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Social Capital and the Mental Health Impacts of Hurricane Katrina: Assessing Long-Term Patterns of Psychosocial Distress

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Hurricane Katrina was the most costly disaster in U.S. history, creating severe physical and mental health impacts among the population exposed along the Gulf Coast. The physical and economic assessments have been the focus of many previous studies with inadequate attention paid to the long-term emotional and psychosocial toll on survivors. This study evaluates the socio-demographic and contextual variations in Katrina's depressive and psychosocial stress impacts among a random sample of survivors in the most devastated counties/parishes of Louisiana and Mississippi three years after the storm. Our primary objective was to assess the influence of social capital, or lack of it, for mental health outcomes. Using a comprehensive random digit dialing telephone survey data-set, descriptive and multivariate statistical techniques including differences of means, factor analysis, multivariate discriminant analysis, and Ordinary Least Squares regression analysis, were utilized to test hypotheses derived from social capital theory. Strong support was found for the hypothesized relationships; empirical evidence clearly shows that lack of social capital predicts both depression and symptoms of posttraumatic stress disorder. The results further reveal that Katrina's mental health impacts are not evenly distributed. Depression, stress, and psychosocial impacts are skewed toward African Americans, older adults, women, unmarried adults, less educated, and people with weak social networks. Theoretical and applied policy implications of these findings are discussed for understanding lingering mental health problems three years post-Katrina.

Keywords: Disasters, Hurricane Katrina, Post Traumatic Stress Disorder, Social Capital, Psychosocial Impacts, Mississippi and Louisiana Counties/Parishes.

Introduction

Hurricane Katrina has been ranked as the costliest and the third deadliest storm to hit the Gulf Coast of the United States since the 1900s (Barnshaw and Trainor 2007; Blake et al. 2007; U.S. Department of Commerce 2006). This disaster represents one of the most powerful and devastating hydrometeorological events experienced by Gulf Coast communities during the last one hundred and fifty years. Katrina destroyed almost everything along its regional path, disabled local response systems, displaced almost one million survivors and, as a catastrophic event, continues to have severe adverse consequences (Erikson 2007; McQuaid and Schleifstein 2006; Quarantelli 2006).

In addition to physical devastation, Katrina was responsible for a significant elevation of both physical and mental health problems among survivors, especially within the severely devastated area we refer to as "ground zero" in southeastern Louisiana and southwestern Mississippi (Galea et al. 2005; Kessler et al. 2006). By all accounts, Katrina exacted a heavy toll on human lives, resources (including physical, human, and social capital), and psychosocial health in the region. After a catastrophe such as Katrina, social capital is often impacted due to the dispersion, dislocation, and relocation of people and the breakdown of social relationships (Barnshaw and Trainor 2007; Hurtado et al. 2011; Kawachi and Beckman 2001; Kaniasty and Norris 2004; Ritchie 2004; Ritchie and Gill 2007; Wind et al. 2011). Thus, the buffering effect of social capital for mental health in the wake of Katrina's devastation may have become attenuated or for some groups, rendered ineffective or counterproductive. Resource loss and social capital diminution have been linked to adverse mental health and psychosocial dysfunctions among disaster survivors (Arata et al. 2000; Hobfoll 1989; Smith and Freedy 2000). Damage to social capital directly contributes to the breakdown of social relationships, trust, and norms; family separation; and reduction of empowered individuals to participate in the recovery process (Barnshaw and Trainor 2007; Ritchie 2012; Ritchie and Gill 2007; Wind et al. 2011). As an emerging theoretical framework for framing disaster impacts and, most importantly, long-term patterns of personal recovery, we employ indicators of social capital to explain lingering impacts of Katrina across the devastated region of "ground zero."

The primary objective of this research is to assess the influence of social capital on mental health of survivors who were still residing in severely damaged Gulf Coast counties/parishes of Mississippi and Louisiana, three years after the storm. In addition, we seek to determine if there are specific mental health conditions of survivors that are perceived to be directly related to Katrina. The socio-demographic factors explaining the likelihood of Katrina-induced psychosocial problems, independent of social capital, will also be examined. Furthermore, differences in mental health outcomes among survivors by state and by preponderance of natural or natural-technological (natech) root-causes will be evaluated along with the racial disparities in the psychosocial impacts of Katrina.

Overall, the role of social capital for reducing psychological stress, depression, and other psychosocial symptoms of Katrina among survivors will be examined. We proceed by presenting background information concerning the scope of devastation by Katrina in the counties/parishes severely affected. A brief review of the literature will follow and subsequently data collection and methods of analysis will be discussed. The results of empirical analyses will be addressed with some concluding remarks concerning social policy, theory and future research needs.

Background

Graumann and associates have narrated Katrina's chronology during August 25-31, 2005, explaining how it created paths of destruction across the Gulf Coast (Graumann et al. 2005). An area of approximately 90,000 square miles along the Gulf Coast was subjected to high intensity (Categories 3 – 5) hurricane wind and storm surge.[1] About 14 counties/parishes within the 100-mile radius of the storm's landfall experienced flooding due to severe storm surge (ranging from 10 to 33 feet) and structural damage based on Federal Emergency Management Administration (FEMA) assessments (Gabe et al. 2005). A significant proportion of the energy infrastructure of the United States is located within this region, including oil refineries, oil terminals, offshore platforms, oil and gas wells, pipelines, and petrochemical industrial installations along the Mississippi River corridor (Picou and Marshall 2007; Pine 2006; Santella et al. 2010). The destruction of oil and petrochemical facilities by the storm led to massive oil spills and the release of huge amounts of toxic chemical compounds into the flood water (Fox et al. 2009; Frickel 2005; Picou 2009). At least 54 Superfund sites were identified in the area impacted by Katrina, including those with pesticides, dioxins, and other mixture of toxic chemical compounds, which pose serious threat to human health and the natural environment (Adeola 2009b; Fox et al. 2009).

Many small towns within the Louisiana and Mississippi Gulf Coast region were literally obliterated, while Plaquemines and St. Bernard parishes in Louisiana were extensively damaged. The Greater New Orleans metropolitan area is especially susceptible to periodic flooding given its location within the Mississippi Alluvial Plain between the Mississippi River in the South and Lake Pontchartrain in the North with a network of drainage canals connected to the lake (Heerden and Bryan 2006; Pistrika and Jonkman 2010). A combination of levee breaches, floodwall failures, and high discharges from the Mississippi River Gulf Outlet (MR-GO) inundated the New Orleans metropolitan area, which made the origins of the disaster a combination of both natural and technological or anthropogenic forces (Freudenburg et al. 2009; Picou 2009). Storm surges led to the breaches of multiple levees in Orleans parish including the 17th Street Canal, Industrial Canal, and London Avenue Canal within the central bowl which rapidly filled up with flood waters. A large segment of the city was practically turned into a lake

by flood waters measuring 4-20 feet for several weeks. The New Orleans East and St. Bernard polders were particularly hardest hit by multiple channels of flooding from levee breaches and MR-GO (Heerden and Bryan 2006). By August 30, 2005, about 80 percent of the city of New Orleans was flooded, while most of the St. Bernard polder (bowl) was severely impacted by a combination of flooding mixed with oil and chemical spills. In the city of Chalmette in St. Bernard parish, the fence-line communities once marking the boundary of environmental justice battlefields between industrial polluters and their working class neighbors were destroyed and submerged in a lake of toxic brew (Frickel 2005).

