ORIGINAL RESEARCH

Mental Illness Prevalence and Disparities Among Hurricane Sandy Survivors: A 2-Year Retrospective

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ABSTRACT

This study examined mental health status among Hurricane Sandy survivors in the most severely damaged areas of New York and New Jersey in 2014, approximately 2 years after this disaster. We used the 2014 Associated Press NORC survey of 1009 Sandy survivors to measure the prevalence of probable mental illness and to analyze its association with selected socioeconomic characteristics of survivors, direct impact by Sandy, as well as social support and social trust. The study found major disparities in mental illness by race/ethnicity, age groups, and employment status. Higher Sandy impact levels were strongly associated with higher rates of mental illness and accounted for much of the disparity between blacks and Hispanics compared with whites in our study group. Social support was more strongly associated with lower rates of mental illness than was social trust. In addition, social support served as a significant mitigating factor in the mental health disparities between blacks and whites. The severity of mental illness among Sandy survivors differed significantly among racial and ethnic groups but was moderated by both the direct impact of this disaster on their lives and the degree of social support they received, as well as how trusting they were.

Key Words: disaster, mental illness, racial disparity, social support, social trust

Hurricane Sandy struck New Jersey and New York on October 29, 2012, leading to 159 deaths, affecting millions of residents and causing over US $70 billion in damage.[1,2] Existing literature suggests that natural disasters have potentially significant impacts on the mental health of survivors.[1-3] This is reflected by the fact that rates of mental illness among the survivors of Sandy are more than twice the national average (as detailed below). However, it remains unclear whether the risk of mental illness differs among the socioeconomic groups exposed to Hurricane Sandy. Here we focus on the direct impact of Sandy reported by individual survivors together with both their perceptions of social trust and the social support they received following Sandy. We seek to clarify the relationships between hurricane disaster, mental illness, race/ethnicity, and social support and trust.

This study draws conceptually on a number of previous studies of the effects of Hurricane Katrina in New Orleans, which resulted in nearly 1000 deaths and US $161 billion in damage.[3-9] Immediately after Katrina, a higher prevalence of mental illness was found among racial minority groups, and among socially and economically disadvantaged groups.[3-5] For example, Sastry and VanLandingham[5] found higher prevalence rates (weighted population) of probable serious mental illness (SMI) among blacks (32%) vs whites (6%),

among low income (38%) vs higher income (15%), among unemployed (39%) vs employed (21%), among women (27%) vs men (9%), and among those with education not exceeding high school (15%) vs those with higher education levels (30%). Also, Galea and his colleagues[6] found that, after Katrina, both SMI and moderate mental illness (MMI) were consistently associated with low family income and unemployment status. Other studies found that low income and unemployed residents affected by Katrina had higher rates of psychological distress than their higher income and employed counterparts.[4,5] For example, Rhodes et al.[4] found that nearly half (47%) of their study group (low-income mothers) in the city of New Orleans exhibited probable posttraumatic stress disorder (PTSD), which points to the particular vulnerability of low income and African American mothers. Similarly, Galea and his colleagues[6] found a higher prevalence (weighted population) of PTSD (30.3%) among residents of the New Orleans Metropolitan area than other areas of Louisiana, Alabama, and Mississippi. They also found that New Orleans residents who were unemployed and had low income were more likely to have PTSD (odds ratio [OR] = 4.0-5.3). As a result of these studies, much is known about the impact of Hurricane Katrina on the residents in and around New Orleans, but it is not known whether similar patterns of mental health outcomes to those following Katrina are also found in the neighborhoods of

TABLE 1

Sample and Population Characteristics				
Variables		**N**	**Sample %[a]**	**Est. % (CI)[b]**
Race/Ethnicity	Non-Hispanic white	691	72	63 (59, 67)
	Non-Hispanic black	82	9	10 (8, 13)
	Hispanic	140	15	18 (14, 21)
	Other	50	5	8 (6, 12)
	Total	963	100	100
Gender	Male	404	41	48 (44, 53)
	Female	590	59	52 (47, 56)
	Total	994	100	100
Marital Status	Married/living as married	528	52	55 (51, 59)
	Never married/divorced/widowed	481	48	45 (41, 49)
	Total	1009	100	100
Age Group	18-29	77	8	12 (9, 16)
	30-39	111	12	15 (12, 18)
	40-59	393	41	42 (38, 47)
	60-64	93	10	9 (6, 12)
	65+	282	30	22 (19, 26)
	Total	956	100	100
Education	More than high school	732	73	60 (56, 65)
	High school or below	265	27	40 (35, 44)
	Total	997	100	100
Household Income	≥ US $50 000	577	64	59 (54, 63)
	< US $50 000	327	36	41 (37, 46)
	Total	904	100	100
Employment	Full-time employed	472	47	47 (43, 52)
	Part-time employed	112	11	12 (10, 16)
	Unemployed	411	41	40 (36, 44)
	Total	995	100	100
Sandy Impact	Only a little/not at all affected	241	24	27 (23, 31)
	Moderately affected	263	27	27 (23, 31)
	Very/extremely affected	480	49	46 (42, 50)
	Total	984	100	100
Social Support	None	29	3	4 (2, 6)
	A little	132	15	16 (13, 20)
	Some	295	33	33 (29, 37)
	Most	303	34	33 (29, 38)
	All	127	14	14 (12, 18)
	Total	886	100	100
Social Trust	No	448	55	51 (45, 53)
	Yes	537	45	49 (47, 55)
	Total	985	100	100

[a] Percent of the sample.
[b] Estimated population percentages and 95% confidence interval (CI) based on AP-NORC weights.

