness in a non-disaster context, however, and suggested it may be a prevalent response to traumatic events: 57.7% of participants exhibited consistently low levels of both PTSS and depression following exposure to a traumatic injury (deRoon-Cassini, Mancini, Rusch, & Bonnano, 2010).

Second, extant disaster studies generally have focused solely on mental health outcomes, and have inadequately integrated other domains of general wellness, including role functioning and physical health. The limited research to date has provided evidence that

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outcomes in different domains tend to be related; for example, postdisaster declines in physical health have been found to be associated with declines in mental health (e.g., Lowe, Willis & Rhodes, 2013). Although such findings suggest that resilience in one domain might be related to resilience in another, rates of resilience across domains – that is, rates of general wellness – have not been quantified. Without an estimation of postdisaster mental health and general wellness, it remains unknown how many disaster survivors do not experience mental health and general wellness (i.e., experience a non-resilient trajectory of symptoms of one or more mental health conditions, or a non-resilient trajectory in one or more broader domains of mental health, role functioning, or physical health, respectively). This information would provide important information on the proportion of survivors who might be in need of postdisaster services.

An improved understanding of the predictors of mental health and general wellness could likewise help identify targets for population recovery after disasters or other mass traumatic events. A large body of literature has explored predictors of resilience on single indicators of mental health (e.g., PTSS, depression). This body of work has shown that lower exposure to disaster-related traumatic events and stressors, lower peri-event emotional reactions, and higher community resources (e.g., collective efficacy and social support) are consistently predictive of improved mental health (e.g. Galea et al., 2002; Galea, Tracy, Norris, & Coffey, 2008; Norris et al., 2002). The limited research on postdisaster physical health suggests that these factors are also predictive of physical health resilience (Boscarino & Adams, 2009; Dirkzwager et al., 2006; Lu, 2011). Yet, in the absence of studies that explore multiple indicators of mental health or multiple domains of functioning simultaneously, it remains unknown whether these factors truly promote mental health and general wellness, respectively.

In this study, we aimed to quantify both mental health wellness (resilience across multiple mental health conditions), and general wellness (resilience across mental health, role functioning, and physical health domains) in a population-based sample in the aftermath of a major natural disaster, Hurricane Ike. We also aimed to examine predictors of both forms of wellness, including factors previously associated with resilience in the individual domains (i.e. disaster-related trauma and stressor exposure, peri-event emotional reactions, and postdisaster social and community resources).

Method

Participants and Procedures

Hurricane Ike make landfall over Gavleston, Texas, on September 13, 2008 as a Category 2, with the highest storm surge occurring in Galveston and Chambers counties (Berg, 2009). Eligible participants in the current study were those 18 years and older who were living in Galveston County or Chambers County for at least one month prior to the hurricane. Detailed methods used to sample study participants have been described elsewhere *(masked for blind review)*. Briefly, the two counties were divided into five strata and, within the five strata, 80 area segments were selected and 2,263 households were contacted. A total of 658 participants completed interviews at Wave 1 (W1), which conducted approximately two to five months after Hurricane Ike, resulting in a response rate of 40% (American Association

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for Public Opinion Research [AAPOR] RR4; AAPOR, 2011). Follow-up interviews were conducted at five to 9 months (Wave 2 [W2]; *n* = 529) and 14 to 19 months (Wave 3 [W3]; *n* = 487) postdisaster. A total of 448 participants completed all three waves, and no significant differences were detected between completers and non-completers on any of the outcome or exposure variables, or covariates included in the current study, which are listed in Table 1. Interviews were conducted using a computer assisted interview system. After the study was described to participants at each wave, oral informed consent was obtained. All study procedures were approved by *(masked for blind review)*.

Measures

Posttraumatic stress symptoms (PTSS)—Posttraumatic stress symptoms related to Hurricane Ike were assessed at each wave using the Posttraumatic Stress Disorder (PTSD) Checklist-Specific version (PCL-S; Blanchard, Jones-Alexander, Buckley, & Forneris, 1996). Whereas the PCL-S is typically asked in reference to the prior month, the instructions were modified for the current study such that at W1, questions were asked in reference to the period since the hurricane, and at W2 and W3, the period since the previous interview. The PCL-S consists of 17 items (e.g., “repeated, disturbing memories of Hurricane Ike”) assessing DSM-IV-TR symptoms of PTSD. Items are rated from 1 (not at all) to 5 (extremely), and a severity score was calculated as the sum of responses, ranging from 17 to 85. The PCL-S has been shown to have excellent internal consistency and substantial agreement with PTSD diagnosis and symptom ratings (Weathers, Litz, Herman, Huska, & Kean, 1993). Cronbach’s α for the PCL-S scale in the current study ranged from .92 to .96.