Along the Mississippi Gulf Coast, about 55% of Hancock County's population was estimated to have experienced flooding or structural damage and in Harrison County, about 19% of its population was affected. Storm surge accounted for most of the flooding in these areas and hurricane winds caused most of the damage to homes, business establishments, and infrastructure. Technological failure was not a prominent factor in Mississippi when compared to the impacts within the New Orleans metropolitan area. According to a Congressional Research Service (CRS) report, in the state of Louisiana, an estimated 645,000 people were displaced and in Mississippi, about 66,000 people were displaced by Katrina (Gabe et al. 2005). These estimates are extremely conservative, especially when compared to other sources that placed the total number of displaced population at 2 million (Lowe and Shaw 2009). As noted by Erikson (2007: xvii), the number of people impacted by Katrina in one way or another has now reached epidemic proportions. Katrina's death toll was estimated at 1,833 with the majority of deaths occurring in Louisiana (1,577) followed by Mississippi (238) and a few from adjacent states of Alabama and Florida.[2] Even though the overall cost of damage to the Gulf Coast region was estimated at over $125 billion, which dwarfed $44 billion cost of Hurricane Andrew, the long-term costs may far exceed these estimates. Most important, the mental health and psychosocial costs of Katrina remain hidden and have persisted over time, but unfortunately, these lingering impacts have not been adequately addressed in the literature.

Disasters and Mental Health

A significant body of research literature has been devoted to examining the mental and physical health consequences of exposure to disasters (Galea et al. 2005; Gerrity and Flynn 1997; Jonkman et al. 2009; Noji 1997; Rhodes et al. 2010; Rubonis and Bickman 1991; Shultz et al. 2005). Social scientists have investigated mental health and psychosocial impacts among Katrina survivors in various settings (Adeola 2009a; Bourque et al. 2006; DeSalvo et al. 2007; Glass et al. 2009; Mills et al. 2007; Norris et al. 2009; Picou and Hudson 2010; Weems et al. 2007). Most of these studies found substantial evidence of the prevalence of acute stress symptoms and posttraumatic stress

disorder (PTSD) among Katrina survivors. DeSalvo et al. (2007) found a significant burden of symptoms consistent with a diagnosis of PTSD in a sample of 1,542 employees from the largest employer in New Orleans six months post-Katrina. They identified the risk factors for PTSD symptoms to include being female, displaced for a long period, knowing someone who died due to Katrina, and having a longer work commute relative to pre-Katrina. Kessler et al. (2006) found significantly higher prevalence of serious mental illness among a sample of 1,043 adult residents who lived in the high impact zone before and after Katrina. Even though high suicide rates were reported within a few months after the storm, suicidal ideation was later found to be significantly lower than pre-Katrina rates (Kessler et al. 2006; Nossiter 2005; Saulny 2006).

Other studies have examined a number of factors explaining vulnerability to mental breakdown following exposure to various traumatic events (Bryant and Guthrie 2005; Gil and Caspi 2006; McLeish and Del Ben 2008; Rao 2006). Subcultural ethnic groups such as African Americans, Vietnamese Americans, and other minorities with prior traumatic life experiences such as exposure to war, concentration camps, and extreme prejudice and discrimination are more likely to display mental health problems, or exhibit symptoms related to acute stress disorder (ASD) and PTSD following exposure to various catastrophic events (Norris et al. 2009; Rao 2006; Rhodes et al. 2010). Social scientists seem to agree that among the predictors of PTSD in the wake of exposure to traumatic stressors are poor cognitive skills, a pre-existing psychopathology, use of avoidant coping strategy, catastrophic thinking about stress, low levels or lack of social support, pre-existing heightened reactivity to trauma-related stimuli, and general negative thoughts (Bryant and Guthrie 2005; Keane and Wolfe 1990; Suendermann et al. 2010, Taylor, 2012). Kim et al. (2008) found poor mental health to be a significant predictor of physical morbidity (also see Bourque et al. 2006). In a research note on Mississippi Gulf Coast residents, Picou and Hudson's (2010) analysis found that African Americans, females, and less educated subjects manifested the most severe mental health impacts. On the contrary, Adams and Boscarino (2005) found no post-disaster racial/ethnic differences for PTSD or PTSD symptom severity, depression, or physical health among a representative sample of New York residents one year after the terrorist attacks on the World Trade Center. Thus, studies of racial/ethnic differences in mental health outcomes of exposure to disasters offer mixed results.

Long before Katrina, beginning with the Buffalo Creek disaster in West Virginia (Erikson 1976), a number of studies have concentrated on exposure to community disasters as a special type of stressor with adverse mental health or psychosocial *sequelae* (see Green 1995; 1998; Green and Lindy 1994). Factors that can exacerbate or attenuate the impacts of such stressful community events have been investigated. Reviews of the disaster literature have led to the conclusion that large scale traumatic events will significantly increase psychosocial problems in the acute phase and can also have long-

lasting adverse physical and mental health outcomes for many survivors (Adams and Boscarino 2005; Ahern et al. 2005; Brewing et al. 2000; Ursano et al. 2008).

Disasters that include threats to life, death, destruction of property and society, as well as the continuous stressful events in the recovery phase, are correlated with a high degree of psychiatric morbidity among survivors (McLaughlin et al. 2011; Noji 1997). Among adverse psychological *sequelae* of major disasters are anxiety disorder, depression, somatic complaints, relationship problems, substance abuse, suicidal thoughts, and elevated levels of anger, alienation (including social estrangement, isolation, and loneliness), and general mistrust of others and authorities (Fullerton and Ursano 1997; Green and Lindy 1994; Jerusalem et al. 1995; McFarlane 1995). As Glass and associates (2009) note, due to the magnitude of Katrina's impacts, many survivors experienced a wide range of stressors (for example, property loss, exposure to corpses, and violence, etc.). As mentioned, thousands of people were displaced from their homes, and social networks, family and community ties were damaged by Katrina, which all contributed to adverse mental health consequences.

For survivors who were able to sustain their social networks and command some degree of social capital, their ability to cope with stress should increase, while the probability of negative mental health outcomes should decrease. In a recent study, McLaughlin et al. (2011) found predictors of slow mental health recovery following Katrina to include exposure to life-threatening situation, disaster-related housing difficulty, and low income. Other factors—such as a history of psychopathology, social competence, and post-Katrina stressors—were found not to be related to recovery from PTSD. Most recently, Hamano et al. (2010) found both cognitive and structural social capital to be associated with better mental health, controlling for socio-demographic characteristics. These results, as well as other studies, suggest that social capital may be an important consideration for understanding the chronic mental health outcomes of Katrina.

Social Capital and Psychosocial Effects of Disaster

Social capital is generally considered to be a buffer against physical and mental health impacts of disasters.[3] Both as a concept and theoretical framework, social capital has attracted considerable attention across multiple disciplines over the past three decades (Bourdieu 1986; Coleman 1988; 1990; Flora 1998; Fukuyama 1995; Portes 1998; Portes and Landolt 1996; Pretty and Ward 2001; Ritchie and Gill 2007; Reimer et al. 2008; Putnam 1995; 1996; Sobel 2002; Warner 1999; Woolcock 2001). Portes (1998) contends that the concept underlying social capital is not new to the sociological literature, noting the work of renowned French sociologist, Emile Durkheim, and his suggestion that community attachment and social bonding represent important remedies to anomie and suicide (Durkheim 1951 [1979]). However, the sociological importance of social capital

was first identified by Hanifan (1916) and used by Jacobs (1961), Bourdieu (1986), Coleman (1988, 1990), and eventually popularized by Putnam (1993, 1995).[4]

Although there is no universally agreed upon definition of social capital, there seems to be an emerging consensus that it connotes the resources available to individuals and groups by virtue of their social ties, networks, and membership in a community. According to Hanifan (1916: 130), social capital consists of "good will, fellowship, sympathy, and social intercourse among a group of individuals and families who make up a social unit." As summarized by Pretty and Ward (2001), social capital constitutes relations of trust, reciprocity, common rules, norms and sanctions, and connectedness in social institutions. In other words, it includes the institutions, social relationships, shared norms and values, trust, and expectations governing interactions among people that affect economic and social activities (Bordieu 1986; Coleman 1988; Putnam 1993; 1995; World Bank 2001). Nakagawa and Shaw (2004) view social capital as a function of mutual trust, social networks of both individuals and groups, and social norms such as obligation and willingness to participate in mutually beneficial collective action.[5]