New Jersey and New York damaged by Hurricane Sandy. In particular, the sociodemographic composition of these areas (especially racial demographics) is different from that of New Orleans,[10-12] as detailed in Table 1, and further discussed later.

In addition to the above-noted sociodemographic associations with mental health outcomes, existing disaster research has begun to look at the influence of social relations on pre- and post-disaster vulnerability and resilience.[13] In particular, *social support* has been described as "helping behaviors that are being provided" to victims by their communities.[14] For example, Galea and his colleagues[6] found that lower social support was associated with the risk of PTSD among the survivors during the first 2 years after Hurricane Katrina. In contrast, *social trust* has been described by Wind and his colleagues[15] as an individual's "subjective experience of … mutual support and reciprocity in a community." These authors also found, in their study of the 2008 flood in Morpeth, England, that "Perceptions of higher levels of social trust … decreased the negative relationship between coping intensity and mental health outcomes," specifically PTSD and anxiety.[15] But while existing studies of disasters such as Katrina[6,15] suggest that social support and social trust may mitigate mental health impacts on disaster survivors, the questions of how and for whom continue to be debated.[16,17] With respect to "how," some researchers have hypothesized that social support received by disaster victims may act as a buffer against

negative psychological consequences.[17,18] To date, clear and consistent evidence to support this hypothesis for Sandy victims is lacking. With respect to "who," Galea and his colleagues[19] found that received support after September 11 was an important determinant of differences in PTSD risk for Hispanics. But, in terms of Sandy, the major demographic groups in New York and New Jersey include non-Hispanic blacks and whites, and these groups have yet to be compared with Hispanics for possible differences in the moderating effects of both social trust and social support.

Thus, the main objectives of this study are to identify which racial/ethnic groups were most vulnerable (susceptible) to mental illness after Hurricane Sandy, and to examine whether and how social support and social trust affected these groups. More specifically, we address the following 3 research questions. First, among those groups found by Sastry and VanLandingham[5] to be at risk for mental illness after Hurricane Katrina in New Orleans – Were the same groups also vulnerable (susceptible) to mental illness following Hurricane Sandy in New Jersey and New York? Second – To what extent did social support and social trust affect the mental illness status of these Sandy victims? Finally – To what extent was vulnerability to mental illness among racial/ethnic groups moderated by social support and social trust?

METHODS
Sampling and Sample Characteristics
The present study is based on publicly available survey data from the Associated Press NORC (AP-NORC) Center for Public Affairs Research.[20] This survey was designed to explore the disaster resilience of Hurricane Sandy survivors and was conducted approximately 2 years after the event (from June 28 to September 9, 2014). The multi-mode address-based sample design (Web, telephone, or in-person) was used to survey residents of 12 neighborhoods in New York and New Jersey that the Federal Emergency Management Agency (FEMA) designated as having been "highly impacted"[20(p4)] by Sandy. The survey was conducted in English and Spanish and yielded sample data for 1009 victims residing in the 12 neighborhoods, which were a mix of urban, suburban, and rural communities. The final response rate was 24%, as calculated by Response Rate Method 3 of the American Association of Public Opinion Research.[20] This response rate appears to be typical of similar recent public affairs surveys, such as the California Health Interview survey.[21(p6-12)] However, to guard against possible nonresponse bias, AP-NORC calculated sampling weights for these 12 neighborhoods in order to adjust for differential response rates across various demographic groups. Further details of the sampling procedure are available on the AP-NORC website.[20]