Depression—Depressive symptoms in the past month were assessed at each wave using the Patient Health Questionnaire (PHQ-9) (Kroenke & Spitzer, 2002). The PHQ-9 has been widely used and has excellent internal consistency, construct validity, and test-retest reliability (Martin, Rief, Klaiberg & Braehler, 2006). Participants were asked if there was a two-week period in the month prior to the interview in which they experienced of nine symptoms (e.g., “feeling down, depressed, or hopeless”) and, if so, how often they were affected by the symptoms, from 1 (several) to 3 (nearly every day); symptoms that were not endorsed were coded as 0. PHQ-9 scores were computed as the sum of responses to all items, ranging from 0 to 27. Cronbach’s α for the PHQ-9 scale in the current study ranged from .79 to .89.

Functional impairment—Functional impairment in the past month was assessed at each wave using the six items from the Short Post-Traumatic Stress Disorder Rating Interview-Expanded version (SPRINT-E) (Norris, Hamblen, Brown, & Schinka, 2008). SPRINT-E was developed to assess current disaster-related distress and functional impairment. The complete SPRINT-E consists of 11 questions; for the purposes of this study, five questions that overlapped with PTSD (e.g., “how much have you been bothered by unwanted memories, nightmares or reminders of the event?”) were removed. The six remaining items (e.g., “In the past month, how often have your reactions [to Hurricane Ike] interfered with your ability to carry out daily activities, such as housework or school work?”) were scored from 0 (not at all) to 4 (very much), yielding scores ranging from 0 to 24. Cronbach’s α of the SPRINT-E in the current study was .91 at each wave.

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Days of poor health—Days of Poor Health in the past month prior to the interview were assessed at each wave using one of the four items that comprise the Center for Disease Control and Prevention's Health-related Quality of Life-4 (CDC HRQOL-4) (Moriary, Zack, & Kobau, 2003). Participants were asked to report how many days in the prior month their physical health was not good.

Exposures—Exposure variables in the study were assessed at W1. The main exposures in this analysis were hurricane-related traumatic events, hurricane-related stressors, peri-event emotional reactions and community-level social assets. The scales were amended from measures used in previous studies on natural disasters such as Hurricane Katrina and Hurricane Andrew (Galea et al., 2008; Riad & Norris, 1996).

Hurricane-related traumatic events: Participants indicated (Yes/No) whether they had experienced the following: 1) physical injury, 2) death of a family member or a close friend, 3) saw dead bodies, and 4) family member or close friend injured. This measure was dichotomized to at least one exposure versus none due to the low frequency of each item.

Hurricane-related stressors: Participants indicated (Yes/No) whether they had experienced seven stressors due to the hurricane: 1) lack of any resource (food, water, shelter, electricity) for over a week, 2) any personal property loss, 3) loss of sentimental possessions or pets, 4) self or household member had health problems, 5) financial loss, 6) increased demands or relationship problems, and 7) displaced from home. Each hurricane-related stressor was examined separately.

Peri-event emotional reactions: Peri-event emotional reactions were assessed using the four-item STRS (shortness of breath, tremulousness, racing heart, and sweating) checklist (Bracha et al., 2004). The scale asked participants to recall how they felt at the time of the hurricane and the first few hours following the hurricane, with items shortness of breath; trembling, shaking, or buckling knees; heart pounding or racing; and sweaty palms or other sweating. Cronbach's α of the STRS in the current study was .86. The measure was categorized into tertiles representing high, medium and low levels of peri-event emotional reactions (using cut-offs for the 33rd and 67th percentile scores in the sample). This approached was used to address the high level of skewness in the measure, and to identify threshold effects and non-linear relationships between peri-event emotional reactions and wellness probabilities.

Community-level social assets: Community-level social assets included collective social support and collective efficacy. Social support was measured through the Inventory of Postdisaster Social Support, which included 11 items (e.g., "How often did family members or friends comfort you with a hug or another sign of affection?" Barrera, Sandler, & Ramsay, 1981; Kaniasty & Norris, 2000). Responses ranged from 1 (never) to 4 (many times), yielding a mean score ranging from 1–4. Cronbach's α of the scale in the current study was .85. Collective efficacy was assessed using a 10-item scale assessing social cohesion and trust (e.g., "this is a close fit or unified neighborhood"), and informal social control (e.g., "If a group of neighborhood children was skipping school and hanging out on a street corner, how likely is it that your neighbors would do something about it?" Echeverria,

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Diez Roux, & Link, 2004; Lochner, Kawachi, & Kennedy, 1999; Sampson, Raudenbush, & Earls, 1997). Social cohesion and trust items were rated from 1 (strong disagree) to 5 (strongly agree), and informal social control items were rated from 1 (very unlikely) to 5 (very likely). Collective efficacy scores were calculated as the mean of the 10 items, ranging from 1–5. Cronbach's α of the Collective Efficacy scale in the current study was .83. Because social support and collective efficacy are conceptualized as functioning at the community-level rather than the individual-level (Norris, et al., 2008), aggregate means at the census block level for each measure were included in the analysis.

