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Trajectories of Psychological Distress among Low-Income, Female Survivors of Hurricane Katrina

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TRAJECTORIES OF PSYCHOLOGICAL DISTRESS

AMONG LOW-INCOME, FEMALE SURVIVORS OF HURRICANE KATRINA

A Dissertation Presented

by

SARAH R. LOWE

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ABSTRACT

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December 2011

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The purpose of this study was to investigate trajectories of psychological distress among low-income women, primarily unmarried and African American, who survived Hurricane Katrina ($N = 386$). Data were collected in the year prior to the hurricane, as well as approximately one and three years thereafter. Using Latent Class Growth Analysis (LCGA), we detected six distinct trajectory groups. Over half of participants fit into a trajectory consistent with resilience; that is, they maintained low levels of psychological distress over the course of the study, but experienced an elevation in symptoms at the first pre-disaster time point, followed by a return to pre-disaster levels. The other trajectories reflected the range in psychological responses to disasters, and suggested pre-disaster functioning as having a major influence on post-disaster psychological outcomes. Exposure to hurricane-related stressors, experiences of human

and pet bereavement, perceived social support, and socioeconomic status were significant predictors of trajectory group membership. Based on these findings, we recommend policies that protect against hurricane exposure, promote the rebuilding of social support networks, and assist survivors in identifying employment and educational opportunities, as well as well as empirically supported clinical interventions that help survivors cope with longstanding or emergent symptoms. Further longitudinal quantitative studies, as well as qualitative analysis of survivors' accounts of post-disaster psychological experiences, would advance our understanding of resilience and other trajectories of functioning in the aftermath of traumatic events.

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CHAPTER 1

INTRODUCTION

Hurricane Katrina was the most devastating disaster in recent United States history, leading to nearly 2,000 deaths and over 650,000 persons displaced (Knabb, Rhome, & Brown, 2006; U.S. Department of Commerce, 2006). Low-income and African American communities were at disproportionate risk of damage and destruction due to the storm and its aftermath (Logan, 2006), in part because of their increased likelihood of living in housing that was unable to withstand disaster exposure (Ruscher, 2006; Weems et al., 2007) and proximity to levees in need of repair (Park & Miller, 2006). Furthermore, existing evacuation policies did not take into account the increased transportation needs of low-income citizens in the days leading up to the storm, heightening their risk for exposure (Lavelle & Feagin, 2006; Park & Miller, 2006) and post-disaster psychological distress (e.g., Brewin, Andrews, & Valentine, 2000). Their disproportionate exposure to additional stressors in the immediate aftermath of the storm, including higher rates of residence in shelters and unemployment (Brodie, Weltzien, Altman, Blendon, & Benson, 2006; Elliot & Pais, 2006), also may have heightened low-income African Americans' mental health risks.

Researchers of communities exposed to Hurricane Katrina and its aftermath have detected elevated rates of psychological distress and disorder among women, low-income individuals, and African Americans in comparison to their counterparts (e.g., Elliot & Pais, 2006; Rhodes et al., 2010). Yet, even among vulnerable groups there is variability in psychological responses to disasters. In fact, *resilience*, defined in the current study as the return to pre-disaster levels of functioning after an initial post-disaster elevation in distress, is thought to be the normative psychological response (Bonnano, 2004). Due to understandable limitations of their data (e.g., lack of pre-disaster data and multiple waves of post-disaster data), researchers have not adequately explored this phenomenon and other trajectories of psychological symptoms. The primary purpose of this study is to investigate the variability in trajectories of psychological distress in a sample of vulnerable hurricane survivors: low-income mothers, primarily unmarried and African American. Drawing on a rich dataset that includes a measure of psychological distress from the year prior to the disaster, as well as one year and three years thereafter, we document rates of psychological distress trajectories among the women. In addition, we investigate how factors commonly associated with post-disaster psychological responses (e.g., demographic variables, disaster exposure, and social and material resources) predict trajectory group membership.

CHAPTER 2

BACKGROUND

Researchers and theorists have long acknowledged variation in human's adaptive

functioning following stress and adversity. The concept of resilience emerged in the

1960s and 1970s, with the work of such scholars as Michael Rutter, Norman Garmezy,

and Emmy Werner (Masten, 2007). Rutter, Garmezy, Werner, and other researchers in

psychology and medicine noted unexpected positive outcomes among youth with early-

onset schizophrenia, or whose mothers suffered from schizophrenia. From their work

came the notion of resilience as a personal trait, with youth possessing such a trait

achieving high levels of functioning despite considerable adversity. Researchers then

explored factors associated with resilience, including those residing in individuals (e.g.,

optimism), families (e.g., secure attachment to parents), and communities (e.g., high

quality schools).

Over time, researchers became more attuned to resilience as a process, rather than

an outcome (Masten, 2007; Vanderbilt-Adriance & Shaw, 2008). That is, they

recognized that developmental outcomes are not static, but rather that psychological

functioning varies over time. As noted by Luthar, Cicchetti and Becker (2000), the

concept of resilience has considerable "ontogenetic instability" and "individuals at high

risk rarely maintain consistently positive adjustment over the long-term" (p. 551). By studying resilience longitudinally, researchers were able to explore the processes behind such instability, including interactions between psychological functioning and contextual variables. These studies led to great advances and insights in prevention and intervention efforts for at-risk youth and other populations exposed to trauma and adversity (Masten, 2007).

Yet, despite these advances, methodological limitations have precluded researchers from exploring the prevalence and predictors of resilience and other psychological trajectories among individuals who have faced traumatic stress (Green, Lowe, & Rhodes, 2011). For example, in cross-sectional research, resilience is necessarily applied post-hoc (Tarter & Vanyukov, 1999). That is, studies of resilience commonly describe all participants without post-trauma psychopathology as being resilient. Such findings likely overestimate rates of resilience because they include participants who did not initially experience elevated psychological symptoms. More accurate estimations of resilience and other psychological trajectories (e.g., *chronic distress*, wherein post-trauma psychopathology persists over time; or *delayed distress*, wherein the survivor has normative levels of functioning initially, but later exhibits psychopathology) require two waves of post-disaster data (Hobfoll et al., 2009). Additionally, data points that span multiple years in the aftermath of a disaster are necessary to discern longer-term trajectories of psychological symptoms.

Furthermore, the definition of resilience as the trajectory in which survivors with high pre-trauma psychological functioning "bounce back" after an initial increase in

psychological symptoms requires pre-trauma data. Without data from prior to the

traumatic event, it is inherently impossible to determine whether a survivor has returned

to pre-trauma levels of psychological functioning. Unfortunately, pre-trauma data have

been largely absent in previous studies of natural disasters. For example, in a

comprehensive review by Norris and colleagues (2002), only 7 out of 160 studies of

natural disaster survivors included baseline data.

Without baseline data, it is impossible to discern whether post-disaster elevations

in psychological symptoms are due to pre-existing conditions or to the impact of the

disaster and its aftermath. This is a particularly important limitation, given that previous

researchers have found that pre-disaster indices of psychological symptoms are among

the strongest predictors of psychological outcomes (e.g., Ginexi, Weihs, Simmens, &

Hoyt, 2000; Weems et al., 2007).

Therefore, although theorists have postulated that resilience is the norm after

trauma exposure, empirical research has not adequately documented rates of resilience

and other psychological trajectories. To do this, at least one wave of pre-trauma data and

two waves of post-trauma data are necessary. In the current study, we draw upon such a

dataset, enabling us to provide estimates of resilience and other psychological trajectories

among a sample of low-income women.

Investigating Psychological Distress Trajectories Statistically

Even with multi-wave datasets, there is no consensus among researchers on how

to best quantify or investigate resilience statistically. Continuous measures of

psychological distress maximize the statistical variance that can be predicted, but such

approaches leave to speculation how to categorize participants' resilience, growth, or decline (Luthar & Cushing, 1999). In addition, conventional growth curve modeling approaches assume that all participants come from the same population, that a single growth trajectory can be approximated for the entire sample, and that covariates affect growth the same way for each participant (Andruff, Carraro, Thompson, Gandreau, & Louvet, 2009; Jung & Wikrama, 2008; Raudenbush, 2001). These assumptions are at odds with theoretical frameworks and research findings that posit subpopulations within a larger population that are related to measureable variables (e.g., socioeconomic status, risk status) and that exhibit varying patterns of growth and decline (Jung & Wickrama, 2008). Therefore, such techniques are thought to oversimplify the complex patterns of growth and decline within a given population (Jung & Wickrama, 2008).

To overcome these limitations, a common approach applied in previous studies of natural disasters is using cut-off scores or averages at each time point to categorize participants into groups representing stability and change over time (e.g., Bonanno, Galea, Bucciarelli, & Vlahov, 2007; Hobfoll et al., 2009). Yet, with multiple waves of data, the shear number of categories produced could undermine the utility of this approach, and categories with few participants could represent statistical outliers. Furthermore, cut-off points are somewhat arbitrary and do not adequately capture variance in the data.