Table 1 shows the numbers of respondents (*N*) in each variable category, together with both the corresponding *sample percentages* of the total respondents for that variable and the weighted *population percentages* associated with these respondents (in terms of sampling weights constructed by AP-NORC). In particular, of the 963 respondents who reported their race/ethnicity, 72% (691) were non-Hispanic whites. In addition, 9% (82) were non-Hispanic blacks, 15% (140) were Hispanic, and 5% (50) were of other races or ethnicities. Of the 995 respondents who reported employment status, 47% (472) were employed full-time, 11% (112) were employed part-time, and 41% (411) were unemployed. Of the 997 who reported education level, 27% (265) were at the high-school graduate level or lower. Finally, of the 904 who reported annual household income, 36% (327) earned lower than US $50 000.
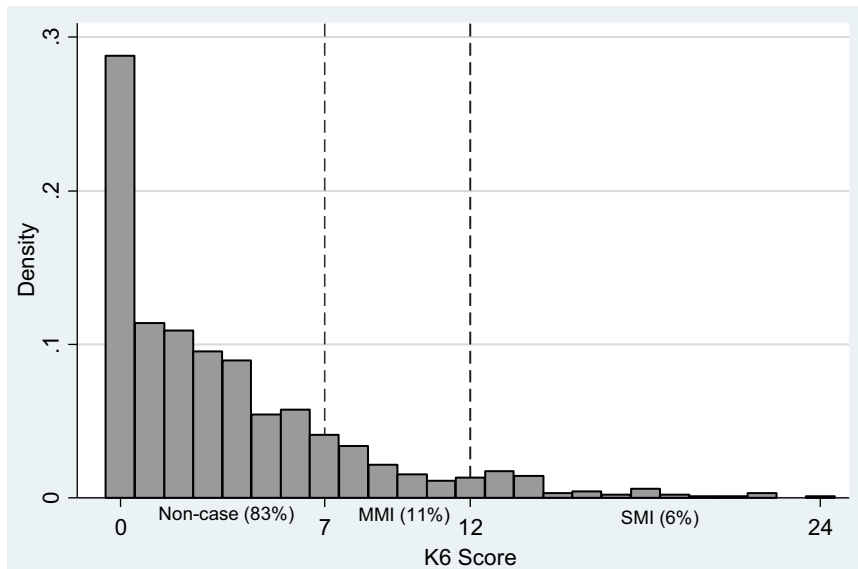
Measurement
The measure of mental health status used in our study was based on the short screening K6 scale.[22] This K6 scale is a rigorously validated community epidemiological measure of nonspecific psychological distress that has been used in the United States and abroad since the end of World War II.[5,7,22,23] The classifications are derived from scored answers to 6 questions regarding the nonspecific psychological status of respondents during the 30-day period before the interview. K6 questions addressed depressed mood (2 questions), motor agitation, fatigue, worthless guilt, and anxiety. Answers to each question were coded from 0 (none of the time) to 4 (all of the time), with a total score ranging from 0 to 24. Following Kessler and his colleagues,[3,22,23] the respondents in our study with K6 scores of 0-7 were classified as *no mental illness* (NMI); those with scores of 8-12 were classified as *probable mild* or *MMI*; and those with scores of 13-24 were classified as *probable SMI*.[3(p376)] A more detailed distribution of K6 scores among respondents is shown in Figure 1.

Notably, the same K6 scoring procedure was used to study the nonspecific psychological effects of Hurricane Katrina on survivors in and around New Orleans.[3-5,7] These Katrina studies showed that there was a high prevalence of MMI after the hurricane,[3] and that over time there was a substantial risk of its transition to SMI. In the group of survivors studied by Kessler and his colleagues,[3] the prevalence (weighted population) of SMI increased from 10.9% in the first 6 months following Katrina to 14% 1 year later. Thus, 1 objective of the present study was to examine the prevalence of MMI (as well as SMI) 2 years after Hurricane Sandy.

The socioeconomic covariates in our analysis include the respondents' race-ethnicity, gender, marital status, age, post-Sandy employment status, education attainment, and household income (with specific measurement categories detailed in Table 1). To measure the direct impact of Hurricane Sandy, the AP-NORC study asked respondents how seriously they personally were affected by the hurricane, using the response categories of "very or extremely affected," "moderately affected," and "little or not at all affected."[20(p6)] (The desirability

FIGURE 1

K6 Scores for Hurricane Sandy Survivors by Probable Mental Illness Categories.

MMI = probable mild or moderate mental illness.
SMI = probable serious mental illness.

of more objective measures of damage is also mentioned in the *Discussion* section.)

The AP-NORC study asked hurricane survivors about the adequacy of the support they received, which was our study's interest as well. As such, we used this AP-NORC item in our analyses: "Do you think that most people in your neighborhood have gotten the help they need to recover and restore their lives after Superstorm Sandy?" The corresponding response categories were "all," "most," "some," "a little," or "none."

Understanding that social relationships are multidimensional, we also examined how social trust might have affected the survivors' mental health 2 years after the hurricane. Although "social trust" is often conceptualized as a part of social capital[24,25] or a result of social network cooperation,[26] social trust is viewed in both the AP-NORC study and our study as the degree to which an individual feels confident in the supportive actions of others in the community. To gauge social trust, AP-NORC asked respondents: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" The 2 possible responses were "most can be trusted" or "cannot be too careful in dealing with people."

Statistical Analysis

The analysis begins with weighted cross tabulations of mental health illness by respondent characteristics (race-ethnicity,

gender, marital status, age, household income, education attainment, employment status after Hurricane Sandy, direct impact by Sandy, social trust, and social support). Each characteristic is treated as a categorical variable, where, for example, the values of "gender" are "male" and "female." In this context, a design-based F-test was used to identify possible significant disparities in mental health outcomes among the various categories for each characteristic, as reported in Table 2.