Covariates—Covariates in the study were collected at W1. Demographic covariates included age, sex, race and ethnicity, marital status, and education. Additionally, we included indicators of predisaster trauma exposure and psychopathology (PTSD and major depression). First, participants completed a traumatic events inventory (Breslau et al., 1998) in which they indicated (Yes/No) whether they had experienced ten events (e.g. sudden unexpected death or someone close, serious accident) at any point in their lifetime and, if so, whether the event occurred prior to Hurricane Ike. The total number of predisaster trauma was computed and, for the analysis, divided into three categories: 0–1 traumas, 2–3 traumas and 4 or more traumas. Second, we included a variable indicating probable predisaster PTSD (Yes/No). Second, participants completed a modified version of the PCL-S in reference to the predisaster traumatic event they designated as the "worst." Applying DSM-IV-TR criteria for PTSD, participants met criteria for predisaster PTSD if they rated moderately (a score of 3) or higher for one or more re-experiencing symptoms (criteria B), three or more avoidance symptoms (criteria C), and two or more arousal symptoms (criteria D), as well as if they felt helpless or terrified at the time of event (criteria A), had symptoms that lasted at least 30 days (criteria E), and reported significant impairment or distress (criteria F). Third, we included a variable indicating probable predisaster major depression (Yes/No). At W1, participants completed the PHQ-9 in reference to any two-week period in their lifetime. Participants with scale scores of 10 or greater, and who indicated that symptoms occurred together with onset prior to Hurricane Ike, were classified as having probable predisaster major depression (Kroenke et al., 2001).

Data Analysis

SAS Proc Traj, a group-based mixture modeling procedure, was used to identify trajectories of each of the outcomes of interest (PTSS, depression, functional impairment, and days of poor health) from W1 to W3. Group-based modeling is contrasted with traditional growth curve modeling (GCM), wherein an average trajectory is estimated for the full sample and predictor variables are entered to explain residual variance in intercept and slope terms. A drawback is GCM is that it is assumed that participants come from the same population and that therefore a single growth trajectory can be approximated for the entire sample (Jung & Wickrama, 2008). These assumptions are at odds with theoretical frameworks and research findings showing subpopulations with varying patterns of growth (Jung & Wickrama, 2008). Group-based mixture models identify different latent, or unobserved, classes of trajectories within a sample (Nagin & Nagin, 2009). Each participant is assigned a probability of being in each trajectory and, based on these values, a most likely trajectory. Most likely trajectory

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membership can then be used as a categorical variable in more conventional analyses (e.g., logistic regression).

Proc Traj assumes that missing data on dependent variables are missing completely at random, and therefore all participants were included in the trajectory analysis. Model distribution differed by the type of outcome estimated: we used zero-inflated Poisson distribution to model highly skewed continuous variables (depression, functional impairment) and the count variable (days of poor health), and censored normal distribution to model the continuous variable (PTSS). The optimum number of trajectory groups for each outcome was determined using both statistical criteria (Bayesian information criterion [BIC], with lower values indicating better fit; mean of posterior probabilities, with higher values indicating better fit), and theoretical considerations of interpretability, parsimony, and clinical significance (Jung & Wickrama, 2008). After selecting the best-fitting number of the trajectories, the shape of each respective trajectory (i.e. linear, quadratic, cubic) was identified using Wald tests for parameters at a significance level of $p < .05$. Resilience trajectories for each outcome were defined as having stably low levels over time. Non-resilient trajectories were given names based on their initial levels and patterns of change over the study.

After the best-fitting models were established, the most likely trajectory membership of each participant for each outcome was exported as a categorical variable. We assessed the frequency of most likely membership in each trajectory for each outcome. Concordance in the resilience trajectory across outcomes was assessed using chi-square analyses. Next, we computed the number of participants exhibiting mental health wellness (most likely membership in the resilience trajectories for PTSS and depression), and general wellness (most likely membership in the resilience trajectories for all four outcomes). Finally, hierarchical logistic regression models were run to investigate W1 predictors of mental health and general wellness. These analyses consisted of six steps: demographic covariates were in included in Step 1, predisaster trauma exposure and psychopathology were added in Step 2, hurricane-related trauma in Step 3, hurricane-related stressors in Step 4, peri-event emotional reactions in Step 5, and community-level social assets in Step 6. Missing data on exposure variables and covariates in the logistic regressions was handled through multiple imputation. Five imputed datasets were created using the Sequential Regression Imputation Method implemented in IVEware (Raghunathan, Solenberger, & Van Hoewyk, 2002), and results represent an average of the five separate analyses with Rubin's (1987) correction of standard error. All analyses were conducted in SAS software Version 9.3 and were adjusted for sampling strata, clustering and sample weights.

Results

Descriptive analysis

Descriptive statistics for all variables included in the study for the full sample are shown in Table 1. We noted that each of four outcomes decreased between W1 and W2, and increased between W2 and W3, although we did not assess whether trends in the full sample reached statistical significance. In terms of exposures, 11.7% of participants experienced one or more hurricane-related trauma, whereas more than 20% of participants experienced each

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hurricane-related stressor, ranging from 23.3% (self or household member had health problems as a result of the hurricane) to 85.7% (any personal property loss). About one fifth (20.7%) had peri-event emotional reactions in the high tertile. Mean scores of community-level social support and collective efficacy were 2.48 (*SD* = 12.48) and 3.89 (*SD* = 8.41), respectively.