The literature also reveals many areas of sociological inquiry in which social capital theory has been used—including schooling and education, community life, work and organizations, democracy and governance, social theory, socio-economic development, families and youth behavior, collective behavior, political consumerism, the environment, community health, and most recently, natural and technological disaster preparedness and recovery (Aldrich 2011; Baum 2000; Cannuscio et al. 2003; Nakagawa and Shaw 2004; Neilson and Paxton 2010; Portes 1998; Pretty and Ward 2001; Ritchie and Gill 2007; Tye and Williams 2009; Woolcock 1998). Evidence suggests that the well-connected are more likely to be better off in terms of housing, education, employment, health, disaster resiliency, and nondiscriminatory encounters (Woolcock 2001:12). Woodcock and Narayan (2000:226) further note that the fundamental idea of social capital is that one's family, friends, neighbors, and associates constitute a significant asset, one that can be relied upon in a crisis, enjoyed for its own sake, or leveraged for material gain. Communities with a diverse stock of social networks and civic associations are more capable of confronting poverty and vulnerability (Moser 1996; Woolcock and Narayan 2000). In his assessment of the educational performance of high school students, Coleman (1988, 1990) contends that obligations and expectations, information, and norms accompanied by sanctions represent the three basic forms of social capital needed both within and outside the family. According to Dynes (2002:4-6), Coleman's (1990) basic forms can be divided into six forms including obligations and expectations, information potential, norms and effective sanctions, authority relations, appropriate social organizations, and intentional organizations.

The application of social capital theory for assessing the psychosocial effects of Katrina on survivors residing along the Gulf Coast is a promising area of inquiry. Rhodes et al. (2010) analyzed a limited sample of 392 low-income African American single

mothers who reported living in an area impacted by Katrina at the time the hurricane struck, and found that adverse health and psychological consequences persisted for a year or more and were more severe for those who experienced the most stressors and economic loss. Nonetheless, the limited sample utilized precludes any generalization from this study. Weems et al. (2007) looked at regional differences in psychosocial impacts of the storm between Mississippi Gulf Coast and metropolitan New Orleans residents and found higher levels of emotional symptoms and greater level of perceived social support among the former and a higher levels of perceived discrimination among the latter. In a systematic review by De Silva et al. (2005), strong evidence for an inverse association between individual level cognitive social capital and common mental disorders was found (also see Almedom and Glandon 2008). However, the results for the type of association existing between other measures of social capital and mental disorders were inconsistent.

It has been suggested in the literature that not all forms of social capital may be beneficial. As noted by Pretty and Ward (2001:213) quoting Knight (1992), a society may be well-organized, have strong institutions and embedded reciprocal mechanisms, but be based not on trust but on fear, power, and coercion, such as feudal, hierarchical, racist and unjust social systems. A system may appear to have high social capital, with strong families and religious groups, but contain some individuals with severely depleted human capital through abuse, neglect, prejudice and discrimination, conditions of slavery or servitude, or other modes of exploitation. The case of New Orleans, where the overwhelming majority of the displaced victims of hurricane Katrina were poor African Americans, appears relevant to this point. Beside the destruction of property and other economic assets, pre-existing social capital in African American communities was substantially diminished. According to Murphy (2007:303):

> There are several studies that indicate that negative externalities are associated with social capital. Aid is not necessarily extended to strangers or people who are considered different…; disaster response aid is more likely to be advanced to people with whom a relationship is already established…Thus, a 'pattern of neglect' may emerge in which black, *Hispanic, immigrant*, older or less educated victims are excluded from altruistic or *therapeutic* communities. (emphasis in original)

Furthermore, it has been suggested in the literature that social capital may actually exacerbate individual's level of stress and other psychosocial impacts in a catastrophe such as Katrina where the burden of reciprocity may be too heavy to bear, given the regional impact of the disaster (Kaniasty and Norris 2004; Ursano et al. 2008; Woolcock 2001). Thus, as suggested by a number of researchers, social capital may be both a risk

and a protective factor in the aftermath of catastrophes (Quarantelli 2006; Sampson 2003; Ursano et al. 2008).

Nevertheless, several studies have indicated the beneficial effects of social capital in disaster recovery both at the macro and micro levels. For example, in a case study of survivors of earthquake in Kobe, Japan and Gujarat, India, social capital was found as the most effective factor enhancing collective actions and subsequent disaster recovery (Nakagawa and Shaw, 2004). In an analysis of Kobe, Japan earthquake survivors, Aldrich (2011) found social capital to be the strongest and most significant predictor of population recovery in the aftermath of this disaster. Munasinghe (2007) compared and contrasted the experiences and impacts of the 2004 Asian Tsunami in Sri Lanka and Hurricane Katrina flood in New Orleans and found that enduring strong social capital in the former attenuated ethnic conflicts, crimes, and contributed to resilience while, in the case of New Orleans, social capital attrition contributed to the chaos that ensued after Katrina—including violent crimes, property crimes, and the breakdown of law and order.

Previous research has also demonstrated the utility of differentiating between various forms and levels of social capital. The analysis at the micro level derives from Putnam (1993, 1995) with emphasis on cognitive social capital. Coleman (1990) introduced a broader macro and meso level interpretation of social capital, emphasizing the structural components to include aspects of social structure (De Silva et al. 2005; Grootaert and van Bastelaer 2001). Grootaert and Bastelaer (2001: 5) point out that at any level of analysis, social capital exerts its influence on development as a result of the interaction between two distinct types of social capital—structural and cognitive. Cognitive social capital refers to shared norms, values, trust, attitudes, and beliefs—a more subjective and intangible concept (Uphoff 2000). Noting the multidimensional structure of social capital, Woolcock and Sweetser (2002) emphasize the importance of three forms of social capital including bonding, bridging, and linking. Bonding social capital refers to connections to people (e.g., co-workers, neighbors, etc.); bridging social capital involves connections to people who are different in some demographic sense (e.g., different race, class, gender, culture, or geographical location); and linking social capital relates to connections or linkages with people in positions of power and authority (Woolcock and Sweetser 2002). Bonding social capital is the type of relationship existing within a homogeneous group, and bridging social capital tends to connect people across diverse social backgrounds. Lin (2001) depicts interactions as homophilous (i.e., among individuals who share similar characteristics) or heterophilous (among actors who are different in specific attributes). As noted by Hawkins and Maurer (2010), in most cases, homophilous bonding appears as the strongest connection, albeit with the least valuable dividends. On the other hand, heterophilous bridging and linkages tend to be generated from weaker ties but yield more valuable outcomes.

Structural social capital facilitates information sharing, collective action and decision-making through established roles, social networks and other social structures

supplemented by rules, procedures, and precedents. Although structural social capital can be measured by self-reports, it is a relatively objective and externally observable factor. These two forms of social capital can be, but are not necessarily, complementary. Cooperation between neighbors can be based on a personal cognitive affinity that may not be reflected in a formal structural arrangement. Similarly, the existence of a community association does not necessarily translate into strong personal ties among its members, either because participation in activities is not voluntary or because its existence has outlasted the external factor that led to its formation. Social interaction can become capital through the persistence of its effects, which can be ensured at both the cognitive and structural level. It is apparent that the measurement of social capital should include indicators of both cognitive and structural capital. From the literature review presented above, we evaluate the following hypotheses:

H1: Due to contextual differences between the New Orleans metropolitan area and Mississippi Gulf Coast in the nature of Katrina's impacts, with the former displaying a na-tech etiology more than the latter, there will be higher psychosocial distress for Louisiana residents than for Mississippi residents.

H2: There will be substantial differences in depression and Katrina-induced psychosocial symptoms by race—with African Americans being the most likely to have higher levels of psychosocial dysfunctions relative to their white counterparts.[6]

H3: The more available social capital is, the lower the level of psychosocial dysfunction among the survivors; lack of social capital (or diminished social capital) is a direct function of psychosocial dysfunctions among the survivors, controlling for all other social factors.