This approach was then refined by constructing a series of 5 ordered logistic regression models (nested by sets of appropriate characteristics) to estimate the contributions of each characteristic category to the severity of mental health outcomes, as reported in Table 3. These analyses used the sample weights mentioned previously, together with design-based estimates of standard errors based on Taylor linearization methods. All analyses were performed in STATA 14 (StataCorp, College Station, TX).

The key regression analyses reported in Table 3 were carried out using ordered logistic regression to allow more meaningful interpretations of results than is possible in simpler categorical models (such as multinomial logistic regression). For the analysis of survey data, in particular, we used the *gologit2* procedure in STATA 14[27] to verify that the standard proportional-odds condition for ordered logistic regression was satisfied in all cases. More specifically, by letting NMI denote "no mental illness," it was verified that the estimated

TABLE 2

Weighted Cross-Tabulations Probable Mental Illness by Survivors' Characteristics

Variables	No Mental Illness N	No Mental Illness Est. % (CI)[a]	Mild/Moderate Illness N	Mild/Moderate Illness Est. % (CI)	Serious Mental Illness N	Serious Mental Illness Est. % (CI)	Total N	Chi2[b] (df[c])	P[d]
Race/Ethnicity								32.44 (6)	0.072
Non-Hispanic white	454	85 (85, 98)	47	9 (6, 13)	27	6 (3, 10)	528		
Non-Hispanic black	39	65 (45, 81)	4	13 (4, 38)	8	21 (10, 40)	51		
Hispanic	70	69 (56, 80)	16	19 (11, 32)	13	11 (6, 21)	99		
Other	30	80 (52, 93)	2	14 (3, 45)	2	6 (1, 24)	34		
Total	593	80 (75, 84)	69	12 (8, 16)	50	8 (6, 12)	712		
Gender								6.36 (2)	0.266
Male	252	83 (76, 89)	21	9 (5, 15)	23	8 (5, 13)	296		
Female	341	77 (70, 83)	48	15 (10, 21)	27	9 (5, 14)	416		
	593	80 (75, 84)	69	12 (8, 16)	50	8 (6, 12)	712		
Marital Status								10.44 (2)	0.111
Married	335	84 (78, 89)	30	9 (6, 14)	20	7 (4, 12)	385		
Unmarried	258	75 (67, 81)	39	15 (10, 22)	30	10 (7, 16)	327		
Total	593	80 (75, 84)	69	12 (8, 16)	50	8 (6, 12)	712		
Age Group								24.28 (8)	0.127
18-29 yr	39	71 (51, 85)	8	21 (9, 41)	3	8 (2, 26)	50		
30-39 yr	75	86 (72, 94)	7	11 (4, 27)	3	2 (1, 7)	85		
40-59 yr	248	75 (67, 85)	35	13 (8, 20)	27	12 (7, 19)	310		
60-64 yr	61	86 (73, 94)	6	9 (3, 21)	5	5 (2, 15)	72		
65+	170	87 (80, 92)	13	6 (3, 12)	12	6 (3, 13)	195		
Total	593	80 (75, 84)	69	12 (8, 16)	50	8 (6, 12)	712		
Education Attainment								0.76 (2)	0.845
>High school	457	81 (75, 86)	46	11 (7, 16)	28	8 (5, 13)	531		
≤ High school	136	78 (70, 85)	23	13 (8, 20)	22	9 (5, 15)	181		
Total	593	80 (75, 84)	69	12 (8, 16)	50	8 (6, 12)	712		
Employment Status								21.42 (4)	0.028
Full-time	323	84 (77, 89)	26	9 (6, 15)	20	6 (3, 12)	369		
Part-time	64	90 (79, 96)	5	7 (2, 17)	3	3 (1, 12)	72		
Unemployed	206	72 (63, 79)	38	16 (10, 24)	27	12 (8, 19)	271		
Total	593	80 (75, 84)	69	12 (8, 16)	50	8 (6, 12)	712		
Household Income								24.42 (2)	0.005
≥ 50k	409	86 (81, 90)	35	9 (6, 14)	18	5 (3, 9)	462		
< 50k	184	71 (63, 79)	34	16 (10, 24)	32	13 (8, 20)	250		
Total	593	80 (75, 84)	69	12 (8, 16)	50	8 (6, 12)	712		
Sandy Impact								23.01 (4)	0.020
Not at all/only a little affected	134	85 (75, 91)	12	10 (5, 19)	7	5 (2, 12)	153		
Moderately affected	164	86 (78, 92)	20	11 (6, 20)	5	2 (1, 7)	189		
Very/extremely affected	295	74 (67, 81)	37	12 (8, 19)	38	13 (9, 20)	370		
Total	593	80 (75, 84)	69	12 (8, 16)	50	8 (6, 12)	712		
Social Support								36.13 (8)	0.025
None	15	87 (66, 96)	1	3 (0, 18)	6	10 (3, 31)	22		
A little	74	65 (50,77)	10	14 (6, 30)	14	21 (11, 35)	98		
Some	187	79 (71, 85)	28	14 (9,21)	17	8 (4,13)	232		
Most	226	85 (75, 91)	24	11 (6, 19)	9	5 (1, 13)	259		
All	91	87 (76, 93)	6	8 (3, 18)	4	5 (2, 14)	101		
Total	593	80 (75, 84)	69	12 (8, 16)	50	8 (6, 12)	712		
Social Trust								16.26 (2)	0.023
No	237	74 (67, 81)	40	16 (11, 23)	33	9 (6, 15)	310		
Yes	356	86 (79, 90)	29	7 (4, 11)	17	7 (4, 13)	402		
Total	593	80 (75, 84)	69	12 (8, 16)	50	8 (6, 12)	712		