Trajectories and Wellness

A four-trajectory solution was selected for each outcome based on the aforementioned statistical and theoretical criteria for model selection (see Supplemental Table 1). Each outcome evidenced a similar set of trajectory groups. In addition to a resilience trajectory of stably low levels over time, we found a chronic trajectory (stably high levels over time), a recovery trajectory (initially high levels that decreased over time), and a delayed trajectory (initially low levels that increased over time) for each outcome (see Figures 1a–1d; Supplemental Table 2). Nearly three quarters of participants (*n* = 493, 74.9%) had most likely membership in the resilience trajectory for PTSS; over half for depression (*n* = 381, 57.9%) and days of poor health (*n* = 346, 52.6%); and less than half for functional impairment (*n* = 297, 45.1%). Chi-square analyses revealed significant concordance in resilience, versus non-resilience, across each pair of outcomes (all *ps* < .001, see Supplemental Table 3). Slightly more than half of participants (51.2%, *n* = 337) were categorized as exhibiting mental health wellness. In contrast, approximately a quarter of participants were categorized as exhibiting general wellness (26.1%, *n* = 172).

Predictors of Mental Health Wellness

The results of the hierarchical logistic regression model predicting mental health wellness are shown in Table 2. Table 2 lists only the odds ratios (ORs) and 95% confidence intervals (CIs) for the new variable or variables entered into each step (under the columns labeled “Stepwise Results”), as well as the results for the model with all variables entered (under the columns labeled “Final Model”). The full set of results, with values for all variables included in each model, is listed in Supplementary Table 5. None of the demographic covariates were significant in Step 1. In Step 2, predisaster depression was associated with a lower likelihood of mental health wellness (OR = .28, 95% CI = .15–.55). In Step 3, experiencing any hurricane-related traumatic event was associated with a lower likelihood of mental health wellness (OR = .31, 95% CI = .14–.70). In Step 4, hurricane-related loss of sentimental possessions or pets and financial loss as a result of Ike were associated with a lower likelihood of mental health wellness (OR = .45, 95% CI = .23–.87 and OR = .43, 95% CI = .23–.80, respectively). In Step 5, meeting criteria for the medium and high tertiles of peri-event emotional reactions, relative to the low tertile, were associated with a lower likelihood of mental health wellness (OR = .31, 95% CI = .15–.64, and OR = .18, 95% CI = .07–.44, respectively). Lastly, higher community-level collective efficacy was associated with a higher likelihood of mental health wellness in Step 6 (OR = 1.73 95% CI = 1.02–2.94). In the final model, predisaster depression (OR = .27, 95% CI = 12–.62), loss of sentimental possessions or pets and financial loss as a result of Ike (OR = .55, 95% CI = .32–.97 and OR = .48, 95% CI = .48–.84, respectively), and medium and high tertiles of peri-event emotional reactions (OR = .31, 95% CI = .15–.65, and OR = .17, 95% CI = .07–.42, respectively) remained associated with decreased likelihood of mental health wellness.

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Older age was associated with decreased likelihood of general wellness in the final model (OR = .42, 95% CI = .18–.94).

Predictors of General Wellness

The results of the logistic regression models predicting general wellness are shown in Table 3. As with Table 2, Table 3 lists only the odds ratios (ORs) and 95% confidence intervals (CIs) for the new variable or variables entered into each step (under the columns labeled "Stepwise Results"), as well as the results for the model with all variables entered (under the columns labeled "Final Model"). The full set of results, with values for all variables included in each model, is listed in Supplementary Table 6. In Step 1 Non-Hispanic Black participants had a lower likelihood of exhibiting general health wellness than non-Hispanic White participants (OR= .42, 95% CI = .19–.91). In Step 2, predisaster depression was associated with a lower likelihood of general health wellness (OR = .19, 95% CI = .10–.38). Experiencing any hurricane-related traumatic event was not associated with general wellness in Step 3. In Step 4, hurricane-related personal property loss and loss of sentimental possessions or pets were associated with a lower likelihood of general wellness (OR = .36, 95% CI = .19–.70 and OR = .36, 95% CI = .13–.98, respectively). In Step 5, meeting criteria for the medium and high tertiles of peri-event emotional reactions, relative to the low tertile, were associated with a lower likelihood of general wellness (OR = .32, 95% CI = 16–.65, and OR = .22, 95% CI = .06–.82, respectively). Last, higher community-level collective efficacy was associated with a higher likelihood of general wellness in Step 6 (OR = 1.86, 95% CI = 1.05–3.29). In the final model, predisaster depression (OR = .19, 95% CI = .08–.43), hurricane-related personal property loss (OR = .41, 95% CI = .20–.84) and medium and high tertiles of peri-event emotional reactions (OR = .33, 95% CI = .15–.72, and OR = .22, 95% CI = .06–.84, respectively) remained associated with decreased likelihood of general wellness. Older age was significantly associated with decreased likelihood of general wellness in the final model (OR = .27, 95% CI = .12–.61).