An alternative approach is Latent Class Growth Analysis (LCGA), a person-centered technique wherein trajectory classes are produced through statistical analysis. Unlike in conventional growth models, wherein it is assumed that growth parameter

estimates are the same for each individual, LCGA allows for different estimates for unobserved, or latent, classes within a sample (Nagin & Tremblay, 1999; Raudenbush & Bryk, 2002). This is also true for Growth Mixture Modeling (GMM), of which LCGA is a special case. What differentiates GMM from LCGA is that variances terms are fixed for LCGA; that is, intercept and slope terms are assumed to be constant within each class (Jung & Wickrama, 2008). With variance terms fixed, models are more easily specified and have faster convergence, as there are fewer terms to be estimated. In the current study, an additional advantage is that LCGA allows for estimation of quadratic effects with only three waves of data, whereas GMM would require four. Moreover, LCGA fits the aims of the current study in that it allows for identification of latent class trajectories, grouping individuals empirically based on their patterns of behaviors over time, which can then be predicted through more conventional statistical methods (e.g., chi-square tests, analysis of variance).

Although ideally suited, few studies to date have employed LCGA in their analysis of post-trauma resilience. Bonanno and colleagues (2008) used this approach in a study of severe acute respiratory syndrome (SARS) survivors in Hong Kong. Drawing from assessments at 6, 12, and 18 months after hospitalization, the researchers identified four latent classes (*chronic dysfunction*: consistently low psychological functioning; *delayed dysfunction*: initially high functioning, followed by a decrease to low functioning; *recovery*: initially low functioning, followed by an increase to high functioning; and *resilience*: consistently high functioning). More recently, deRoon-Cassini, Mancini, Rusch and Bonanno (2010) used this approach with a sample of

traumatic injury survivors at 1, 3 and 6 months after hospitalization and detected the same latent classes. In the aftermath of the September 11, 2001 terrorist attacks, Nandi, Tracy, Beard, Vlahov and Galea (2009) identified five psychological trajectory groups among a representative sample of adult residents in the New York metropolitan area; the most common response was having few symptoms over time, but two groups had sustained increases (mild and severe, respectively), one group evidenced a decrease in symptoms, and the last group sustained chronic symptoms over the course of the four-wave study, which spanned from approximately 6 months to 30 months after the disaster. Lastly, Norris, Tracy and Galea (2009) recruited representative samples in four-wave longitudinal studies in the aftermath of two disasters: the 1999 floods in Mexico and the September 11 terrorist attack. Six and seven trajectories were identified, respectively, with the most common response in both disasters being low levels of symptoms over time, and lower proportions of other patterns (e.g., sustained severe symptoms; moderate symptoms decreasing over time). The authors discussed notable differences between the results for the two disasters, for example that a pattern of delayed distress was only detected in the September 11 sample.

These studies have demonstrated the utility of LCGA and provided a better understanding of common psychological trajectories after a traumatic event. Yet, because they do not include pre-trauma assessments, they do not adequately measure patterns of responses. The primary purpose of this study was to address this limitation by conducting LCGA with a three-wave dataset, including one pre-trauma assessment, of psychological distress among low-income women who survived Hurricane Katrina.

Factors that Predict Post-Disaster Psychological Responses

In addition to understanding variation in psychological responses to disasters and other traumatic events, it is important for researchers to investigate variables that predict psychological trajectories. That is, what variables predict whether an individual exhibits one pattern (e.g., resilience) over another (e.g., chronic psychological distress)?

Researchers to date have explored and identified several variables that seem to predict survivors' psychological responses. First, although the results have been mixed, research has suggested that demographic predictors, such as younger age, having young children, and being an ethnic minority, increase the risk of post-disaster psychopathology (e.g., Brewin et al., 2000; Elliot & Pais, 2006; Gibbs, 1989; Morrow, 1997). More consistently, researchers have demonstrated a dose-response relationship between indices of disaster exposure and post-disaster psychological distress (e.g., Goenjian et al., 2001; Shore, Tatum, & Vollmer, 1986). Specific stressors endured during disasters, including human bereavement, pet loss, and displacement, have also been shown to heighten risk of psychological dysfunction (Gibb, 1989; Lowe, Rhodes, Zwiebach, & Chan, 2009; Magdol, 2002). However, although disaster exposure and stressors have shown clear associations with short-term psychological responses, less clear is how they relate to longer-term psychological outcomes. Some researchers (e.g., Kaniasty & Norris, 2009; Smith & McCarty, 1996) suggest that persistent post-disaster psychological distress is more related to the chronic stressors following disasters (e.g., unstable housing, disrupted social support networks) than to disaster exposure.

Researchers have explored such stressors and, indeed, have found that lower social support and socioeconomic status are associated with higher levels of post-disaster psychological symptoms (e.g., Brewin et al., 2000; Elliot & Pais, 2006; Lowe, Chan, & Rhodes, 2010). Again, however, most of this research has been cross-sectional and it is important for researchers to understand relationships between social and material resources and psychological distress over time. As argued by Luthar and colleagues (2000), resilience is a multidimensional phenomenon, occurring at different levels of analysis, including psychological, social, and economic domains. Phenomena at each level has the potential to be disrupted by a traumatic event, and to rebound after such disruption. As Masten noted (2007), this is "dramatically apparent" (p. 927) in the case of natural disasters. Natural disasters not only affect individual lives and functioning, but also disrupt social, economic, and other systems. Such disruption could exacerbate the direct effects of disasters on individuals, rendering survivors more vulnerable to psychological distress.

Such interdependence in resilience at different levels of analysis has several implications for research on natural disasters. First, studies should include variables at different levels, including those assessing social and economic functioning, since these likely explain significant variance in psychological outcomes. Moreover, to the extent possible, researchers should include multiple waves of data to understand how these variables relate to psychological trajectories at different points in time. Pre-disaster data in particular is integral to an improved understanding of psychological trajectories. For example, pre-disaster indices of social and economic functioning relate to survivors'

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trajectory starting points – that is, survivors with fewer social and economic resources prior to disaster are more likely to be suffering from pre-disaster psychological symptoms than their counterparts. Furthermore, just as survivors with pre-disaster psychopathology are more likely to suffer from post-disaster psychological distress, survivors who had fewer pre-disaster resources might also be more likely to sustain low levels of resources, contributing to their continued risk of distress.

Therefore, the secondary aim of this study was to explore predictors of various psychological trajectories. We included variables that prior research has found to predict variation in disaster survivors' psychological responses, including demographic characteristics (age, race and ethnicity, number of children) and those related to disaster exposure (stressors endured during the hurricane, instances bereavement and pet loss, and moves). We also included assessments of perceived social support and access to social benefits, a proxy for socioeconomic status, to determine how social and economic functioning at all three time points relate to psychological trajectories.

CHAPTER 3

CURRENT STUDY

The primary purpose of the current study was to document rates of different psychological distress trajectories among a sample of low-income women who survived Hurricane Katrina. By conducting LCGA with a three-wave dataset, including one pre-disaster wave, the study built upon previous research showing variation in psychological responses, but that has to date not included pre-trauma assessments, a significant limitation. Through LCGA, both linear and quadratic patterns of growth and decline among trajectory groups were explored. The secondary purpose of the study was to determine factors associated with membership in each trajectory group, including demographic and disaster-related variables, and indices of perceived social support and socioeconomic status assessed at each time point.

CHAPTER 4

RESEARCH DESIGN AND METHODS

Participants and Procedure

Participants were initially part of a study of low-income parents who had enrolled in three community colleges in the city of New Orleans in 2004-2005. The purpose of this initial study was to examine whether performance-based scholarships affected the academic achievement, health, and well being of low-income parents (Richburg-Hayes et al., 2009). To be eligible for the study, students had to be between the ages of 18 and 34; be parents of at least one dependent child under 19; have a household income under 200 percent of the federal poverty level; and have a high school diploma or equivalent. Students were recruited through a general marketing and outreach campaign, which included flyers, newspaper and radio announcements, and oral presentations in mandatory orientation and testing sessions for incoming freshman. At baseline (i.e., upon enrollment in the study and prior to random assignment) participants provided primarily demographic information (e.g., age, race, number of children).

By the time Hurricanes Katrina and Rita made landfall, on August 29, 2005 and September 24, 2005, respectively, 492 participants had been enrolled in the program long enough to complete a 12-month, pre-disaster follow-up survey (Time 1). Trained

interviewers conducted the survey, which included measures of psychological distress and perceived social support, and items assessing access to social benefits, over the phone and compensated participants with $20 gift cards. After Hurricanes Katrina and Rita, between May 2006 and March 2007, 402 of these 492 participants (81.7%) were successfully located and surveyed. Trained interviewers administered the post-disaster survey (Time 2), which included the same questions as the 12-month follow-up survey, as well as a module of hurricane experiences and a measure of posttraumatic stress, and sent participants $50 gift cards. Approximately three years after the hurricanes, between April 2009 and March 2010, trained researchers administered an additional follow-up survey over the phone and compensated participants with $50 gift cards for their participation (Time 3). The Time 3 survey included the same measures as the previous surveys. All participants provided written consent to be part of the original study, and verbal consent to participate in the post-disaster survey.

In the current study, only participants who completed both the Time 1 and Time 2 surveys were included. Of these 402 participants, the subsample of male participants ($n = 16$) was dropped in light of consistent findings of gender differences in psychological distress following natural disasters (e.g., Norris et al., 2002). The analyses therefore drew on a sample of 386 women, 334 (86.5%) of whom also completed the Time 3 survey. The results of t-tests and chi-square tests, with Bonferroni corrections for multiple tests, showed no significant differences between the 334 participants who completed the Time 3 survey and the 52 who did not.