[a] Estimated population percentages and 95% confidence interval (CI) based on AP-NORC weights.

[b] Chi2 = chi-square test.

[c] Degree of freedom.

[d] P = P-value.

parameter effects for independent variables were proportional across all relevant comparisons between the ordered states (NMI, MMI, SMI).

Finally, it should be stressed that 29% of this respondent data (297 observations) exhibited missing values for 1 or more variables studied (including 36 missing for our dependent

variable). While multiple imputation techniques, in principle, could be used here, all such methods require some form of "missing at random" (MAR) assumption.[20] In view of the many correlations between patterns of missing values, we consider this assumption questionable for the present data. Therefore, we employed list-wise deletion in all contingency-table and logistic regression analyses, reducing our effective sample size to 712. For logistic regression, in particular, it is well known[28] that list-wise deletion is the single most robust procedure to violations of MAR. While this procedure yields a smaller sample size, it is our view that this smaller sample allows more statistically reliable results. In addition, we note that any remaining biases in this approach tend to understate significance levels, thus providing conservative estimates of effects.

RESULTS

The mental-health impacts of Hurricane Sandy are perhaps best summarized by the fact that the overall weighted population rates of mental illness among survivors, 2 years after Sandy (see Figure 1), are almost twice the national average. Specifically, the percentages were 11% for MMI (mild-to-moderate mental illness) and 6% for SMI versus the national averages of 6% for MMI and 3% for SMI, as reported by the US Department of Health and Human Services, 2014.[29]

With respect to the summary of individual characteristics shown in Table 1, we highlight the key differences between this population and those of Hurricane Katrina survivors in New Orleans (also in terms of weighted population percentages). Turning first to race-ethnicity, the single most important difference is the small proportion of non-Hispanic blacks (10%) in our Sandy study versus the dominant proportion of non-Hispanic blacks (more than 50%) reported in a comparable Katrina study.[5] A second key difference is educational attainment. While 60% of Sandy survivors achieved education levels beyond high school, this figure was only 30% for Katrina survivors.[5] Even more dramatic is the difference in unemployment rates, which was 40% for Sandy survivors, but only 9% for Katrina survivors.[5] This partly explains why the relationship between unemployment and mental illness found in that Katrina study is far less significant than for Sandy.

Turning to the weighted cross-tabulations in Table 2, there are significant disparities in probable mental health outcomes with respect to race/ethnicity, employment status, household income, perceived impact level by Hurricane Sandy, social support, and social trust (as later discussed further in the regression models). Of most interest for our present purposes is the fact that survivors experiencing the most extreme effects of Sandy also exhibited uniformly higher rates of mental illness, especially SMI.

Finally, the results of our ordered logistic regressions are summarized in Table 3, where 5 nested regression models are

considered. Model 1 controls for all demographic variables: race-ethnicity, gender, marital status, and age group. Model 2 adds 3 socioeconomic variables: education, income, and employment. These 2 models are directed to our first research question. Model 3 then adds Hurricane Sandy impact as perceived by survivors. Model 4 further includes social support and social trust. Together, these 2 models focus on our second research question. Finally, to address our third research question, Model 5 includes interaction effects between race-ethnicity attributes and the variables of social support and social trust.

Turning first to the common features of these models, in all models involving unemployment in Table 3, this is the single most significant predictor of increased mental illness (with all P-values below 0.01 and OR above 2.8). This finding dramatically differs from Katrina, where the unemployment rate was much lower (9% for Katrina vs 40% for Sandy) and the relation between unemployment and mental illness was far less significant.[5] But these differences are most likely the result of external economic factors just prior to the 2 disasters. Katrina occurred in 2005, when the national unemployment rate was only 5.3%, whereas Sandy occurred in 2012 when the unemployment rate was still very high, 8.3%, following the Great Recession of 2008–2009.[30] In particular, the economic stress created by the Great Recession may well have accounted for much of the mental stress experienced by unemployed Sandy survivors. Thus, in terms of Sandy itself, these significant results should be interpreted with caution.