Discussion

The purpose of this study was to quantify mental health wellness (resilience across multiple mental health conditions) and general wellness (resilience across mental health, role functioning, and physical health domains), and to examine predictors of each form of wellness in a population-based sample of natural disaster survivors. We found that the prevalence of resilience, defined as consistently low levels of symptoms or problems over time, was 74.9% for PTSS, 57.9% for depression, 45.1% for functional impairment, and 52.6% for days of poor health. Therefore, on each single indicator, approximately 50% or more of participants exhibited resilience. However, the proportion of participants who demonstrated resilience across multiple domains, or wellness, was substantially lower. Mental health wellness was exhibited by 51.2% of the sample, and general wellness by 26.1%. We found that lower peri-event emotional reactions and higher collective efficacy were consistently associated with both mental health and general wellness. Additionally, specific hurricane-related stressors decreased the likelihood of both outcomes: loss of sentimental possessions or pets and financial loss due to the hurricane were negatively

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associated with mental health wellness, and personal property loss was negatively associated with general wellness.

These findings suggest that general wellness is not the dominant response to instances of mass trauma. Instead, only a quarter of respondents exhibited general wellness. Hence, research focusing on only one domain is likely to overestimate the prevalence of postdisaster general wellness. Although previous research suggests that these domains are related, reflected by significant associations between postdisaster mental and physical health, they are not entirely overlapping (Lowe et al., 2013). Similarly, although we found significant concordance in resilience between the mental health, role functioning, and physical health, there were some participants who exhibited resilience in the mental health outcomes but not in role functioning or physical health, and vice versa.

The analysis of predictors of mental health and general wellness provide evidence of three factors that cut across different domains in promoting postdisaster wellness. First, higher peri-event reactions – characterized by panic-like symptoms of shortness of breath, tremulousness, racing heart, and sweating – were negatively associated with both forms of wellness. This is consistent with the results of studies showing such reactions to be predictive of a range of mental health consequences, including PTSS, depression, panic disorder, in the aftermath of disasters (e.g., Galea et al., 2002; Person, Tracy, & Galea, 2006; Wood, Salguero, Cano-Vindel, & Galea, 2013). Only one published study to our knowledge has linked peri-event emotional reactions to a negative physical health outcome: poor health two years postdisaster (Boscarino & Adams, 2009). However, this association, along with the association between peri-event emotional reactions and mental health outcomes, reduced to non-significance once other factors (e.g., demographic characteristics, indicators of stress exposure) were considered. It is therefore possible that associations between these reactions and general wellness are limited to shorter-term outcomes.

Second, the results indicate that community-level collective efficacy is an important resource in promoting postdisaster mental health and general wellness. Notably, although disaster literature has provided ample evidence that individual-level social resources, including perceived social support and social embeddedness, are protective against postdisaster psychological adversity (e.g., Norris et al., 2002), community-level resources such as collective efficacy and collective levels of social support have received relatively less attention. To our knowledge, no study has examined the impact of community-level collective efficacy or social support on postdisaster mental health and general wellness. Two studies (Ursano et al., 2014; Wind & Komproe, 2013) examined the relationship between community-level collective efficacy and PTSS, however: one (Ursano et al., 2014) found that higher levels of collective efficacy were negatively associated with PTSS, while the other found that the negative effects of lower perceived social support on PTSS were attenuated for participants living in communities with higher collective efficacy (Wind & Komproe, 2013). Further multilevel studies exploring the role of community-level resources in the postdisaster context are clearly needed to understand its role in shaping wellness.

Third, our findings show the key role of economic loss, including loss of sentimental possessions, loss of income, and personal property loss, to wellness. However, in this case,

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the different manifestations of economic loss were distinctly related to mental health and general wellness. The finding that loss of sentimental possessions or pets seems was significantly predictive of mental health wellness suggests that this particular loss has unique effects on mental health that do not extend to other domains of functioning. Disaster-related loss of income also seems to have unique effects on mental health wellness, which aligns with previous studies showing the influence of this stressor on mental health outcomes (e.g., Galea et al., 2008), and that the effects of disaster-related financial stressors on physical health do not hold once postdisaster social resources are accounted for (Chen et al., 2007). In contrast, the finding that personal property was significantly predictive of general wellness, but not mental health wellness, could indicate that disaster-related property loss had broader effects on wellness that were not specific to mental health. Conversely, property loss might have conferred a particular risk for postdisaster role functioning or physical health problems. A previous study showing disaster-related household damage was associated with a broad range of mental health, role functioning and physical health outcomes provides support for the former possibility (van Kamp et al., 2005).