Data and Methods

The data used in this study came from a random digit dialed (RDD) telephone survey of Gulf Coast counties of Hancock and Harrison in the state of Mississippi and five parishes (counties) of Jefferson, Orleans, Plaquemines, St. Bernard, and St. Tammany in the state of Louisiana. These counties/parishes were the most severely impacted by Katrina and, taken together, comprise "ground zero" or the epicenter of the storm. From April 16 through May 28, 2008, the University of South Alabama polling group interviewed 2,548 adult respondents (aged 18 years and above) in the two states, with completed interviews of 810 from Mississippi and 1,738 from Louisiana. The sampling frame consisted of approximately 30,000 RDD landline telephone numbers supplemented with 10,000 cellular phone or wireless numbers in Mississippi and 15,000 RDD numbers (including 10,000 landlines and 5,000 cell phone numbers in Louisiana).[7] To ensure random selection of subjects, the interviewers asked for an adult with the most recent

birthday to participate in the survey. This dataset represents comprehensive empirical information on post-Katrina recovery efforts, physical and mental health issues, and psychosocial problems among the residents of severely impacted counties/parishes of the two Gulf Coast states three years after Katrina.

A questionnaire with 123 items was designed with a variety of measures to obtain desired information from the respondents in an efficient manner. This instrument was reviewed, pre-tested, and refined prior to administration. Consistent with RDD convention, each interview took an average of 17.25 minutes to complete and the overall completion or participation rates of 44% and 24% were achieved in Mississippi and Louisiana respectively. One can speculate that the participation rate was lower in Louisiana mainly because of the relative slow recovery in the area. Multiple analytical strategies including descriptive and multivariate statistical techniques are employed to test the stated hypotheses and to meet the overall objectives of this research.

Measures

In order to accomplish the study objectives, multiple measures and multiple analytical strategies are employed. The socio-demographic characteristics of the sample are shown in Table 1. The percentage distribution by state, county/parish, race, sex, age, home ownership status, level of education, marital status, employment status, and number of children in respondents' household are presented.

Psychosocial Impact Measures: The CES-D and IES

Two measures were used to assess Katrina's psychosocial impacts, including the Center for Epidemiological Studies Depression Scale (CES-D) and the Impact of Event Scale (IES). The CES-D scale is a measure of individual's experiences and feelings over the last seven days (Mirowsky and Ross 1989). This scale has been validated and found to be a reliable measure for detecting symptoms of depression in community samples and in the general population (Orme et al. 1986; Bradley et al. 2010). The CES-D has strong psychometric properties and is an appropriate measure of self-reported depressive symptoms (Sugawara et al. 2011).

In the RDD telephone survey, each respondent was asked to listen to the following statements which refer to his/her experience during the last seven days and to indicate how many days (from 0 to 7) he/she had the experiences or feelings including: "trouble keeping my mind on what I was doing," "everything I did took a great effort," "I felt sad," "I felt I could not get going," "I lost my appetite," "I had trouble falling asleep or staying asleep," "I felt lonely," "I was bothered by things that usually don't irritate me," and "I felt I was a failure." It is noteworthy that even though CES-D is not event-related,

it offers a more general measure of feeling sad, lonely, having trouble concentrating, having a bad mood, etc.

Table 1. Socio-Demographic Characteristics of the Sample

Variable(s)	n	Percent (%)	Variable(s)	n	Percent (%)
Domicile State:			**Sex:**		
Mississippi	810	31.8	Male	1,212	47.6
Louisiana	1,738	68.2	Female	1,336	52.4
(County/Parish of Domicile)			**Level of education:**		
Mississippi county			Some High School	122	4.8
Hancock	160	6.3	High School diploma	460	18.1
Harrison	646	25.4	Some college, no degree	568	22.3
Louisiana Parish			Assoc. degree	148	5.8
Jefferson	664	26.1	Bachelor's degree	543	21.3
Orleans	645	25.3	Master's degree	222	8.7
Placquamines	54	2.1	Doctorate degree	61	2.4
St. Bernard	95	3.7	Professional degree (law, med.)	59	2.3
St. Tammany	280	11.0			
Race:			NA/Refused	365	14.3
White	1,657	65.0	**Marital status:**		
African-American	514	20.2	Never married	261	10.2
Hispanic	44	1.7	Married	1,445	56.7
Native American	21	0.8	Divorced	272	10.7
Asian	9	0.4	Cohabitating	17	0.7
Other	40	1.6	Separated	35	1.4
Refused/NA	263	10.3	Widowed	199	7.8
Age Interval:			Refused/Na	319	12.5
18-30	142	5.6	**Employment status:**		
31-45	476	18.7	Working full-time	1,170	45.9
46-64	1,043	40.9	Working part-time	198	7.8
65 or over	547	21.5	Unemployed	850	33.4
Refused	340	13.3	Refused	330	13.0
Home ownership status:			**Number of children in household under 18:**		
Owner	2,170	85.2	0	1,481	58.1
Renter	297	11.7	1-2	563	22.1
Living with someone	44	1.7	3-4	124	4.8
Living in FEMA trailer	22	0.9	5-8	21	0.8
DK/NA	15	0.6	Refused/NA	359	14.1

Total N = 2,548

For the second Katrina-related measure of psychosocial problems, items from the Impact of Event Scale (IES) were employed. The IES was originally constructed and published before the recognition of PTSD and its entry into the DSM-III and DSM-IV (American Psychiatric Association 1980; 1994). It has been used extensively for exploration of the psychological impacts of traumatic life events (American Psychiatric Association 1980; Horowitz 1974; 1976; Sundin and Horowitz 2002). The psychometric properties of this scale have also been evaluated extensively and found to be adequate, reliable, and valid (Aghanwa et al. 2003; Creamer et al. 2003; Sundin and Horowitz 2002). In the present study, the IES was used as the primary indicator of Katrina-related psychosocial stress symptoms. It measures Katrina-induced cognitive and behavioral responses that have transpired over the last week at the time of the interview. The contents of the IES were originally established from statements obtained from subjects who had experienced a wide range of stressful life events (Horowitz 1974; 1976; Picou and Hudson 2010; Weiss 2007).[8]

In the survey, respondents were prompted by the interviewers stating that "the next questions deal with the impact of a stressful life event; for each statement, think only about Hurricane Katrina (HK) and tell me whether the experiences have occurred not at all (= 1), rarely (= 2), sometimes (= 3), or often (= 4) in the past week." The items included are: "I thought about HK when I didn't want to," "pictures of HK popped into my mind", "other things kept making me think about HK", "I had trouble falling asleep or staying asleep", "I had waves of strong feelings about HK" (measuring cognitive stress), and "I felt irritable and angry because of HK", "reminders of HK caused me to have physical reactions such as sweating, trouble breathing, etc.", "I had dreams about HK", "any reminders brought back feelings about HK", "I was jumpy and easily startled", and "I was watchful and always on guard" (measures of hyper-vigilance).[9] Confirmatory factor analysis was performed to estimate factor scores for both the depression (CES-D) and psychosocial stress (IES) variables. Factor loadings and percent of variance explained for the two factors that emerged are displayed in Table 2. The factor scores for CES-D and IES constitute the dependent variables employed in the subsequent multivariate Ordinary Least Squares (OLS) regression analysis.

Social Trust and Social Capital Measures

Social trust and social capital were measured by a number of items from the survey. For social trust, each respondent was asked to indicate his/her level of trust in the following organizations and groups—local government, state government, federal government, faith-based groups, and church as 1 = "a great deal of trust," 2 = "a good deal of trust," 3 = "some trust," 4 = "very little trust," and 5 = "no trust at all." The response was reverse coded as 1 "no trust at all," 2 "very little trust," 3 "some trust," 4 "a good deal of trust," and 5 "a great deal of trust," respectively. Six items measuring the presence or absence of social capital in the survey were also used. These items, measured on a Likert scale of 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree, included the statements "since HK, people in my neighborhood have been more likely to help each other out" and "faith-based volunteer groups have helped my community recover from the impacts of HK" on the positive aspects. On the negative side (or lack of social capital), the statements were "since HK, there have been more arguments in my family", "since HK, I don't feel I have the power to make important decisions to change my life", "since HK, I have been less involved in organizations and groups in my community", and "the amount of crime in my community has delayed the process of recovery from the storm". These items indicate the presence or absence of homophilous bonding and heterophilous connections required for both bonding and bridging social capital.[10] Factor analysis was also performed for these items and upon varimax rotation, two factors were extracted. The first factor consists of trust and social capital items loading together consistent with the measures suggested by

Woolcock (2001) and World Bank (2001). The four items representing lack of or diminished social capital, loaded strongly on the second factor displayed in the last column of Table 2. The calculated factor scores for both constructs are used as independent variables in conjunction with socio-demographic variables in the subsequent OLS regression models predicting depression and Katrina-related psychosocial stress.