We also note that, with respect to age, mental health effects are most severe among the middle age (reference) group (40 to 59 years), with all ORs less than 1. This result is consistent with previous findings[5] that middle-aged residents in New Orleans were more likely to suffer mental illness after Hurricane Katrina.

Turning next to a comparison of Model 1 (*M1*) and Model 2 (*M2*), the most striking difference here is the decrease in ORs and significance levels for both Hispanics and blacks when controlling for socioeconomic variables and, in particular, unemployment (OR = 3.03 [M1] vs OR = 2.55 [M2] for blacks and OR = 2.11 [M1] vs OR = 1.76 [M2] for Hispanics; P = 0.04 [M1] vs P = 0.07 [M2] for blacks and P = 0.02 [M1] vs P = 0.08 [M2] for Hispanics). This suggests that the more probable levels of SMI and MMI among those with higher unemployment (as well as less income and education) are largely attributable to the disproportionately higher number of blacks and Hispanics with these characteristics.

When adding perceived levels of Sandy impact in Model 3, the OR and significance of blacks and Hispanics further decrease (OR = 2.20 and P = 0.11 for blacks; OR = 1.72 and P = 0.11 for Hispanics). The highest perceived impact (*very/extremely affected*) is by far the most significant (OR = 2.10

TABLE 3

Weighted Ordered Logistic Regressions[a,b] to Estimate Mental Illness by Respondent Characteristics

Variables	Model 1 (Demographics) OR[c]	95% CI	P[d]	Model 2 (SES) OR	95% CI	P	Model 3 (Sandy Impact) OR	95% CI	P	Model 4 (Support & Trust) OR	95% CI	P	Model 5 (Interaction Effects) OR	95% CI	P
Race (reference: white)															
Black	3.03	1.07, 8.60	0.038	2.55	0.94, 6.89	0.065	2.20	0.84, 5.77	0.108	2.16	0.86, 5.44	0.101	2.05	0.74, 5.72	0.169
Hispanic	2.11	1.13, 3.96	0.019	1.76	0.93, 3.34	0.084	1.72	0.88, 3.35	0.111	1.91	0.99, 3.66	0.053	2.47	1.15, 5.31	0.020
Other	1.55	0.45, 5.31	0.488	1.12	0.28, 4.50	0.873	1.11	0.30, 4.11	0.879	1.02	0.25, 4.19	0.973	1.00	0.22, 4.56	0.996
Gender (reference: male)															
Female	1.33	0.77, 2.33	0.308	1.20	0.67, 2.12	0.540	1.20	0.69, 2.09	0.514	1.25	0.72, 2.16	0.433	1.22	0.68, 2.19	0.500
Marital status (reference: married)															
Unmarried	1.42	0.76, 2.65	0.272	1.19	0.57, 2.50	0.641	1.19	0.55, 2.57	0.654	1.18	0.55, 2.54	0.663	1.17	0.56, 2.46	0.676
Age group (reference: 40-59 yr)															
18-39 yr	0.87	0.36, 2.10	0.753	0.91	0.39, 2.16	0.833	1.00	0.43, 2.33	0.995	0.94	0.41, 2.15	0.875	1.01	0.44, 2.30	0.985
30-39 yr	0.36	0.15, 0.84	0.019	0.31	0.13, 0.73	0.007	0.29	0.12, 0.71	0.006	0.27	0.11, 0.67	0.005	0.22	0.08, 0.56	0.002
60-64 yr	0.50	0.19, 1.34	0.168	0.31	0.10, 0.93	0.038	0.29	0.09, 0.92	0.035	0.29	0.08, 0.96	0.044	0.38	0.12, 1.19	0.097
65 & 65+	0.46	0.22, 0.94	0.034	0.23	0.10, 0.50	0.000	0.23	0.10, 0.52	0.000	0.24	0.10, 0.57	0.001	0.28	0.12, 0.66	0.004
Education (reference: ≥ high school)															
< high school				0.75	0.39, 1.45	0.391	0.81	0.42, 1.57	0.541	0.74	0.38, 1.43	0.365	0.77	0.41, 1.47	0.430
Employment status (reference: full-time employed)															
Part-time				0.48	0.17, 1.32	0.156	0.53	0.20, 1.40	0.197	0.45	0.17, 1.23	0.118	0.45	0.15, 1.32	0.145
Unemployed				2.96	1.40, 6.26	0.005	3.08	1.46, 6.48	0.003	2.88	1.35, 6.17	0.006	3.01	1.38, 6.53	0.005
Household income (reference: ≥ 50k															
<50K				1.73	0.73, 4.13	0.213	1.65	0.69, 3.94	0.259	1.69	0.70, 4.13	0.246	1.62	0.69, 3.83	0.270
Sandy impact (reference: not at all/a little affected)															
Moderately affected							1.14	0.51, 2.53	0.748	1.22	0.54, 2.76	0.639	1.17	0.50, 2.76	0.721
Very/extremely affected							2.10	1.06, 4.17	0.033	1.95	0.96, 3.95	0.065	1.93	0.94, 3.97	0.073
Social support															
(cardinal variable)										0.71	0.53, 0.97	0.030	0.77	0.51, 1.16	0.205
Social trust (reference: no)															
Yes										0.89	0.47, 1.71	0.732	1.38	0.07, 27.20	0.834
Race interacting with social support (reference: white # social support)															
Black # social support													0.43	0.19, 0.98	0.044
Hispanic # social support													0.75	0.36, 1.52	0.419
Other # social support													3.60	0.53, 24.50	0.190
Race interacting with social trust (reference: white # social trust)															
Black # social trust													0.80	0.04, 16.70	0.887
Hispanic # social trust													0.19	0.01, 9.58	0.402
Other # social trust													0.29	0.01, 7.38	.455
Constant cut 1	5.33	3.01, 9.43	< 0.001	6.31	3.27, 12.17	<.001	9.90	4.78, 20.50	<.001	9.08	3.96, 20.82	.001	10.33	4.26, 25.02	<.001
Constant cut 2	15.44	7.61, 31.29	< 0.001	19.59	8.74, 43.95	<.001	31.33	13.40, 73.27	<.001	29.41	12.25, 70.61	<.001	35.19	13.79, 89.82	<.001
F-statistics	3.09 (9; 692)		0.001	3.40 (13; 688)		<.001	3.09 (15; 686)		<.001	2.83 (17; 684)		<.001	3.51 (23; 678)		<.001
N	712			712			712			712			712		