The mean age of the 386 women at baseline was 26.40 (*SD* = 4.43) and their average number of children at the one-year follow-up was 1.95 (*SD* = 1.06). All of the participants reported living in an area affected by Hurricane Katrina, and nearly half (48.9%) reported living in areas affected by Hurricane Rita when it struck less than a month later. Most participants (84.8%) self-identified as African American, 10.4% as White, 3.2% as Hispanic, and 1.8% as "other."

Measures

Demographic variables. Participants' age at baseline, race and ethnicity, and number of children at Time 1 were included as covariates. These variables were selected based on previous findings suggesting that they influence post-disaster psychological outcomes (e.g., Brewin et al., 2000; Gibbs, 1989).

General psychological distress. The K6 scale, a six-item screening measure of nonspecific psychological distress (Kessler et al., 2002), was used to assess pre- and post-disaster psychological distress. This scale has been shown to have good psychometric properties (Furukawa, Kessler, Slade, & Andrews, 2003), and has been used in previous research on the psychological functioning of Hurricane Katrina survivors (e.g., Galea et al., 2007). Participants rated items (e.g., "During the past 30 days, about how often did you feel so depressed that nothing could cheer you up?") on a 5-point Likert-type scale ranging from 0 (*none of the time*) to 4 (*all the time*). Reliability of the K6 scale in this study was Cronbach's alpha of .70 at Time 1, .80 at Time 2, and .80 at Time 3.

Posttraumatic stress. The Impact of Event Scale-Revised (IES-R), a 22-item self-report inventory of symptoms of PTSD (Weiss & Marmar, 1997) with good

psychometric properties (e.g., Creamer, Bell, & Failla, 2003), was used to measure PTSD symptoms as a result of hurricane experiences. The total score for this scale ranges from 0 to 88, with scores above 33 classified as indicating probable PTSD (Weiss & Marmar, 1997). Unlike the other mental health measures we used, this measure was specific to the respondent's hurricane experiences and was included only in the post-Katrina surveys. Participants were asked how often, over the prior week, they were distressed or bothered by experiences related to the hurricane, with sample items including "Any reminders brought back feelings about it," "Pictures about it popped into my mind," and "I was jumpy and easily startled." The scale was rated in a 5-point scale, ranging from 0 (*Not at all*) to 4 (*Extremely*). Cronbach's alpha reliability for the IES-R scale in this study was .95 at Time 2 and .95 at Time 3.

Hurricane-related stressors. Four variables were included as indicators of hurricane exposure. First, a *Hurricane-Related Stressors* scale that included sixteen questions assessed stressors experienced during the hurricanes and the week that followed. The questions were drawn from a larger survey of the demographic and health characteristics, evacuation and hurricane experiences, and future plans of Hurricane Katrina evacuees. The Washington Post, the Kaiser Family Foundation, and the Harvard School of Public Health jointly designed the scale (Brodie, Weltzien, Altman, Blendon, & Benson, 2006). Participants were asked to indicate whether they had experienced the following as a result of the hurricanes: 1) lacked enough fresh water to drink, 2) lacked enough food to eat, 3) felt their life was in danger, 4) lacked necessary medicine, 5) lacked necessary medical care, 6) had a family member who lacked necessary medical

care, 7) lacked knowledge of safety of children, and 8) lacked knowledge of safety of other family members. These questions were asked for both Hurricane Katrina and Hurricane Rita, yielding 16 items in total. A composite score with the count of affirmative responses to these items was created (KR-20 = .84).

Second, a dummy code indicating whether participants had lost a family member or close friend due to the hurricanes and their aftermath (*bereavement*) was included, as previous research has indicated this as a stressor that increases survivors' likelihood of psychopathology (e.g., Gibbs, 1989). Third, previous research has found that experiences of pet loss are associated with post-disaster psychological distress above and beyond human bereavement (e.g., Lowe, Rhodes, Zwiebach, & Chan, 2009), and so this was included as a dummy-coded variable. Lastly, based on previous research linking residential mobility with decreased social support and increased stress (e.g., Magdol, 2002; Magdol & Bessel, 2003), we included the number of moves in the year after Hurricane Katrina as a continuous variable.

Social and material resources. An eight-item measure of perceived support was included in the Times 1 and 2 assessments, the Social Provisions Scale (Cutrona & Russell, 1987; Russell & Cutrona, 1984). Perceived social support, defined as beliefs about the availability of support should a need arise, is generally considered a better predictor of mental health, including post-trauma distress than the more structural measures of support (Fleming, Baum, Gisriel, & Gatchel, 1982; Kaniasty, Norris, & Murrell, 1990; Kaniasty & Norris, 1993). The 24-item Social Provisions Scale was designed to assess six relational provisions identified by Weiss (1974). Instead of the full

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scale, which consists of six subscales each with four items, an 8-item version was used.

The shortened version included two items from four of the six original subscales: *Social Integration* (e.g., "I am with a group of people who think the same way I do about things"), *Reassurance of Worth* (e.g., "There are people who value my skills and abilities"), *Guidance* (e.g., "I have a trustworthy person to turn to if I have problems"), and *Reliable Alliance* (e.g., "There are people I know will help me if I really need it").

The full scale was not employed to reduce the burden on participants, with the intention of increasing retention in the study. The retained items were selected a priori because they aligned with the goals of the Opening Doors program, which was to increase community college students' sense of social integration, connection, and guidance from their community colleges. Items were rated using a 4-point Likert-type scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*), and half of the items were reverse scored. Cutrona (1989) provided evidence for the validity of the Social Provisions Scale among young mothers, and reliability (measured with Cronbach's alpha) for the full scale in a previous study was .92 (Cutrona, Russell, & Rose, 1986). In the current study, reliability was Cronbach's alpha of .83 at Time 1, .81 at Time 2, and .78 at Time 3.

Second, as a proxy for socioeconomic status, we used the number of the following social benefits received in the past month: unemployment, social security income, welfare or food stamps. Access to benefits was assessed at all three data points.

CHAPTER 5

RESULTS

Heuristic Analysis

As indicated above, the current study included only female participants who completed both the Time 1 and Time 2 surveys ($n = 386$). The results of t-tests and chi-square tests, with Bonferroni corrections for multiple tests, found no differences between the participants who completed both assessments and those who only completed the Time 1 survey. In addition, of the 386 women who completed the Time 2 assessment, 334 (86.5%) completed the Time 3 survey. Again, t-tests and chi-square tests, with controls for multiple tests, detected no significant differences completers and non-completers. For the 386 women included in the study, we also tested for differences between participants for whom we had complete data (70.5%, $n = 272$) and those who were missing data on any of the variables included in the current study (29.5%, $n = 114$). Again, no significant differences were found. Among the variables that we included in this study, the missing rate was 4.9% at the item level. We conducted single imputation using the Amelia II software (Honaker, King, & Blackwell, 2008) in R to handle missing data, and a single complete dataset was then used for statistical analysis. Notably, we replicated our

analysis using only the 272 complete cases and the trends in the data persisted. Lastly, we examined the univariate normality of the data. We found no severe violation of normality in terms of skewness (all < 1.5) and kurtosis (< 3.0) on any of the variables (Tabachnick & Fidel, 2007).

Categories of Psychological Distress over Time

Prior to LCGA, we conducted descriptive analysis of the sample using the cutoff for probable mild or moderate (K6 = 8) mental illness at the pre-disaster and two post-disaster time points. The purpose of these descriptive analyses was to provide preliminary evidence of whether there was variation in symptom trajectories among the sample.

Results of these descriptive analyses are illustrated in Figures 1 and 2, with Figure 1 showing the pathways of participants with and without probable mental illness at Time 1, and Figure 2 the pathways of those with and without probable mental illness at Time 3. As shown in the figures, although it was most common for participants to be below the cutoff across three time points, the majority of participants (54.1%, $n = 209$) surpassed the cutoff at least one time point of the study.

Furthermore, the analyses showed both stability and change in mental illness status over the course of the study. Of the 89 participants at Time 1 above the probable mild or moderate mental illness cutoff, 55 (61.8%) were above the cutoff at Time 2 and 42 (47.2%) were above the cutoff at Time 3. Among the 297 participants who were below the cutoff at Time 1, 207 (69.7%) were below the cutoff at Time 2 and 231 (77.8%) were below the cutoff at Time 3. In addition, of the 108 participants above the

cutoff for probable mild or moderate mental illness at Time 3, 70 (64.8%) were above the cutoff at Time 2 and 42 (38.9%) were at Time 1. Among the 278 participants below the probable mild or moderate mental illness at Time 3, 203 (73.0%) were below the cutoff at Time 2 and 231 (83.1%) were at Time 1.

In sum, although the descriptive analyses suggested that it was most common for participants to have low levels of psychological distress across the three time points, there was variation in the course of symptoms within the sample. That is, the analysis provided evidence that levels of psychological distress were not changing in the same way for all participants. Yet, as mentioned previously, this approach did not permit analysis of more subtle changes in psychological distress over time. For example, even participants who never exceeded cut-off point for likely mental illness at any point of the study might have experienced changes in symptoms over the course of the study. We therefore proceeded to LCGA to further explore psychological distress trajectories.