Table 2. Factor Analysis of Depression, Katrina-related Psychosocial Dysfunctions, Trust and Social Capital Measures

Variables	Depression and Psycho-stress (IES)		Trust/ Social Capital	Lack of Social Capital
	Factor 1	Factor 2	Factor 1	Factor 2
Depression and psychosocial stress				
I felt sad	.817			
I felt I could not get going	.802			
I felt I could not get rid of the blues	.785			
Everything I did took a great effort	.762			
I was bothered by little things	.748			
I felt lonely	.744			
I had trouble keeping my mind on what I was doing	.742			
I lost my appetite	.701			
I felt my life was a failure	.690			
I had trouble falling asleep	.689			
Pictures of HK popped into my head		.833		
Other things kept making me think about HK		.822		
I thought about HK when I didn't want to		.821		
I had waves of strong feelings about HK		.794		
Any reminders brought back feelings about HK		.733		
I felt irritable feelings and angry because of HK		.673		
I was watchful and on guard		.623		
I had trouble falling asleep		.618		
I was jumpy and easily startled		.576		
I had dreams about HK		.574		
Reminders of HK caused me to have physical reactions	.539	.518		
Social capital and Trust				
Trust in state government			.847	
Trust in local government			.821	
Trust in federal government			.771	
Trust in faith-based recovery groups			.751	
Faith-based volunteer groups helped my community recover from HK impacts			.661	
Trust in church			.610	
Since HK, people in my neighborhood have been more likely to help each other			.441	
Since HK, there have been more arguments in my family				.732
Since HK, I don't feel I have the power to make important decisions				.731
Since HK, I have been less involved in organized groups in my community				.671
The amount of crime in my community has delayed recovery				.509
Percent of variance explained	33.63	29.47	33.22	17.56

N = 2,511. HK = Hurricane Katrina.

Socio-Demographic Variables

Among the socio-demographic variables included in the analysis are respondents' state of domicile, parish (county) of residence, race, marital status, and gender as categorical variables recoded into dummy variables in the OLS regression models. In the multivariate discriminant analysis, state of domicile and race are used as indicator variables. Other socio-demographic variables employed include age and level of education. Among the measures of resource loss are the extent of damage to respondents' pre-Katrina residence originally coded as 1 = no damage, 2 = minor damage, 3 = moderate damage, 4 = major damage, and 5 = totally destroyed, recoded into the range of 0 = no damage to 4 = totally destroyed; dollar value of losses from HK was measured in dollars and financial difficulties to the family as a result of HK was measured by an item that asked respondents to complete the following sentence: HK has caused my family to have (1) severe financial problems, (2) some financial problems, (3) minor financial problems, (4) no financial problems, and (5) my financial situation has improved since HK. This item was reversed coded as 5 = severe financial problems, 4 = some financial problems, 3 = minor financial problems, 2 = no financial problems, and 1 = my financial situation has improved since HK.

Analysis

As previously discussed, multiple multivariate statistical techniques are employed in this study to test the stated hypotheses and to accomplish the overall objectives. In order to assess state of residence and racial differentials or similarities in selected measures of depression and other Katrina mental health impacts, multivariate discriminant analysis (MDA) was used. MDA has entered the social science statistical toolbox as one of the preferred methods for studying group differences on several variables simultaneously (Huberty 1994; Klecka 1980; McLachlan 2004; Pedhazur 1997; Warner 2008). The categorical variables of state of domicile were coded as Louisiana = 1 and Mississippi = 2; race coded as 1 = Whites and 2 = Blacks (African Americans) were used as the indicator variables for the two models of MDA performed.[11] Depression (CES-D) and psychosocial distress (IES) items as previously operationalized, were used as discriminant/predictor variables. Specifically, nine IES and 12 CES-D items and two other psychosocial items from the questionnaire were included as predictor variables.

OLS regression analysis was subsequently applied to estimate six models of psychosocial dysfunctions as predicted by social capital, controlling for relevant socio-demographic variables including the extent of damage to respondents' pre-Katrina residential structures. The measurement and coding of these variables remained as described in the previous section.

Findings

The results of the MDA and OLS regression are summarized in Tables 3 to 5. Tables 3 and 4 display the results of the MDA including standardized discriminant function coefficient, Fischer's coefficient, and F-ratio computed for each discriminating variable. Wilk's lambda, chi-square, and other summary statistics for the state of residence and racial group discriminant models are also displayed. To determine if Louisiana residents exhibited more depressive and psychosocial dysfunction symptoms than their Mississippi counterparts, means difference in measures of these symptoms were tested. Out of 23 items in the analysis, there are no statistically significant mean differences for ten, the mean differences for five items are significant at $p < .05$, and another five items are marginally significant at $p < .10$, with Louisiana subjects displaying higher means scores on depression and stress items such as "I felt I could not get rid of the blues", "I felt irritable and angry…", and "I had waves of strong feelings about HK". MDA estimating the discriminating power of each item for group membership while controlling for all other variables is necessary to establish if Louisiana residents are indeed more depressed and stressed as hypothesized. For eight of the psychosocial indicators, mean scores for Katrina survivors in Louisiana were significantly higher than for those in Mississippi. Indeed, the pattern for all but one indicator was higher mean scores in Louisiana, strongly suggesting an elevated psychosocial impact for Louisiana survivors.

The results of the MDA by state and CES-D and IES items and other psychosocial distress measures are presented in Table 3. Since two groups are used in this analysis, only one discriminant function can be obtained (see Huberty 1994; Klecka 1980; Warner 2008).[12] Of the 23 items in the analysis, there is no substantial difference for ten, which suggest that Louisiana and Mississippi Gulf Coast residents may exhibit similar episodes of depression and stress regardless of whether Katrina stressors were purely of natural or natech cause. Based on standardized discriminant function coefficients (SDFCs) (analogous to beta weights in regression), Wilks' Λ, and F-ratio, the IES item "I felt irritable and angry because of HK," has the highest discriminating power (SDFC = .826) followed by the CES-D item "I felt I could not get rid of the blues" (SDFC = .447) and another IES item "I had waves of strong feelings about HK" (SDFC = .348) ($p < .001$). Other depressive and psychosocial symptoms separating the two groups are asterisked in order of statistical significance. Significant differentials are found for the following items "I had trouble falling asleep or staying asleep", "I felt sad", "I was watchful and on guard", "I was jumpy and easily startled" (higher for Mississippi than Louisiana), and "I thought about HK when I didn't want to" (significant at $p < .05$). The model's chi-square (60.15) is significant at $p < .001$, suggesting a substantial difference between Louisiana and Mississippi in Katrina's mental health impacts.

To assess racial differences in Katrina's mental health impacts, the same set of discriminant variables used in Table 3 was entered into MDA with race recoded into two

categories of Whites and African Americans/Blacks employed as indicator variable. Evidence remains mixed concerning the mental health effects of Katrina on race, with some researchers indicating higher levels of PTSD among African Americans or other minorities and others finding higher levels of stress among Whites (Adams and Boscarino 2005; Adeola 2009a; Chen et al. 2007; DeSalvo et al. 2007; Mills et al. 2007). Jones-Webb and Snowden (1993) reported similar results prior to Katrina, revealing inconclusive evidence concerning race and disaster-related impacts.