[a] In STATA 14, the add-on program, *gologit2*, includes options for analyzing ordered logistic regression models based on weighted survey data. In particular, this procedure allows both global and partial parallel-line tests to be carried out in terms of appropriately defined sequential Wald tests. In the present case, such tests confirmed that the global parallel-line assumption is warranted.
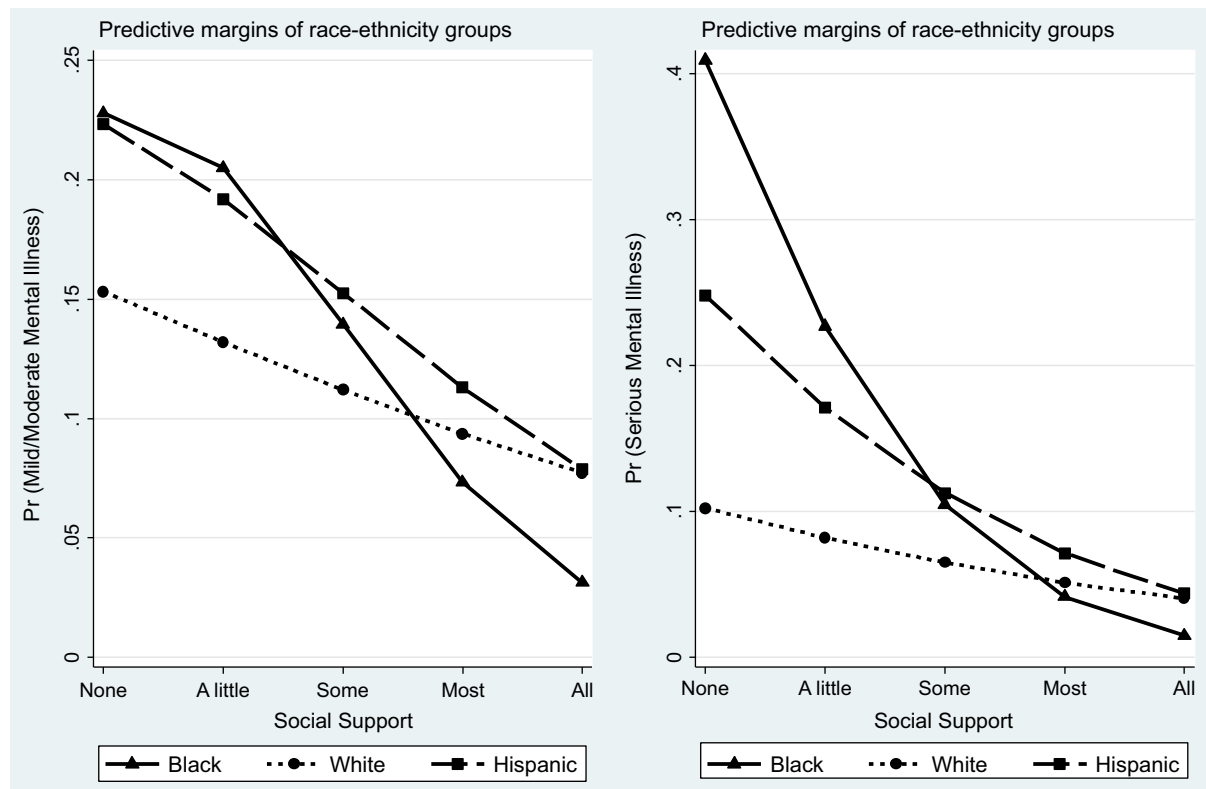
[b] The Taylor linearization method was used to calculate standard errors.