Trajectories of Psychological Distress

We used the Bayesian information criterion (BIC), entropy statistic, and posterior probabilities, as well as considerations of parsimony and interpretability, to compare models with different numbers of trajectory groups (Andruff et al., 2009; Jung & Wickrama, 2008), and included both linear and quadratic effects and the intercept term set both at the pre-disaster and first post-disaster time points. We found that a model with six trajectory groups, the intercept set at the first post-disaster time point, and linear and quadratic terms provided the best fit for the data (BIC = 6646.79, Entropy = 0.85).

The average posterior probabilities of group assignment ranged from 0.80 to 0.94 (M = .87, SD = .05).

Table 1 lists the mean and standard error of intercept, linear, and quadratic terms for each of the six trajectory groups. As evident in the table, the *Resilient* and *Increased Distress* trajectories were best defined by intercept, linear, and quadratic terms, the *Delayed Distress*, *Decreased Distress* and *Improved* trajectories were best defined by intercept and linear terms, and the *Coping* trajectory by intercept and quadratic terms. It is important to note here that, because of the differing sample sizes within each trajectory group (ranging from 11 to 231), statistical power to detect significant effects varied.

Also in Table 1 are means and standard deviations for K6 scores for each trajectory group at the three time points, as well as the results of analysis of variance (ANOVA) for group differences in K6 and post-hoc Bonferonni-corrected pair-wise comparisons. As evident in the table, there were several significant differences in psychological distress among the groups at each time point, providing evidence that LCGA produced unique groups. In addition, growth curves for the six trajectory groups, with mean psychological distress scores at each time point, are shown in Figure 3. The two most prevalent groups, *Resilient* and *Coping*, evidenced a pattern of growth typically associated with resilience; that is, both groups had an increase in psychological distress from pre- to post-hurricane, followed by a decrease in distress between the two post-disaster time points. *Resilient* was the most common trajectory (n = 231, 59.8%) and participants on this group on average began at 3.74, increased less than one point from pre- to post-disaster, and then decreased to below pre-disaster levels. *Coping*, the second

most common trajectory group ($n = 96$, 24.9%), exhibited a similar pattern, but at a higher level of psychological distress. On average, participants in this group began below the cutoff for probable mild or moderate psychological distress, increased to above the cutoff, and then decreased but remained above the cutoff.

The remaining four trajectory groups included far fewer participants, but nonetheless were evident in the best fitting model. *Increased Distress* and *Delayed Distress* both evidenced adverse psychological reactions in the aftermath of the storm, but different patterns of growth. Participants in *Increased Distress* ($n = 16$, 4.1%) on average reported levels of psychological distress in the probable mild or moderate mental illness range, and in the probable serious mental illness range ($K6 \geq 13$) at both post-disaster time points. In contrast, participants in *Delayed Distress* ($n = 16$, 4.1%) reported low levels of psychological distress pre-disaster and in the first post-disaster period; however, in the second post-disaster period, this group on average reported levels of psychological distress in the probable severe mental illness range.

The final two trajectory groups had average negative linear trajectories; that is, on average members of these groups had decreases in psychological distress over the course of the study. *Decreased Distress* ($n = 16$, 4.1%), however, reported above average psychological distress throughout the study. At Time 1, they reported psychological distress in the probable severe mental illness category, decreased to probable mild or moderate mental illness from Time 1 to Time 2, and further decreased within the mild to moderate range from Time 2 to Time 3. Members of *Improved* ($n = 11$, 2.8%), the least prevalent group, began just below the cutoff for probable serious mental illness in the

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pre-disaster period, decreased to probable absence of mental illness at Time 2, and further

decreased from Time 2 to Time 3.

Relationship between Distress Trajectories and PTSD Symptoms and Diagnosis

We then conducted analyses to determine whether there were significant

differences in posttraumatic stress symptoms and disorder among the six trajectory

groups. The rationale behind these analysis to provide a way of validating the trajectory

groups; that is, we aimed to determine whether the trajectories with low levels of

symptoms over time also had low levels of posttraumatic stress. In addition, we aimed to

determine which patterns might be especially associated with posttraumatic stress.

Table 2 includes means and standard deviations for each group on the measure of

posttraumatic stress, the IES, as well as percentages of participants in each group

exceeding the cut-off for probable PTSD (IES = 33), at each time point. In addition,

Table 2 includes the results of one-way analysis of variance (ANOVA), chi-square, and

Bonferroni-corrected post-hoc tests, to determine whether there were significant

differences in IES scores and PTSD rates at both post-disaster time points. At Time 2,

there were significant differences among the groups in IES scores, and post-hoc tests

found that *Resilient* had significant lower scores than *Coping*, *Increased Distress*, and

Decreased Distress. There were also significant differences in probable PTSD at Time 2,

and post-hoc contrasts found that *Resilient* had significantly lower rates of PTSD than

Coping, *Increased Distress*, and *Decreased Distress*.

There were also significant differences among the groups at Time 3, both in

posttraumatic stress symptoms and rates of likely PTSD. For posttraumatic stress

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symptoms, post-hoc tests found that *Resilient* participants had significantly lower scores

than *Coping*, *Increased Distress*, and *Decreased Distress*, as well as *Delayed Distress*. In

addition, for rates of PTSD, *Resilient* again had significantly lower rates of PTSD than

Coping, *Increased Distress*, and *Decreased Distress*. At Time 3, *Resilient* also had

significantly lower rates of PTSD than *Delayed Distress*, as did *Improved*.

Predictors of Psychological Distress Trajectory Groups

Next, we investigated whether predictors of post-disaster psychological responses

found in previous literature significantly differentiated between the trajectory groups,

using chi-square and one-way ANOVAs and Bonferroni-corrected post-hoc tests. Table

3 includes the results of these analyses, as well as descriptive data on these variables for

the full sample and trajectory groups.

First, demographic variables (age, race/ethnicity, number of children) were tested

and no significant differences were detected.

Second, pre-disaster social and material resources were tested, and there were

significant differences among the groups in Time 1 perceived social support. Post-hoc

tests found that *Decreased Distress* had significant lower perceived social support than

Resilient and *Delayed Distress*.

Third, we tested for differences among the groups at the first post-disaster time

point (Time 2), including participants' reports of hurricane exposure. Among the

exposure variables, there were significant differences in hurricane-related stressors,

bereavement, and pet loss. Post-hoc tests found that *Resilient* participants reported

exposure to significantly fewer hurricane related stressors than *Coping* and *Decreased*

Distress and were less likely to experience bereavement than *Coping*. In addition, *Increased Distress* participants were significantly more likely to experience pet loss than *Resilient*, *Coping*, and *Delayed Distress*. Among the Time 2 social and material resource variables, there were significant differences among the groups in perceived social support and number of benefits. Post-hoc tests found that participants in *Resilient* reported significantly higher perceived social support than those in *Coping* and *Increased Distress*, and that participants in *Increased Distress* had significantly lower perceived social support than those in *Coping*. *Decreased Distress* received significantly more benefits than *Resilient*, *Coping*, and *Improved*.

Lastly, we detected significant differences in perceived social support and number of benefits at the second post-disaster assessment (Time 3). For perceived social support, *Resilient* reported significantly higher levels than *Coping* and *Increased Distress*, and *Increased Distress* also reported significantly lower levels than *Delayed Distress*. For number of benefits received, *Resilient* reported receiving significantly fewer benefits than *Coping*, *Increased Distress*, *Delayed Distress*, and *Decreased Distress*.

CHAPTER 6

DISCUSSION

The primary aim of this study was to determine rates of resilience and other

psychological trajectories in a sample of low-income mothers who survived Hurricane

Katrina. In doing so, we built on prior work documenting distinct patterns of symptoms

in the aftermath of natural disasters and other trauma (e.g., Bonanno et al., 2008; Norris

et al., 2009). Unlike previous studies, however, we benefitted from a dataset that

includes pre-disaster (one wave) and post-disaster (two waves) of data. As such, we were

able to investigate the influence of pre-disaster mental health in shaping patterns of

growth and decline, and explore both short- and longer-term mental health outcomes.

Using latent class growth analysis (LCGA), we detected six distinct trajectories.

The majority (59.8%) of participants fell into a class consistent with the concept of

resilience (*Resilient*). That is, although they reported relatively low levels of

psychological distress at each time point, they experienced an increase in symptoms at

the first post-disaster assessment, followed by a return to baseline levels at the second

post-disaster assessment. The consistently low levels of distress among the majority of

participants align with the results of previous studies using LCGA (e.g., Bonanno et al.,

2008; Nandhi et al., 2009). The unique contribution of the current study, however, is that we can see that the resilient majority was functioning well prior to the storm and likely had existing psychosocial resources that protected them from adverse post-disaster psychological outcomes. Moreover, the results show that slight elevations in psychological symptoms commonly occur among resilient individuals. Such elevations, although not surpassing cut-offs for probable mental illness, could have a clinically significant impact on survivors. With pre-disaster data, we were therefore able to show the more nuanced patterns of psychological symptoms among resilient participants.