Table 3. Discriminant Analysis of Katrina-Induced Depression and Psychosocial Symptoms among Louisiana and Mississippi Gulf Coast Respondents

Discriminant Variables	SDFCs	Fischer's Coefficients		Wilks' Lambda	F-Ratio	Sig.
		MS	LA			
Since Katrina, there are more arguments in my family	-.051	.058	.055	1.000	.000	.991
Since Katrina, I feel powerless about important decisions	.239	.048	.064	.998	3.496	.062*
I thought about Katrina when I didn't want to	.231	.188	.230	.998	4.140	.042**
Pictures of Katrina popped into my mind	-.515	.183	.090	1.000	.087	.768
Other things kept making me think about Katrina	.114	.412	.433	.999	3.051	.081*
I had trouble falling or staying asleep	-.314	-.207	-.268	.999	2.256	.133
I had waves of strong feelings about Katrina	.348	.024	.086	.994	11.722	.001***
I felt irritable and angry because of Katrina	.826	-.146	.007	.988	25.673	.000***
Reminders of Katrina caused me physical reactions	-.282	-.383	-.451	1.000	.838	.360
I had dreams about Katrina	.017	-.192	-.188	.998	3.335	.068*
Any reminder brought back feelings of Katrina	-.303	.196	.139	.999	1.254	.263
I was jumpy and easily startled	.079	-.316	-.299	.998	4.258	.039**
I was watchful and on guard	.207	.096	.131	.997	5.896	.015**
I felt that I could not get rid of the blues	.447	-.010	.067	.996	8.605	.003***
I had trouble keeping my mind on what I was doing	-.313	.108	.059	1.000	.357	.550
Everything that I did took great effort	.004	.036	.037	.999	2.462	.117
I felt sad	.029	.027	.032	.998	4.527	.033**
I felt that I could not get going	.021	-.018	-.014	.999	2.631	.105
I lost my appetite	.125	.198	.223	.998	3.479	.062*
I had trouble falling asleep or staying asleep	.304	.198	.239	.998	4.676	.031**
I felt lonely	.087	.046	.061	.998	3.598	.058*
I was bothered by things that usually do not irritate me	-.567	.094	.002	1.000	.359	.549
I felt that my life was a failure	-.029	.255	.248	.999	1.771	.183
Summary Statistics:						
Group Centroids:						
MS	-.246					
LA	.118					
Cannonical Correlation (CCr)	.168					
CCr^2	.028					
Eigenvalue	.029					
Wilks' Lambda	.972					
Chi-square (*df* = 23)	60.154***					

Note: *N* = 2,111; ***p < .001, **p < .05, *p <.10 significance respectively. SDFCs = Standardized discriminant coefficients; 55.3% of original grouped cases are correctly classified.

Table 4 presents the results for each depression and stress (IES) item. Examining the two groups yielded 22 items with significant mean differences. African Americans scored higher means for all items except one. To achieve a more robust statistical assessment, the MDA model with statistical control was computed and the results are displayed in

Table 4. The table shows one discriminant function for the two groups and other relevant statistics including Fischer's coefficients, Wilk's Λ, and *F*-ratio computed for each discriminating variable. The SDFC of .749 for the item "everything I did took a great effort" shows this is the strongest discriminating item, followed by "I was watchful and on guard" (SDF = .414), and "I had trouble keeping my mind on what I was doing" (SDFC =.339). As predicted by H2, the results show that African Americans were disproportionately depressed and stressed as hypothesized. Higher Fishers' coefficients were obtained for eight CES-D items and five IES items for Blacks relative to four CES-D items and four IES items for their White counterparts. Thus, it appears that African Americans maintained serious Katrina mental health outcomes three years after the storm. The present result is at odds with the results obtained by Adams and Boscarino (2005), DeSalvo et al. (2007), and Weems et al. (2007). The latter found that Mississippi residency was actually associated with a greater number of PTSD symptoms (Weems et al., 2007:2302).

Table 4. Discriminant Analysis of Depression and Katrina-Induced Psychosocial Problems among Black and White Respondents on the Louisiana and Mississippi Gulf Coast

Discriminant Variables	SDFCs	Fischer's Coefficients		Wilks' Lambda	F-Ratio	Sig.
		White	Black			
Since Katrina, there are more arguments in my family	.034	.053	.057	.999	2.843	.092*
Since Katrina, I feel powerless about important decisions	-.112	.064	.047	1.000	.264	.607
I thought about Katrina when I didn't want to	.133	.201	.257	.979	42.276	.000***
Pictures of Katrina popped into my mind	.129	.124	.178	.974	50.965	.000***
Other things kept making me think about Katrina	-.135	.428	.370	.986	27.854	.000***
I had trouble falling or staying asleep	.089	-.248	-.211	.973	54.723	.000***
I had waves of strong feelings about Katrina	.087	.042	.077	.976	47.767	.000***
I felt irritable and angry because of Katrina	-.173	-.044	-.117	.984	32.050	.000***
Reminders of Katrina caused me physical reactions	.037	-.425	-.405	.967	67.021	.000***
I had dreams about Katrina	.036	-.174	-.154	.975	49.559	.000***
Any reminder brought back feelings of Katrina	-.186	.193	.114	.989	22.169	.000***
I was jumpy and easily startled	.006	-.298	-.295	.967	66.717	.000***
I was watchful and on guard	.414	.086	.250	.950	101.704	.000***
I felt that I could not get rid of the blues	-.149	.041	-.018	.971	57.254	.000***
I had trouble keeping my mind on what I was doing	-.339	.085	-.038	.982	35.530	.000***
Everything that I did took great effort	.749	.010	.270	.927	152.363	.000***
I felt sad	.121	.034	.079	.958	84.094	.000***
I felt that I could not get going	-.195	-.012	-.083	.970	60.251	.000***
I lost my appetite	.195	.202	.294	.960	79.747	.000***
I had trouble falling asleep or staying asleep	.013	.231	.235	.969	61.787	.000***
I felt lonely	.111	.040	.083	.964	72.098	.000***
I was bothered by things that usually do not irritate me	.111	.051	.093	.959	82.563	.000***
I felt that my life was a failure	.048	.242	.268	.978	44.302	.000***
Summary Statistics:						
Group Centroids:						
White	-.183					
Black	.648					
Cannonical Correlation (CCr)	.326					
CCr^2	.106					
Eigenvalue	.119					
Wilks' Lambda	.894					
Chi-square (*df* = 23)	216.463***					

Note: ***p < .001, **p < .05, *p <.10 significance respectively. SDFCs = Standardized Discriminant Coefficients. 69.3% of original grouped cases were correctly classified.

Among the summary statistics displayed in Table 4, group centroids (-.183 for White and .648 for Blacks), canonical correlation (.226), eigenvalue (.119), and chi-square of 216.46 ($p < .001$), all confirmed the hypothesized differentials in mental health burden of Katrina by race.

The results of the OLS regression analysis are displayed in Tables 5a and 5b. As mentioned, two measures of mental health impacts obtained as factor scores of depression (CES-D) and stress (IES) from the factor analysis constitute the dependent variables used in the OLS regression models 1 to 6 in the tables.[13] Social capital and socio-demographic variables are used to predict mental health problems in each model estimated. In all the models, a lack of social capital appears as the strongest and statistically significant predictor of depression and stress, controlling for all other variables ($p < .001$). In Model 1, age and being African American are positive and statistically significant functions of mental depression, while level of education and marital status appeared as negative functions. In Model 2 estimating IES, lack of social capital, old age, and extent of Katrina damage to respondent's residence positively predict psychosocial stress, controlling for all other variables. Although a positive but non-significant function, African American race is linked with psychosocial stress in the model.