Limitations

Several limitations to this study are noteworthy. First, we did not include other indicators of common postdisaster mental and behavioral health problems (e.g., generalized anxiety and substance use) or health complaints (e.g., headaches, back aches, digestive problems). Had we included these additional indicators, it is likely that the prevalence of both mental and general health wellness would have been lower than observed in the current study. However, our approach was consistent with the majority of postdisaster mental health studies, which focus on PTSS or depression. Moreover, few disaster studies to date have integrated measures of mental health, role functioning, and physical health. Second, we did not take the classification uncertainty in the LCGA models into account when defining mental health and general wellness. This approach, however, was advantageous over alternative methods of defining wellness that would inadequately capture the variance in each measure (e.g., use of cut-off scores). Third, although we included a range of hurricane-related traumatic and stressful events, as well as predisaster traumatic events, our measures lacked detail. For example, participants did not provide information about the severity and duration of each event, which could influence associations with wellness. Fourth, peri-event emotional reactions were assessed two to five months postdisaster and participants' reports might have been subject to recall bias, potentially inflating associations between this construct and general and mental health wellness. Lastly, although the sample was representative of the population affected by Hurricane Ike, the extent to which the results would generalize to survivors of other disasters and in other geographic regions is unclear.

Conclusion

This is the first known study to quantify mental health wellness in the aftermath of a major natural disaster. Moreover, it is the first to integrate measures of physical health and role functioning to estimate general wellness. The results suggest that the majority of disaster survivors do not exhibit general wellness, and that prior studies focusing on single outcomes may have underestimated postdisaster service needs. Additionally, they suggest that peri-event emotional reactions, personal property loss, and neighborhood collective efficacy

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could have a cross-cutting impact on both mental health and general wellness in the aftermath of disasters.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Research Highlights

- The expected modal response to disasters is mental and physical health resilience.
- No previous studies have explored resilience across multiple domains, or *wellness*.
- We examined wellness in a population-based sample of Hurricane Ike survivors.
- Less than half of participants (26.1%) exhibited wellness.
- Peri-event reactions, property loss and collective efficacy predicted wellness.

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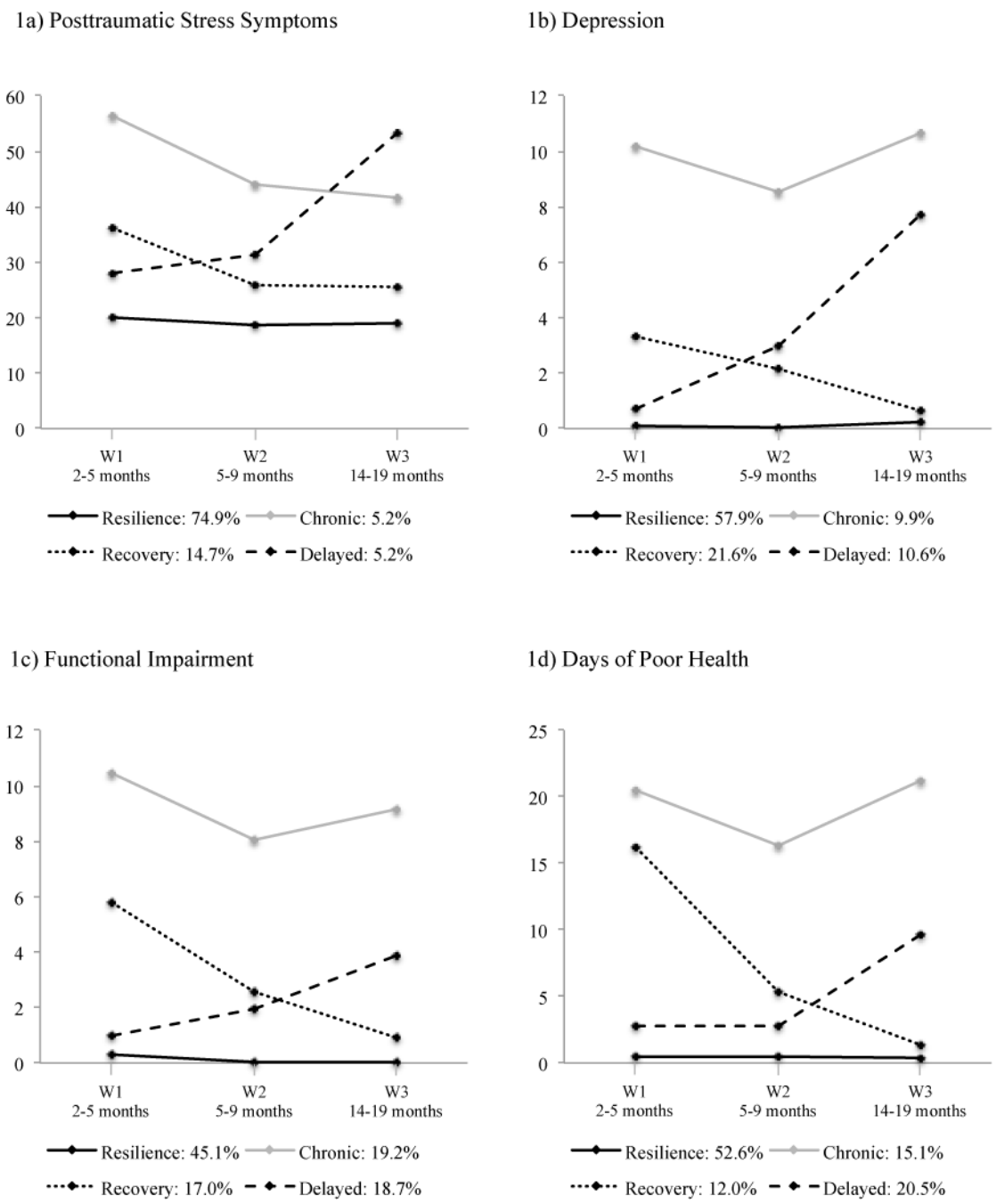

Figure 1.
Graphs of observed means for trajectories within each outcome.