[c] Odds ratio.

[d] Design-based F-statistics (df1; df2) and *P*-values were reported for all 5 models.

FIGURE 2

Predictive Margins of Mental Illness Probabilities by Levels of Social Support for Race/Ethnicity Groups.

and $P = 0.03$), suggesting that part of the significance of blacks and Hispanics in Model 2 is now being accounted for by differences in mental health effects among those perceiving higher levels of Sandy impact. This was further confirmed by an auxiliary ordered logistic regression of perceived impact on all demographic and socioeconomic variables (not shown), where blacks and Hispanics were indeed seen to be more likely to experience extreme rather than moderate Sandy effects.

When we add social support and social trust in Model 4, it is seen that social support is far more significant than social trust in reducing mental illness (OR = 0.71 and $P = 0.03$ for social support; OR = 0.89 and $P = 0.73$ for social trust). This difference can be partly explained by the differences of blacks and Hispanics (vs whites) with respect to these variables. Auxiliary regressions of these 2 variables on the demographic and socioeconomic variables (not shown) indicate that blacks and Hispanics held significantly lower perceptions of social trust than whites, but that was not the case for social support. Thus, the slight increase of significance for blacks and Hispanics in Model 4 may partly account for the insignificance of social trust.

Finally, in Model 5, social support and social trust are interacted with the race/ethnicity variable. Here, the most striking

effect is the significant reduction in mental illness for blacks (vs whites) with high levels of social support (OR = 0.43 and $P = 0.04$). Indeed, this effect is so strong that it appears to account for the main differences between the mental illness of blacks and Hispanics vs whites. This can also be seen visually in terms of the margin plots from STATA 14 in Figure 2, where changes in mental health probabilities are plotted against changes in social support for each group while holding all other variables at their mean values. Here, again, it is evident that, while social support is a stronger mitigating factor for blacks and Hispanics than for whites, it is clearly most pronounced for blacks.

DISCUSSION

Our analysis produced 4 main findings. First, within this study group of Hurricane Sandy victims, the prevalence of both MMI and SMI 2 years after the hurricane is much higher than prevalence rates nationwide. Second, there are significant mental health disparities among the race/ethnicity groups in this study. In particular, the disparities between both black and Hispanic survivors compared with white survivors are largely due to the former 2 groups' lower socioeconomic status, as well as to their stronger perceived impacts from Sandy.

(Similar disparities were found among the survivors of Hurricane Katrina[5]; so, even though the representation of blacks is much smaller in our study (11% vs 56%), our present results add support to those findings.) Third, while both social support and social trust may help mitigate the severity of mental illness, social support is far more significant than social trust for these Sandy victims. This, in part, may be due to the more immediate relation between social support (as defined) and the hurricane disaster itself. Finally, social support is particularly significant in reducing mental illness among blacks in our study group. In this regard, there is some evidence to suggest a higher prevalence of church participation among blacks than whites in our study group (53% vs 45%), which may contribute to the strength of their social networks.

These findings have a number of possible policy and practice implications. First, the high prevalence of mental illness among blacks and Hispanics suggests that psychological interventions after such disasters, including anxiety management[31] and supportive therapy,[32] should focus more heavily on these groups. Second, the strong moderating effects of social support (rather than social trust) on mental health outcomes suggest that community intervention programs[33,34] should place more emphasis on the provision of tangible support, especially for the identified socially vulnerable groups. Finally, while the unusually high levels of unemployment among Sandy victims may be largely due to the nationwide recession of 2008–2009,[35] which continued to negatively impact employment rates across the United States at the time of Sandy, the strong relationship between unemployment and mental health found in this study suggests that community interventions should focus on restoring local economies, especially in the aftermath of both financial catastrophes and natural disasters, and particularly when the 2 intersect.

As with all such studies, a number of limitations must be stressed when evaluating the results. First, while K6 has been widely used in previous research,[3-5,7] this scoring system is based on self-reported data rather than on clinical diagnoses of mental illness. Second, in the absence of any controlled experimental setting, the directionality of relationships found between survivor views and their states of mental health is not clear. Ideally, one would like to augment survivor views of Sandy's effects with objectively measurable variables, such as property loss or physical injuries. However, such data are currently not publicly available.

CONCLUSION

In summary, this study provides the first analysis of factors influencing the mental illness of individual survivors following Hurricane Sandy. The strongest buffering effect on mental illness was provided by the social support they received. Among racial/ethnicity groups, in particular, this effect was strongest among black survivors. As outlined previously, we believe that these findings should assist policy-makers and health providers

in directing post-disaster assistance to where it is most needed. Without a proper assessment of both vulnerability and support factors relevant for specific disasters, existing policies might actually be missing the target populations most in need of public resources.

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Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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