A second group, comprising nearly a quarter of the sample, exhibited a similar pattern of growth and decline, but did so at a higher level of psychological distress (*Coping*). Their initially elevated post-disaster symptoms were followed by a decline to pre-disaster levels, suggesting that they too were coping with the stressors of the storm. It is important to note, however, that they maintained levels of psychological distress in the probably mild or moderate mental illness category over the course of the study. The *Coping* trajectory, again, demonstrates the added value of pre-disaster data to the current study. If we had access to only post-disaster data, we might assume that the *Coping* survivors' moderate levels of distress stemmed from their experiences during the disaster and its aftermath, whereas, with pre-disaster data, it is clear that they were struggling with psychological symptoms prior to the hurricane.

Taken together, the *Resilient* and *Coping* trajectories constituted 84.7% of the sample and suggest that the pattern of initial elevations in symptoms, followed by decreases to pre-disaster levels, is normative. Although they each comprised less than

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five percent over the sample, the remaining four trajectories deviated from this bell-shaped pattern and demonstrate the heterogeneity of psychological responses to disaster.

In contrast to the *Coping* trajectory, the *Increased Distress* trajectory was defined by consistent elevations of post-disaster psychological distress, with levels surpassing the probable severe mental illness cut-off at both post-disaster time points. A chronic distress trajectory has been detected in previous studies of samples exposed to traumatic stress (e.g., Bonanno et al., 2007; Hobfoll et al., 2009). However, the percentage of participants consistently exhibiting post-disaster symptoms is notably smaller than in previous research. For example, Nandi and colleagues (2009) found that 13.2% of their sample of NYC residents exhibited severe and increasing symptoms and 8.3% exhibited chronic severe symptoms in the aftermath of the September 11 terrorist attacks. Again, because these studies lack pre-disaster data, they cannot determine whether participants experienced increases in distress from pre- to post-disaster and therefore likely include survivors who had severe pre-disaster symptoms in their chronic distress trajectories. In contrast, we provide clear evidence that the *Increased Distress* group had worsening psychological symptoms in the aftermath of the disaster, and distinguish them from survivors suffering from pre-disaster severe distress (i.e., the *Decreased Distress* trajectory).

An additional group of participants exhibited severe post-disaster psychological distress. However, this group began with low levels of distress, maintained low levels one year after the storm, and reported severe distress at the three-year post-disaster assessment (*Delayed Distress*). Previous studies have found mixed results for a delayed

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trajectory. For example, Norris and colleagues (2009) found that 14% of their sample of NYC residents experienced delayed distress in the aftermath of September 11, whereas this trajectory was not detected in their comparison sample of survivors of a Mexican flood. This discrepancy could be due to how long participants were followed: the September 11 sample was followed through 30 months post-disaster, whereas the Mexican sample was followed only through 24 months post-disaster. The results of the current study further suggest the advantages of longitudinal studies of trauma survivors that continue to assess survivors well beyond the initial recovery period. Had our post-disaster assessments spanned a shorter period of time, this delayed response would not have been evident.

The final two groups, again both representing less than five percent of the sample, exhibited declines in psychological distress over the course of the study (*Decreased Distress* and *Improved*). The first of these groups began the study with severe psychological distress and, on average, decreased consistently over the course of the study, reporting levels of distress in the probable mild or moderate mental illness category at both post-disaster time points (*Decreased Distress*). Although the *Decreased Distress* trajectory is suggestive of post-disaster improvements in psychological functioning, it is possible that participants in this group were experiencing a regression to the mean. That is, because they reported such extreme levels of psychological distress prior to disaster, they were likely to experience some decrease with the mere passage of time, independent of disaster exposure. As with the *Coping* and *Increased Distress* trajectories, the *Decreased Distress* trajectory demonstrates that the majority disaster

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survivors with chronically high levels of psychological symptoms had pre-existing psychological conditions. Had we lacked pre-disaster data, we might have erroneously assumed that this trajectory represented an acute post-disaster response and gradual recovery from disaster-related distress to low pre-disaster levels, rather than a steady decreasing of symptoms that were present before the disaster struck.

The last trajectory group, which consisted of the smallest proportion of participants, experienced even steeper declines in psychological distress from the pre-disaster assessment to one year after Hurricane Katrina (*Improved*). More specifically, they began the study with levels of distress in the probable severe mental illness category, but reported distress levels indicating a probable absence of mental illness at both post-disaster time points. This trajectory group, although the least common in the sample, illustrates the broad range of post-disaster psychological responses, and supports the notion that some individuals will experience improvements in psychological functioning after exposure to traumatic events (e.g., Tedeschi, Park & Calhoun, 1998). Without pre-disaster data, we might have assumed that the participants in the *Improved* trajectory were resilient – that they had returned to low levels of pre-disaster distress after experiencing slightly elevated symptoms. Instead, through our analysis, we have shown that some individuals will experience improved mental health in the aftermath of a major disaster.

Predictors of Trajectory Group Membership

The six trajectory groups demonstrate the wide variation in human responses to disaster. What factors might explain why some participants are resilient, while others

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experience chronic and delayed distress, or even improvements in functioning after disasters? The secondary aim of the study addressed this question, by investigating differences among the trajectory group in demographic variables, disaster exposure, perceived social support, and access to social benefits.

In exploring pre-disaster differences among the trajectory groups, we found that the *Decreased Distress* trajectory group began the study with significantly lower levels of perceived social support than either the *Resilient* or the *Delayed Distress* trajectory. Low perceived social could have accounted for the pre-disaster psychological symptoms among the *Decreased Distress* participants, and put them at greater risk for exposure to the storm (Lowe, Chan, & Rhodes, 2010). Indeed, those with fewer social resources may have been less likely to secure transportation out of New Orleans and alternative housing for themselves and their children (Lowe et al., 2010). It is perhaps not surprising, then, that *Decreased Distress* participants experienced significantly more hurricane-related stressors than *Resilient* participants, increasing their likelihood of sustaining high levels of distress in the aftermath of the hurricane (e.g., Goenjian et al., 2001). Also distinguishing the *Decreased Distress* trajectory was their receipt of significantly more social benefits (i.e., food stamps, welfare, unemployment, SSI) in both post-disaster periods (i.e., relative to the *Resilient*, *Coping*, and *Improved* groups at Time 2, and the *Resilient* group at Time 3). Perhaps participants in this group had access to fewer family and network resources and were less able to draw on natural supports to re-establish themselves in the aftermath of disaster. Financial distress, in turn, exacerbates women's risk for psychological symptoms (Belle & Doucet, 2003). Alternatively, chronic mental

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health problems could have prevented participants from engaging in employment activities, increasing their need for social benefits.

The *Coping* group experienced significantly more hurricane-related stressors than those in the *Resilient* group. This group's relatively higher levels of pre-disaster psychological distress could have put them at risk for hurricane exposure (Green et al., 2011). For example, pre-disaster depressive symptoms, including lack of energy, attention, and concentration, could have interfered with the capacity to formulate and execute evacuation plans. *Coping* participants were also significantly more likely to experience bereavement following the storm than *Resilient* participants, which could, in part, account for their consistently higher levels of psychological distress (Gibbs, 1989), as could their significantly lower levels of perceived social support (Kaniasty & Norris, 2009).

Low levels of perceived social support likewise differentiated the *Increased Distress* trajectory from the *Resilient* trajectory at both post-disaster time points, Disruptions in social support networks could therefore account for their sustained psychological distress in the aftermath of Hurricane Katrina. Another unique feature of the *Increased Distress* trajectory was the significantly higher incidence of pet loss relative to the *Resilient*, *Coping*, and *Delayed Distress* trajectories. This finding is consistent with prior research showing that pet loss was a significant predictor of post-disaster distress among Hurricane Katrina survivors (Hunt, Al-Awadi, & Johnson, 2008; Lowe et al., 2009). It could be that losing a beloved pet is experienced as a major loss of

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social support or stress relief. Alternatively, pet loss could be a proxy for more extreme aspects of exposure and displacement not measured in the current study.

Although the variables included in the study predicted membership in the *Decreased Distress*, *Coping*, and *Increased Distress* trajectories relative to the *Resilient* trajectory, such was not the case for the *Delayed Distress* trajectory. In fact, the only significant difference between this trajectory and other patterns was its significant lower incidence of pet loss relative to the *Increased Distress* trajectory. Although this might have shielded participants in the *Delayed Distress* trajectory from short-term psychological reactions to the disaster, it remains unclear why participants in this group went on to experience severe distress three years after the disaster. It could be that variables not included in the current study (e.g., children's functioning, residential instability, exposure to additional traumatic events) led to delayed reactions.

Unmeasured variables might also explain the *Improved* trajectory. It is remarkable that this small group of participants experienced sharp and sustained declines in distress from pre- to post-disaster, and yet there was only one significant difference between the *Improved* and other trajectories: *Improved* participants received significantly fewer social benefits than *Decreased Distress* participants at the first post-disaster time point. Although this phenomenon should be explored further, it could be that, for the *Improved* participants, the hurricane led to economic opportunities that reduced participants' reliance on social benefits and alleviated financial distress, thereby bolstering their mental health. The *Improved* participants might also have experienced other positive changes that researchers have observed among some survivors, including

stronger intimate relationships, residence in safer neighborhoods, and access to higher quality schools (Graif, 2010; Lowe, Scoglio, & Rhodes, 2011; Rosen, 2010).