In Models 3 and 4, respondents' state of residence, trust, and social capital measures were removed and replaced with Orleans Parish residency; being African American re-emerged as a positive and significant predictor of mental depression following the lack of social capital indicator. The dollar value of disaster losses appears significant along with age in determining depression. Although in the expected direction, the regression coefficient for marital status becomes non-significant in Model 3. In Model 4, old age, sex (female), dollar value of losses from Katrina, along with lack of social capital, are found as the key determinants of Katrina-related stress, controlling for all other variables. One unexpected result is the effect of family financial hardship on mental health across models—with Models 1-3 displaying negative effect and Model 4 showing a non-significant effect of this variable on stress. The percentage of variance explained (R^2) and *F*-change for each model were found to be modest. Regression diagnostics including Variance Inflation Factor (VIF) and tolerance statistics suggest the models are quite robust and did not violate any basic assumptions of the OLS regression.

Orleans Parish residency was excluded in Models 5 and 6 and Louisiana residency along with social capital indicators and home ownership were entered into the equations in Table 5b. Model 5 is the depression model while Model 6 is the stress model. The results show the lack of social capital as the strongest and most powerful predictor of depression, followed by African American race/ethnicity, home ownership, and age ($p < .001$). Higher level of education and being married are found as inverse functions of mental depression, holding all other factors constant. Advantages of marriage and social capital for positive mental health functioning are clearly revealed by these results. The

only anomaly in the analysis is the negative functions found for the item "HK has caused severe financial difficulties to my family," expected to be a source of depression, but turned out to be a negative function of both depression and stress in Models 1-3, but becoming a significant predictor of stress in Model 6.

Table 5a. OLS Regression of Depression and Katrina-related Psychosocial Dysfunctions on Social Capital and Socio-demographic Variables

Independent variable	Depression Model 1 b (βeta)	IES Model 2 b (βeta)	Depression Model 3 b (βeta)	IES Model 4 b (βeta)
Respondent state of residency (LA = 1, MS = 0)	.052 (.024)	.009 (.004)	---- ----	----- ----
Extent of damage to residence	.022 (.024)	.063*** (.069)	.009 (.008)	.047 (.050)
Age	.004*** (.090)	.003*** (.071)	.005** (.093)	.006*** (.126)
Race (Black = 2, White = 0)	.130*** (.112)	.016 (.014)	.124** (.098)	.061 (.057)
Marital status (married = 1 non-married = 0)	-.055*** (-.054)	.049*** (.049)	-.054 (-.045)	.011 (.011)
Level of education	-.033*** (-.068)	-.031*** (.064)	-.051* (-.086)	.022 (.044)
Dollar value of losses from HK	2.03E-7 (.026)	1.99E-7 (.026)	1.09E-*** (.016)	4.97E-7* (.083)
Sex (Male= 0 female= 1)	-.004 (-.004)	-.004 (-.004)	.003 (.003)	.149*** (.146)
HK has caused severe financial difficulties to my family	-.127*** (-.148)	-.056*** (-.065)	-.128*** (-.128)	.029 (.034)
Trust and social capital	-.018 (-.018)	---- ----	---- ----	---- ----
Lack of social capital	.336*** (.335)	.400*** (.400)	.407*** (.365)	.389*** (.411)
Orleans Parish residency	---- ----	---- ----	-.020 (-.039)	-.001 (-.002)
Constant	.132	-.551***	.273	-.780***
R^2	.22	.27	.22	.28
Adj. R^2	.22	.27	.20	.27
F-change	63.92***	92.56***	12.65***	17.66***
N	2,511	2,511	456	456

Note: ***p < .01, **p < .05, *p < .10 level of significance respectively. HK = Hurricane Katrina.

In Model 6, the regression coefficients and beta weights for trust/social capital and lack of social capital are the strongest and most significant function of psychosocial stress (IES) followed by female sex ($p < .001$). Other variables influencing the dependent variable include the dollar value of losses from HK, extent of damage to pre-Katrina residence, and the item "HK has caused severe financial difficulties to my family." Contrary to expectation, Louisiana residency appears as a significant inverse function of stress, albeit a non-significant positive function of mental depression. The percent of variance explained in Models 5 and 6 are 22% and 32% respectively. Applicable

regression diagnostics did not suggest any violations of the OLS regression assumptions in all the models estimated in this study.[14]

Table 5b. OLS Regression of Depression and Katrina-related Psychosocial Dysfunctions on Social Capital and Socio-demographic Variables

Independent variable	Depression Model 5 b (βeta)	IES Model 6 b (βeta)
Respondent state of residency (LA = 1, MS = 0)	.060 (.028)	-.095** (-.044)
Extent of damage to residence	.018 (.020)	3.13** (.041)
Age	-.075*** (-.166)	5.30E-6 (.000)
Race (Black = 2, White = 0)	.120*** (.103)	.016 (.014)
Marital status (married = 1 non-married = 0)	-.041** (-.041)	.007 (.007)
Level of education	-.032*** (-.067)	.002 (.005)
Dollar value of losses from HK	2.23E-7 (.031)	3.13E-7** (.041)
Sex (Male= 0 female= 1)	-.005 (-.005)	.125*** (.126)
HK has caused severe financial difficulties to my family	-.124*** (-.145)	.076*** (.089)
Trust and social capital	.015 (.015)	.261*** (.261)
Lack of social capital	.333*** (.332)	.413*** (.414)
Orleans Parish residency	---- ----	---- ----
Home ownership (Home owner = 1, otherwise = 0)	.100*** (.063)	.003 (.002)
Constant	.090	-.194**
R^2	.22	.32
Adj. R^2	.22	.31
F-change	59.80***	95.94***
N	2,511	2,511

Note: ***$p < .01$, **$p < .05$, *$p < .10$ level of significance respectively. HK = Hurricane Katrina.

Discussion and Conclusions

Significant levels of symptoms of depression and psychosocial stress were found among Louisiana and Mississippi residents three years post-Katrina, with depression and stress symptoms being more prevalent among Louisiana survivors. In addition to evaluation of mental health problem differentials by state and race, vulnerability factors for depression (CES-D) and Katrina-related psychosocial stress (IES) were delineated in the results of the multivariate OLS regression analysis. All three guiding hypotheses found substantial support in both the MDA and OLS models. The first hypothesis (H1) that higher psychosocial distress *sequelae* of Katrina would be higher for Louisiana residents, relative to their counterparts in Mississippi, found strong support in the statistical analyses. Out of the 23 symptoms entered into the MDA, Louisiana exhibited higher means scores for 13 relative to nine for Mississippi and there was no difference for one (i.e., since HK, there are more arguments in my family). The MDA results suggest that Louisiana respondents experienced more depression symptoms but similar levels of stress relative to their Mississippi counterparts. However, when Orleans Parish along with adjacent areas impacted by flood and toxic contamination, was entered as a dummy variable in the OLS regression, there was no significant effect on mental health. The OLS regression also showed that being a resident of Louisiana is not necessarily a significant predictor of depression or Katrina-related symptoms of CED-D and IES. Other socio-demographic variables such as being African American, female, elderly, and having social capital deficits were the most important determinants of depression and psychosocial distress consequences of exposure to Katrina.

The second hypothesis (H2)—that there would be substantial racial differences in depression, stress, and other psychosocial dysfunctions, with African Americans carrying a higher burden relative to Whites—was also supported by our analysis. Both in the MDA and OLS regression, African Americans appear to remain more vulnerable to mental health impacts three years after the storm. These results also point to the fact that African Americans are having substantial problems with mental health recovery in the post-Katrina context. The findings further suggest the need to promote measures that can strengthen bridging and linking social capital for better mental health, community recovery and rehabilitation.