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Table 1

Descriptive Statistics for Study Variables (N = 658)

Variable	*M (SD) or N (%)*
Demographics	
Age	
< 35 years	161 (24.4%)
35–54 years	299 (34.8%)
> 55 years	268 (40.7%)
Sex	
Female	394 (59.9%)
Male	264 (40.1%)
Race/ethnicity	
Non-Hispanic White	399 (60.6%)
Non-Hispanic Black	102 (15.5%)
Hispanic	123 (18.7%)
Other race/ethnicity	34 (5.2%)
Education	
< High school	89 (13.5%)
High school or equivalent	151 (23.0%)
> High school	418 (63.5%)
Marital status	
Married	311 (47.3%)
Living with a partner	33 (5.0%)
Separated	35 (5.3%)
Divorced	84 (12.8%)
Widowed	75(11.4%)
Never been married	120 (18.2%)
Predisaster Psychopathology	
Predisaster probable PTSD	
Yes	77 (11.7%)
No	507 (77.1%)
Predisaster probable major depression	
Yes	114 (17.3%)
No	514 (78.1%)
Predisaster traumatic events	
0–1 events	191 (29.0%)
2–3 events	259 (39.4%)
4 or more events	208 (31.6%)
Hurricane-related trauma	
No hurricane-related trauma	581 (88.3%)
1 or more hurricane-related trauma	77 (11.7%)
Hurricane-related stressors	

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Variable	*M (SD) or N (%)*
Without any resource for >1 week	374 (56.8%)
Any personal property loss	564 (85.7%)
Loss of sentimental possessions or pets	202 (30.7%)
Self or household member had health problems as result of hurricane	153 (23.3%)
Financial loss as a result of hurricane	227 (34.5%)
Increased demands or relationship problems	203 (30.9%)
Displaced from home as a result of hurricane	302 (45.9%)
Peri-event emotional reactions	
Low tertile	378 (57.5%)
Medium tertile	144 (21.9%)
High tertile	136 (20.7%)
Community-level social assets	
Social support	2.48 (12.48)
Collective efficacy	3.89 (8.41)
Outcomes – Wave 1	
Posttraumatic stress symptoms	26.44 (243.74)
Depression	1.98 (77.49)
Functional impairment	3.06 (89.19)
Days of poor health	4.26 (146.27)
Outcomes – Wave 2	
Posttraumatic stress symptoms	22.57 (165.34)
Depression	1.51 (57.71)
Functional impairment	2.92 (119.63)
Days of poor health	2.06 (62.34)
Outcomes – Wave 3	
Posttraumatic stress symptoms	24.48 (208.89)
Depression	2.24 (81.17)
Functional impairment	4.84 (144.68)
Days of poor health	2.36 (73.15)

Note. *M* = Mean, *SD* = Standard deviation. Percentages, means, and standard deviations are weighted values.

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Table 2

Results of Logistic Regression Analysis Predicting Mental Health Wellness (N = 658)

	Stepwise Results		Final Model	
	OR	*95% CI*	*OR*	*95% CI*
Step 1. Demographics				
Age				
< 35 years (Reference)	–	–	–	–
35–54 years	.81	.49, 1.35	.84	.43, 1.65
> 55 years	.67	.30, 1.49	**.42***	.18, .94
Sex				
Female (Reference)	–	–	–	–
Male	1.67	1.00, 2.80	1.59	.95, 2.64
Race/ethnicity				
Non-Hispanic White (Reference)	–	–	–	–
Non-Hispanic Black	.64	.29, 1.39	.63	.27, 1.51
Hispanic	.80	.32, 2.03	.63	.24, 1.65
Other race/ethnicity	1.74	.48, 6.30	1.31	.49, 3.53
Education				
< High school (Reference)	–	–	–	–
High school degree or equivalent	.58	.19, 1.79	.54	.18, 1.63
> High School	1.41	.51, 3.94	1.29	.44, 3.78
Step 2. Predisaster Trauma Exposure and Psychopathology				
Predisaster trauma exposure				
0–1 traumatic events (Reference)	–	–	–	–
2–3 traumatic events	.87	.40, 1.90	.84	.38, 1.88
4 or more traumatic events	.88	.37, 2.05	.79	.39, 1.58
Predisaster psychopathology				
Predisaster probable PTSD	.90	.46, 1.77	1.40	.52, 3.74
Predisaster probable major depression	**.28*****	.15, .55	**.27****	.12, .62
Step 3. Hurricane-Related Traumatic Events				
1 or more hurricane-related trauma	**.31****	.14, .70	.66	.29, 1.52
Step 4. Hurricane-Related Stressors				
Without any resource for >1 week	.87	.44, 1.72	.99	.42, 2.32
Any personal property loss	.53	.26, 1.06	.62	.31, 1.22
Loss of sentimental possessions or pets	**.45***	.23, .87	**.55***	.32, .97
Financial loss as a result of Ike	**.43****	.23, .80	**.48***	.27, .84
Increased demands or relationship problems	.89	.49, 1.62	1.05	.66, 1.70
Displaced from home as a result of Ike	1.19	.61, 2.32	1.10	.53, 2.27
Step 5. Peri-Event Emotional Reactions				
Low tertile (Reference)	–	–	–	–
Medium tertile	**.31****	.15, .64	**.31****	.15, .65