Implications

The results of this study have implications for research, policy, and practice. To the extent possible, researchers should identify pre-disaster data when planning post-disaster studies, as pre-disaster levels of psychological distress had a clear influence on post-disaster psychological trajectories. Efforts to include pre-disaster data could provide further insight into how natural disasters alter the developmental course of psychological symptoms, particularly if multiple data points had been collected. Of course, identifying and re-assessing former participants requires financial and organizational resources and, understandably, disaster studies are often focused on practical matters, such as documenting rates of mental and physical illness and identifying survivors in immediate need of services (Benight & McFarlane, 2007). When interpreting such data, we should be mindful of the influence of pre-disaster vulnerabilities in determining both disaster exposure and post-disaster psychological responses.

More generally, the results of this study provide support for group-based statistical approaches when studying the effects of disaster exposure and other traumatic events. Although a resilient trajectory represented the majority of the sample, there were clear subgroups of participants that deviated from this pattern. With traditional latent growth curve modeling, we would have overlooked participants with consistent distress and delayed responses, as well as those who experienced improvements in functioning in the post-disaster period. A categorical approach, wherein cutoff criteria are used, would

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have also detected such variability; however, through LCGA, we were able to demonstrate more subtle changes within each trajectory group. For example, we showed that, even among participants without probable mental illness over the course of the study, there was variation in symptoms over time, with symptoms initially increasing after the disaster before returning to pre-disaster levels.

The psychological trajectories found in our analyses also have implications for post-disaster clinical interventions. Slight elevations in psychological symptoms should be normalized, perhaps through outreach campaigns that detail the nature and course of symptoms that commonly occur in the aftermath of disasters and psychological distress, such as sadness, disruptions in sleep, and difficulties sustaining concentration and attention. Communities exposed to disaster should be informed that these symptoms often occur in mild forms (e.g., with low levels of frequency and intensity) and, in most instances, dissipate over time. At the same time, psycho-educational interventions should provide information on what individuals can do if they or their loved ones experience more intense, persistent psychological symptoms.

Additionally, the findings of the study demonstrate that not all survivors are equally vulnerable to post-disaster psychological distress, and suggest factors predictive of adverse reactions (e.g., higher pre-disaster psychological symptoms, lower social support). Screening for these factors could help practitioners identify survivors that might be in need of mental health services. Once affected individuals are identified, practitioners should employ empirically supported treatments, including cognitive behavioral therapy and stress management (Hobfoll et al., 2007), address grief responses

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to human and pet bereavement, and bolster social support networks. Connecting survivors with mental health services also would provide opportunities to address more longstanding stressors and symptom histories that rendered survivors vulnerable to post-disaster psychological distress.

Disaster policies should likewise include measures for protecting individuals suffering from psychological distress from disaster exposure, including those ensuring timely evacuation, food and shelter during the storm and its aftermath, and access to medicine and medical care. Including means for evacuating pets and reuniting survivors with their animals could also protect against distressing symptoms. Lastly, policies that promote the long-term financial stability of low-income survivors, including diverse training and educational opportunities, increased earnings, affordable childcare, and enforcement of anti-discrimination laws, could help promote the long-term psychological adjustment of low-income women (Jones-DeWeever, 2008; Williams, Sorokina, Jones-DeWeever, & Hartmann, 2006).

Limitations

Despite its potential to inform research, policy, and practice, this study is not without limitations. First, selecting which LCGA model to use in subsequent analyses involved some subjectivity; that is, although statistical indices of good fit provided insight into the optimal LCGA model, we also interpreted results with previous research findings and theoretical considerations in mind. Likewise, although attempts were made to choose labels representative of the trajectory shapes, the names selected are not value-neutral. For example, we chose the term *Resilient* for the trajectory that began low,

experienced an initial elevation of symptoms, and then returned to baseline levels of distress because that fits with the scientific definition of resilience. This definition, however, has been used inconsistently in the empirical literature, and, likewise, resilience has different meanings in its common usage (Luthar et al., 2000; Tarter & Vanyukov, 1999). Therefore, although the results provide insight into the rates of a resilient trajectory in a sample vulnerable to post-disaster distress, they do not fully capture the subjective experience of resilience. Likewise, resilience is a multidimensional phenomenon, present in domains beyond psychological functioning, such as physical, educational, and occupational functioning, and in systems beyond the individuals, such as social networks, communities, and economic systems. Future researchers should explore different domains of resilience and the interrelationships among them. In addition, qualitative methods should be employed to better understand how survivors of natural disasters and other traumatic events define and experience resilience, and the factors they see as promoting positive posttraumatic psychological responses (Luthar & Cushing, 1999). An investigation of how these subjective experiences of resilience map onto statistical trajectories, which would enrich our understanding of how individuals respond and recover in the aftermath of disasters and other trauma.

Second, future researchers should replicate the results with different samples and in the context of other natural disasters. As stated previously, participants in the study – low-income mothers, primarily unmarried and African American – were especially vulnerable to post-disaster psychological distress. The focus on a vulnerable sample is a strength of the study, yet limits its external validity, as do the unique aspects of Hurricane

Katrina, including the destruction of levees in need of repair and the slow governmental response. All of the participants in the study were also community college students, which further limits the generalizability of the study. Methodologies that capture more normative samples (e.g., random digit dialing) could be employed to address this limitation. If such procedures were being used for another study in progress prior to a disaster, researchers could mobilize their efforts to contact and re-assess participants, thereby including pre-disaster data for a normative sample. Normative data would also permit a better understanding of the role of demographic variables in determining post-disaster psychological outcomes. In addition, with a larger sample size, researchers would have more statistical power to detect statistically significant differences between trajectory groups, particularly those represented by smaller proportions of a given sample. The analysis of predictors of trajectory group membership should also be replicated, as the number of between-group comparisons in the current study elevated the risk of Type I errors.

Third, because our study only included three waves of data, and the majority of participants exhibited non-linear trajectories of psychological distress, we were unable to explore predictors of change within each trajectory group. By collecting additional waves of data, we could continue to understand complex patterns of change in the aftermath of disasters. Likewise, studies with additional waves could better capture the complex relationships between psychological and other domains of functioning over time. Although we were able to show that perceived social support and access to social benefits, depending on the timing of assessment, predicted trajectory membership, we did

not model change in these resources. As with psychological distress, resources are likely also changing in non-linear patterns, and additional data waves would allow for modeling of different domains simultaneously.

Additional limitations inherent to our methodology are also worth noting. We relied on self-report measures and perhaps different patterns would have emerged had we included more objective methods of disaster exposure, or psychiatric diagnoses from more sophisticated assessment tools. Likewise, our inclusion of a screening tool of nonspecific distress further limits the scope of the study. Future analyses of patterns of specific psychological disorders commonly found in the aftermath of disasters (e.g., posttraumatic stress disorder, major depressive disorder) would both improve our understanding of post-disaster psychological responses and have implications for clinical interventions. It is also possible that, for some of the participants, more severe psychological symptoms had dissipated by the time of the first post-disaster assessment, which took place approximately a year after the disaster, indicating the need for data points in closer proximity to the disaster (Steinglass & Gerrity, 1990).

Despite these limitations, this study represents a step toward a deeper understanding of disasters survivors' psychological trajectories. Through our inclusion of pre-disaster data, we were able to show that, among disaster survivors without pre-existing psychological vulnerabilities, psychological resilience is the most common response. Yet, a sizeable proportion of survivors, particularly those with pre-disaster mental health problems, experience adverse psychological reactions. High disaster exposure, experiences of bereavement and pet loss, low perceived social support, and low

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socioeconomic status influence survivors' course of symptoms, indicating these variables

as viable targets for disaster policies and clinical interventions. As we continue to

explore psychological resilience and its relationship with other variables, we will be able

to further promote this trajectory among disaster survivors.

Table 1

Growth Parameters and K6 Scores for Six Psychological Trajectory Groups

Group	Resilient	Coping	Increased Distress	Delayed Distress
N	*231*	*96*	*16*	*16*
(%)	*59.8%*	*24.9%*	*4.1%*	*4.1%*
	Estimate (SE)	*Estimate (SE)*	*Estimate (SE)*	*Estimate (SE)*
Intercept	4.31 (0.30)***	10.02 (0.84)***	17.41 (2.00)***	6.20 (3.24)
Linear	-0.56 (0.14)***	0.79 (0.41)	4.23 (0.58)***	5.00 (0.96)***
Quadratic	-1.15 (0.29)***	-2.41 (0.56)***	-3.86 (1.70)*	3.41 (2.94)
	Mean (SD)	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
Posterior Probability	0.94 (.11)	0.82 (.15)	0.91 (.14)	0.86 (.17)
Time 1 K6	3.74 (2.44)	6.85 (2.68)	9.14 (3.88)	4.44 (3.27)
Time 2 K6	4.28 (3.59)	10.20 (3.98)	17.38 (4.63)	4.94 (3.33)

Time 3 K6   2.52 (2.23)   8.74 (2.27)   18.13 (2.59)   14.99 (2.14)

Table 1 (cont.)