Among the primary objectives of this research was to assess the extent to which social capital influences Katrina survivors' mental health. The salient question was whether Katrina survivors with extensive social networks embodied in social capital would be less apt to display mental health problems relative to those without social capital. Our third hypothesis (H3)—the higher the availability of social capital, the lower the probability of mental health symptoms, and lack of social capital (or deteriorated social capital)—found support in our analysis. The role of social capital availability for

the attenuation of mental health problems and in disaster recovery has been emphasized in the literature (see Aldrich 2011, 2010; Almedom and Glandon 2008; Rao 2006; Ritchie 2012; Sampson 2003; Ursano et al. 2008). The present results are consistent with findings previously reported (Kawachi and Berkman 2001; Whitehead and Diderichsen 2001; Wind et al. 2011; Zwiebach et al. 2010) and provides strong evidence that the lack of social capital results in chronic mental health impacts for survivors of catastrophes such as Katrina. As emphasized in the literature, actors with weak ties to their neighbors and with dysfunctional *homophily* relationships are more apt to participate in illegal and disruptive activities that undermine or impede community recovery (see Aldrich 2010; Lee and Bartkowski 2004; Munasinghe 2007).

This study has contributed to the social capital theoretical discourse regarding disasters and mental health. The hypotheses strongly confirmed the critical role of social capital theory—which stipulates that functional social networks, mutual obligations, and norms of reciprocity are primary elements needed by people especially during times of disaster distress for maintaining long-term psychosocial stability. Specifically, diminished social capital brought about by the destruction of community ties and social networks in the wake of Katrina appeared as the precursor of psychosocial dysfunctions prevalent among African Americans.

There are applied policy, theoretical, and methodological implications of these findings. On the applied policy side, there is an urgent need to facilitate the rebuilding of social capital in African American communities devastated by Katrina, especially in Orleans Parish. Restoration of trust in authorities at various levels, promotion of community self-help initiatives, civic engagements, and implementation of crime reduction measures will enhance the restoration of the social capital infrastructure in these communities. Such restoration would facilitate community recovery in these devastated areas. In a number of comparative cross-national studies, researchers have noted the critical roles of social capital in community resilience following devastations from different types of disaster (Hamano et al. 2010; Hurtado et al. 2011; Nakagawa and Shaw 2004).

From a methodological standpoint, the broad inconsistency of disaster research findings on PTSD, ASD, emotional distress, and other psychosocial dysfunctions by race, region, state, disaster type and context, reflect divergent methodological approaches—including different sampling strategies, diverse modes of data collection, and alternative disaster contexts in disaster research. Unfortunately, the underlying cause of disasters (whether natural, man-made or hybrid) may not allow a standardized approach to disaster research. Nonetheless, given our random sampling design, wide geographic coverage, and large sample in the present study, our findings are quite robust and can be generalized across the Louisiana and Mississippi Gulf Coast parishes and counties that were most severely impacted by Katrina. We recognize the limitations of the cross-sectional design used in this research. A longitudinal design assessing how social capital

influences mental health and community recovery over time would shed more light upon these results. The findings concerning demographic predictors of psychosocial impacts revealing that minority status, being female, older age, and less educated are more vulnerable are consistent with previous research (DeSalvo et al. 2007; Kim et al. 2008; Mills et al 2007; Norris et al. 2009; Picou and Hudson 2010). Social capital theory appears to be a promising theoretical framework for future research concerned with understanding ways of promoting community resilience and what people in post-disaster distress require to restore mental and physical health (Adeola 2009a; Adeola and Picou 2012). However, there are challenges ahead in terms of developing universal and more robust indicators of social capital. Improved measures of social capital are needed that can capture all the domains of this concept and help specify areas for promoting disaster recovery. In our examination of negative and positive social capital effects on mental health of Katrina survivors, we conclude that diminutive or negative social capital is detrimental to mental health whereas positive social capital enhances psychological well-being. Given the relatively small percentage of variance explained in all the OLS regression models in our analysis, future studies are encouraged to further explore unaccountable variations in disaster survivors' mental health impacts. Detailed specification of predictors of the mental health impacts of disasters will provide important avenues for promoting recovery throughout the post-disaster timeline. Although our indicators of social capital are limited, the consistency of the findings clearly suggests the importance of social capital theory for understanding the nature of chronic disaster impacts and the lack of timely recovery.

Notes

1. The Saffir-Simpson Hurricane Intensity Scale (SSHIS) was formulated in 1969 by Herbert Saffir and Bob Simpson, Director of the National Hurricane Center. It provides wind, central pressure, and storm surge values. Hurricane with sustained winds in the range of 74-95 mph is Category 1 (minimal damage), 96-110 mph is Category 2 (moderate damage), 111-130 is Category 3 (extensive damage), 131-155 is Category 4 (extreme damage), and 155 and above is Category 5 (with catastrophic damage). A major hurricane is a Category 3 or above on the SSHIS. Available at: http://www.aoml.noaa.gov/general/lib/laescae.html. Accessed on July 1, 2011.
2. The actual number of Katrina deaths may never be known because of the manner in which corpses were handled by contractors. As indicated by Niman (2005:14), Louisiana contracted to pay the Kenyon subsidiary of Texas-based Service Corporation International (SCI), $119,000/day for removing corpses from the New Orleans area. SCI previously made headlines for dumping hundreds of bodies they were contracted to bury. The Louisiana contract puts Kenyon in charge of counting the dead.

3. Although we are aware of studies demonstrating the role of social capital in the context of disaster preparedness and response, scholars are now focusing on how disasters affect social capital.
4. Although the words "social capital" were used with a different meaning by Alfred Marshall back in 1890, Lydia Judson Hanifan (1916) and Jane Jacobs (1961) were the first proponents of the concept as it is used today. Prior to 1981, the number of journal articles listing social capital as a key word totaled only 20; however, from 1991-1995, it has more than quadrupled at 109, and from 1996-2000, the total has exceeded 1,000 (Baum 2000).
5. High rates of crimes represent a significant breach of trust, obligation, and willingness to participate in a mutually beneficial collective action.
6. Racial differences in psychosocial (or PTSD) symptoms between African Americans and White Americans could be expected because the latter have better social capital (including bridging and linking) while the former have weak *homophily* bonding that does not often produce desirable results.
7. A standard RDD sample was obtained from a highly reputable vendor, ASDE Survey Sampler, Inc., for both Louisiana and Mississippi parishes/counties impacted by Katrina. As mentioned, the sample included basic landlines, supplemented by RDD cell phone numbers. Given the nature of RDD sample, the results of the current survey can be generalized to the population of the entire area of study.
8. The measures are consistent with the *Diagnostic and Statistical Manual for Mental Disorders* (DSM) classification—the DSM-IV Diagnostic Criteria for PTSD except that they do not meet the requirement for a minimum symptom duration of one month or more and it does not cover the third major symptom cluster of persistent hyper-arousal. Thus, the CES-D and IES represent important indicators of psychosocial dysfunctions but not a full-blown PTSD. As mentioned by Weiss (2007:220), the original IES was unable to assess symptomatic status in the three domains that constitute the diagnosis of PTSD.
9. The questionnaire has no items measuring avoidance behavior. As mentioned in Note 5 above, the entire PTSD scale is not available for the present analysis.
10. Three indicators of negative or diminished social capital used included the measures of perceived powerlessness in making important decisions to change one's life that often involve identifying and using social networks, withdrawal from organizations and groups in the community, and the adverse effects of crime on community recovery process. High crime rates represent the breakdown of social capital in post-Katrina New Orleans (Frailing and Harper 2010; Van Landingham 2007).
11. Given the relatively small percentage of Hispanic, Native American, Asian, and other racial/ethnic groups in the sample, only White and African American/Black are used in the analysis.

12. A discriminant function is defined as an optimal linear combination of predictor variables (X_i). In a situation where the outcome variable corresponds to just 2 groups (k = 2 groups) as in the present case, the equation for a standardized discriminant function (D_i) is as follows,
    $D_i = d_{11}z_1 + d_{12}z_2 + d_{13}z_3 + d_{14}z_4 \ldots + d_{1p}z_p$,
    where z_1, z_2, z_3, z_4 are the standardized score versions of the predictor variables X_1, X_2, X_3, X_4, . . . , X_p.
13. Due to factorial complexity observed for the item “reminders of Hurricane Katrina caused me to have physical reactions” in the factor analysis, this item was excluded from the factor scores used as the dependent variables.
14. OLS regression diagnostics—including VIF and tolerance scores for all the models or equations in this study are available upon request.

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