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	Stepwise Results		Final Model	
	OR	***95% CI***	***OR***	***95% CI***
High tertile	**.18*****	.07, .44	**.17*****	.07, .42
Step 6. Community-Level Social Assets				
Social support	.86	.62, 1.19	.86	.62, 1.19
Collective efficacy	**1.73***	1.02, 2.94	**1.73***	1.02, 2.94

Note. OR = Odds Ratio; *CI* = Confidence Interval. The columns under "Stepwise Results" include only the values for new variables entered in each step are included. The columns under "Final Model" include the values for the analysis with all variables entered. The full set of results, with values for all variables included in each step, can be found in Supplementary Table 5. Analyses included sampling weights and were clustered at the census tract level (i.e., community-level).

* $p < .05$

** $p < .01$

*** $p < .001$.

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Table 3

Results of Logistic Regression Analysis Predicting General Wellness (N = 658)

	Stepwise Results		Final Model	
	OR	***95% CI***	***OR***	***95% CI***
Demographics				
Age				
< 35 years (Reference)	–	–	–	–
35–54 years	.71	.38, 1.32	.68	.37, 1.25
> 55 years	.50	.22, 1.11	**.27****	.12, .61
Sex				
Female (Reference)	–	–	–	–
Male	1.54	.76, 3.13	1.23	.63, 2.41
Race/ethnicity				
Non-Hispanic White (Reference)	–	–	–	–
Non-Hispanic Black	**.42***	.19, .91	**.37***	.14, .95
Hispanic	.87	.35, 2.18	.79	.28, 2.27
Other race/ethnicity	1.40	.33, 5.87	.77	.18, 3.25
Education				
< High school (Reference)	–	–	–	–
High school degree or equivalent	.93	.27, 3.13	.99	.35, 2.80
> High School	1.60	.55, 4.66	1.56	.50, 4.90
Predisaster Trauma Exposure and Psychopathology				
Predisaster trauma exposure				
0–1 traumatic events (Reference)			–	–
2–3 traumatic events	1.20	.48, 3.00	1.22	.48, 3.10
4 or more traumatic events	1.12	.49, 2.53	1.01	.46, 2.27
Predisaster psychopathology				
Predisaster probable PTSD	.44	.12, 1.63	.47	.05, 4.14
Predisaster probable major depression	**.19*****	.10, .38	**.19*****	.08, .43
Hurricane-Related Traumatic Events				
1 or more hurricane-related trauma	.33	.10, 1.05	.70	.19, 2.61
Hurricane-Related Stressors				
Without any resource for >1 week	1.03	.56, 1.90	1.27	.62, 2.61
Any personal property loss	**.36****	.19, .70	**.41***	.20, .84
Loss of sentimental possessions or pets	**.36***	.13, .98	.45	.17, 1.16
Financial loss as a result of Ike	.47	.21, 1.05	.49	.22, 1.11
Increased demands or relationship problems	1.02	.42, 2.48	1.23	.50, 3.00
Displaced from home as a result of Ike	.71	.37, 1.35	.63	.34, 1.16
Peri-Event Emotional Reactions				
Low tertile (Reference)	–	–	–	–
Medium tertile	**.32****	.16, .65	**.33****	.15, .72

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	Stepwise Results		Final Model	
	OR	***95% CI***	***OR***	***95% CI***
High tertile	**.22***	.06, .82	**.22***	.06, .84
Community-Level Social Assets				
Social support	.77	.53, 1.14	.77	.53, 1.14
Collective efficacy	**1.86***	1.05, 3.29	**1.86***	1.05, 3.29

Note. OR = Odds Ratio; *CI* = Confidence Interval. The columns under "Stepwise Results" include only the values for new variables entered in each step are included. The columns under "Final Model" include the values for the analysis with all variables entered. The full set of results, with values for all variables included in each step, can be found in Supplementary Table 6. Analyses included sampling weights and were clustered at the census tract level (i.e., community-level).

* $p < .05$

** $p < .01$

*** $p < .001$.