Growth Parameters and K6 Scores for Six Psychological Trajectory Groups

Group	Decreased Distress	Improved		
N	*16*	*11*		
(%)	*4.1%*	*2.8%*		
	Estimate (SE)	*Estimate (SE)*		
Intercept	12.11 (1.46)***	5.49 (1.37)***		
Linear	-3.69 (1.01)***	-4.39 (0.82)***		
Quadratic	0.97 (1.60)	1.74 (1.51)		
	Mean (SD)	*Mean (SD)*	*F*	*Comparisons*
Posterior Probability	0.89 (.04)	0.80 (.15)		
Time 1 K6	16.94 (3.17)	12.64 (1.63)	109.89***	Resilient < Coping***, Increased Distress***, Decreased Distress***, Improved***; Coping < Increased Distress*, Decreased Distress***, Improved***; Coping > Delayed Distress*; Increased Distress > Delayed Distress***; Increased Distress < Decreased Distress***, Improved*; Delayed Distress < Decreased Distress***, Improved***; Decreased Distress > Improved**
Time 2 K6	12.19 (5.37)	5.46 (3.96)	67.09***	Resilient < Coping***, Increased Distress***, Decreased Distress***; Coping < Increased Distress***; Coping > Delayed Distress***, Improved**, Increased Distress > Delayed Distress,***, Decreased Distress**, Improved***, Delayed Distress < Decreased

Distress***; Decreased Distress >
Improved***

Time 3 K6	9.30 (3.02)	2.45 (1.97)	284.06***	Resilient < Coping***, Increased Distress***, Delayed Distress***, Decreased Distress***; Coping > Increased Distress*, Delayed Distress*; Coping < Improved***; Increased Distress > Delayed Distress***, Decreased Distress***, Improved*; Delayed Distress > Decreased Distress***, Improved***; Decreased Distress > Improved**

Table 2

IES-R Scores and Rates of Probable PTSD for Full Sample and Trajectory Groups

Group	Full Sample	Resilient	Coping	Increased Distress	Delayed Distress
N	*386*	*231*	*96*	*16*	*16*
(%)	*--*	*59.8%*	*24.9%*	*4.1%*	*4.1%*
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Time 2 PTSD	33.35 (22.75)	26.64 (20.47)	42.43 (20.71)	42.08 (23.04)	40.31 (25.80)
Time 2 PTSD Diagnosis	50.0%	38.5%	68.8%	75.0%	56.3%
Time 3 PTSD	27.27 (21.60)	20.52 (18.32)	37.28 (21.50)	42.08 (19.41)	42.48 (24.28)
Time 3 PTSD Diagnosis	37.6%	23.8%	57.3%	62.5%	75.0%

Table 2 (cont.)

IES-R Scores and Rates of Probable PTSD for Full Sample and Trajectory Groups

Group	Decreased Distress	Improved		
N	*16*	*11*		
(%)	*4.1%*	*2.8%*		
	M (SD)	*M (SD)*	*F / χ2*	*Comparisons*
Time 2 PTSD	50.00 (20.71)	39.69 (29.47)	12.03***	Resilient < Coping***, Increased Distress**, Decreased Distress***
Time 2 PTSD Diagnosis	68.8%	54.5%	32.35***	Resilient < Coping***
Time 3 PTSD	37.00 (20.37)	23.73 (29.47)	14.65***	Resilient < Coping***, Increased Distress**, Delayed Distress***, Decreased Distress*
Time 3 PTSD Diagnosis	56.3%	35.4%	50.76***	Resilient < Coping***, Increased Distress*, Delayed Distress***

Table 3

Descriptive Data and Trajectory Group Differences for Time 1, Time 2, and Time 3

Variables

Group	Full Sample	Resilient	Coping	Increased Distress	Delayed Distress
N	*386*	*231*	*96*	*16*	*16*
(%)	*--*	*59.8%*	*24.9%*	*4.1%*	*4.1%*
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Demographics					
Age	25.42 (4.43)	25.26 (4.27)	25.81 (4.97)	25.81 (4.90)	25.56 (4.47)
Number of Children	1.95 (1.15)	1.85 (1.00)	2.08 (1.47)	1.91 (1.05)	2.37 (1.31)
Race					
African American	83.7%	81.8%	88.5%	93.8%	87.5%
White	11.1%	13.4%	6.3%	6.3%	6.3%
Hispanic	3.4%	3.0%	3.1%	0.0%	6.3%
Other	1.8%	1.7%	2.1%	0.0%	0.0%
Time 1 Variables					
Time 1 Support	18.36 (3.88)	18.83 (3.57)	17.96 (4.03)	17.06 (4.39)	19.31 (4.41)
Time 1 Benefits	.82 (.69)	0.82 (0.68)	0.75 (0.65)	1.06 (0.77)	0.94 (.77)
Time 2 Variables					
Hurricane-Related Stressors	3.79 (3.32)	3.04 (2.79)	5.08 (3.86)	3.44 (3.01)	5.31 (3.44)
Bereavement	28.8%	23.4%	40.6%	25.0%	25.0%

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Pet Loss	17.4%	14.7%	18.8%	50.0%	6.3%
Moves	3.71 (1.35)	3.64 (1.29)	3.87 (1.53)	3.63 (1.54)	3.32 (1.35)
Time 2 Support	17.52 (3.86)	18.26 (3.48)	16.57 (3.85)	13.33 (5.34)	17.25 (4.07)
Time 2 Benefits	.74 (.73)	.69 (.70)	.74 (.73)	.88 (.72)	.81 (.91)

Time 3 Variables

Time 3 Support	18.00 (3.76)	18.82 (3.42)	16.89 (3.45)	14.25 (4.17)	18.03 (3.83)
Time 3 Benefits	.62 (.71)	.54 (.70)	.65 (.67)	.85 (.79)	.75 (.68)

Table 3 (cont.)

Descriptive Data and Trajectory Group Differences for Time 1, Time 2, and Time 3

Variables

Group	Decreased Distress	Improved		
N	*16*	*11*		
(%)	*4.1%*	*2.8%*		
	M (SD)	*M (SD)*	*F / χ2*	*Comparisons*
Demographics				
Age	26.19 (3.92)	23.45 (2.58)	0.76	--
Number of Children	2.31 (1.01)	1.82 (.98)	1.38	--
Race			14.72	--
African American	75.0%	72.7%		
White	12.5%	18.2%		
Hispanic	12.5%	0.0%		
Other	0.0%	9.1%		
Time 1 Variables				
Time 1 Support	15.19 (4.76)	16.91 (3.24)	4.03**	Decreased Distress < Resilient***, Delayed Distress*
Time 1 Benefits	1.06 (0.77)	0.73 (0.90)	1.12	--
Time 2 Variables				
Hurricane-Related Stressors	5.69 (4.19)	3.87 (2.88)	7.62***	Resilient < Coping***, Decreased Distress*
Bereavement	43.8%	27.3%	11.85*	Resilient < Coping*

Pet Loss	25.0%	18.2%	15.17*	Increased Distress > Resilient**, Coping**, Delayed Distress*
Moves	3.94 (1.12)	4.1 (.83)	0.93	--
Time 2 Support	16.94 (3.91)	17.24 (3.87)	7.08***	Resilient > Coping**, Increased Distress***; Increased Distress < Coping*
Time 2 Benefits	1.44 (.73)	.45 (.69)	3.71**	Decreased Distress > Resilient**, Coping**, Improved**

Time 3 Variables

Time 3 Support	17.10 (5.75)	17.13 (3.68)	8.03***	Resilient > Coping***, Increased Distress***; Increased Distress < Delayed Distress*
Time 3 Benefits	1.19 (.81)	0.49 (.78)	3.22**	Decreased Distress > Resilient**

Figure 1

Pathways of Participants with and without Probable Mental Illness at Time 1

Time 1: Pre-Hurricane	Time 2: 1 Year Post-Hurricane	Time 3: 3 Years Post-Hurricane
		Mental Illness (YYY) – 34 (8.8%)
	Mental Illness (YY) – 55 (14.2%)	None (YYN) – 21 (5.4%)
Mental Illness (Y) – 89 (23.1%)		Mental Illness (YNY) – 8 (2.1%)
	None (YN) – 34 (8.8%)	None (YNN) – 26 (6.7%)
		Mental Illness (NYY) – 36 (9.3%)
	Mental Illness (NY) – 90 (23.3%)	None (NYN) – 54 (14.0%)
None (N) – 297 (76.9%)		Mental Illness (NNY) – 30 (7.8%)
	None (NN) – 207 (53.6%)	None (NNN) – 177 (45.9%)
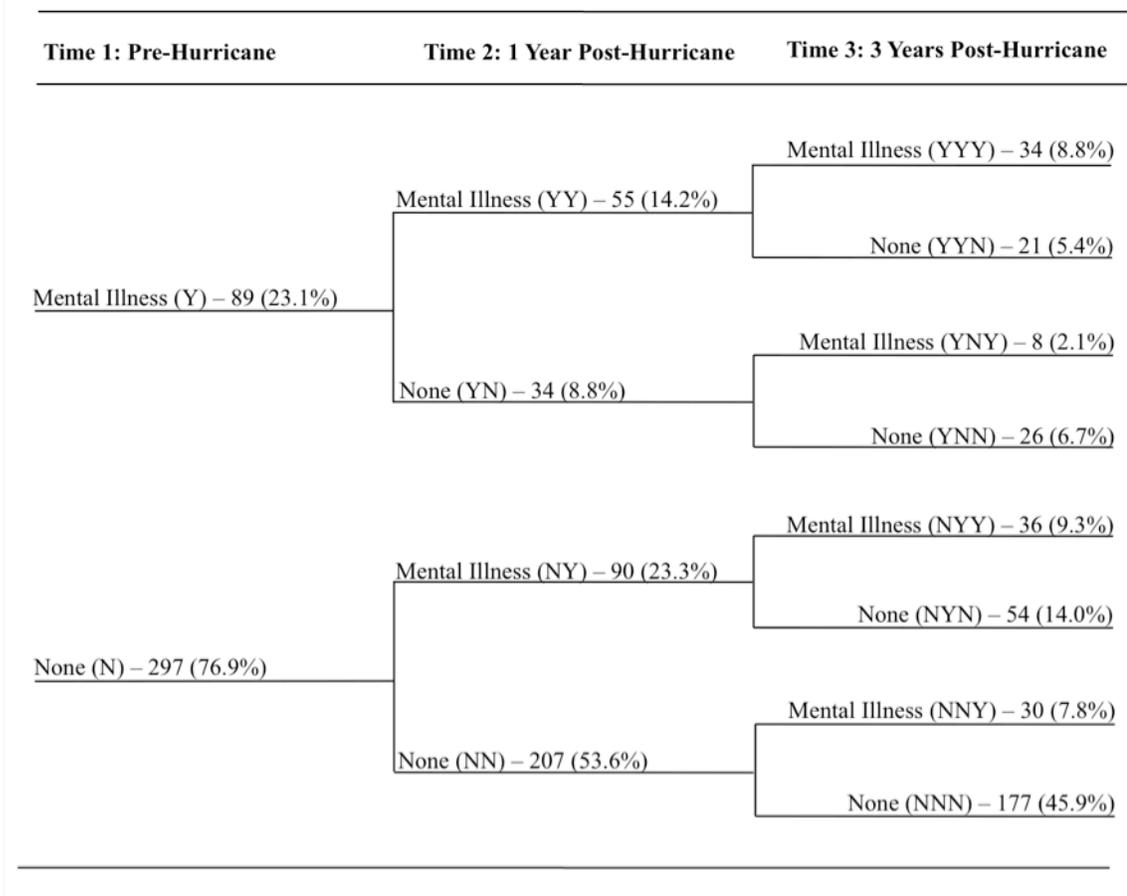
Figure 2

Pathways of Participants with and without Probable Mental Illness at Time 3

Time 1: Pre-Hurricane	Time 2: 1 Year Post-Hurricane	Time 3: 3 Years Post-Hurricane

Mental Illness (YYY) – 34 (8.8%)

None (NYY) – 36 (9.3%)

Mental Illness (YY) – 70 (18.1%)

Mental Illness (YNY) – 8 (2.1%)

None (NNY) – 30 (7.8%)

None (NY) – 38 (9.8%)

Mental Illness (Y) – 108 (28.0%)

Mental Illness (YYN) – 21 (5.4%)

None (NYN) – 54 (14.0%)

Mental Illness (YN) – 75 (19.4%)

Mental Illness (YNN) – 26 (6.7%)

None (NNN) – 177 (45.9%)

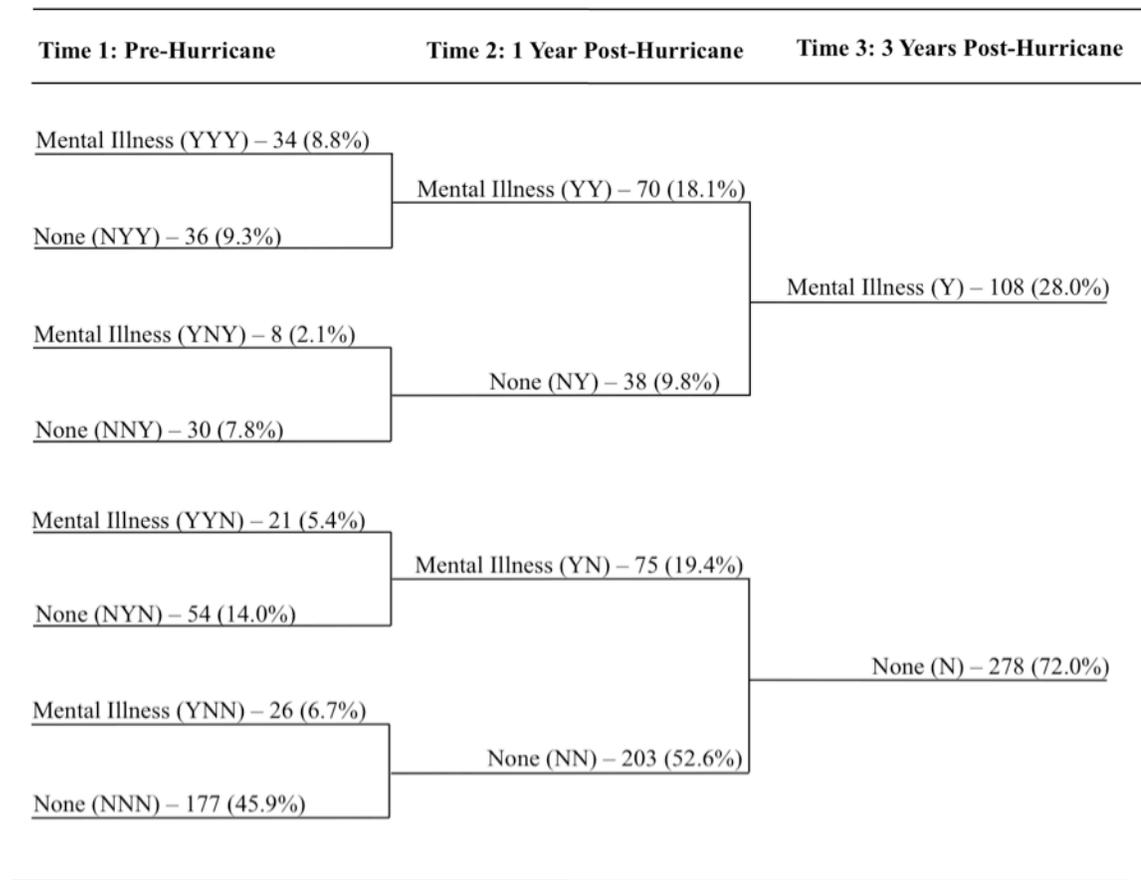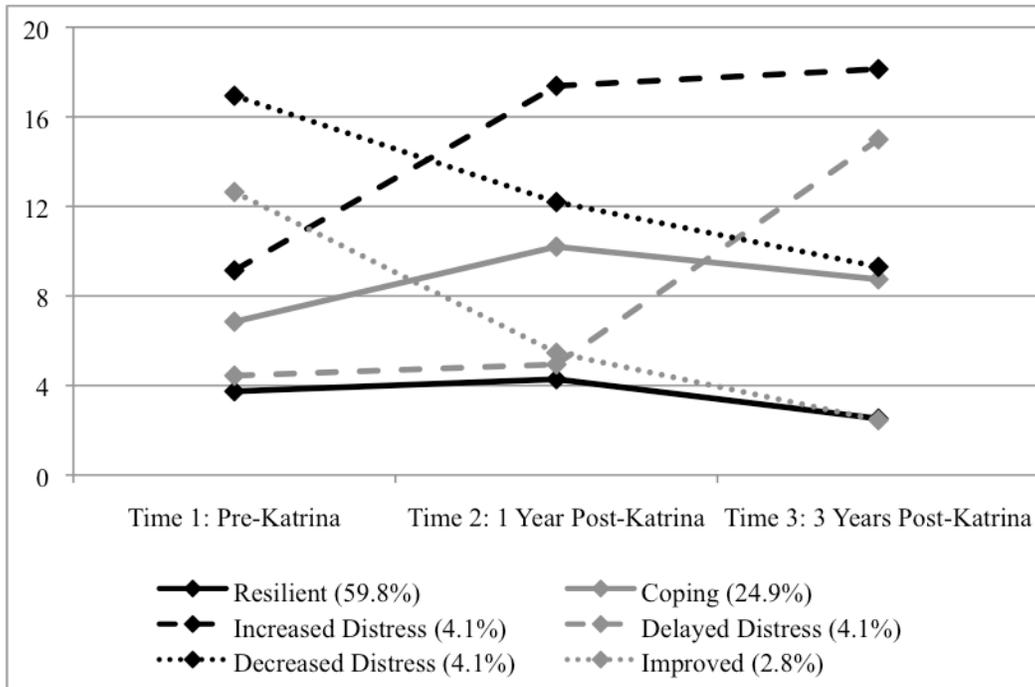None (NN) – 203 (52.6%)

None (N) – 278 (72.0%)

Figure 3

Graph of Average K6 Scores for Trajectory Groups from Time 1 to Time 3

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