Prevalence of and Disparities in Mental Illness Among Pre-Katrina Residents of New Orleans One Year After the Hurricane Katrina*

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Narayan Sastry
University of Michigan and RAND Corporation

Mark VanLandingham
Tulane University

Abstract

We examine the mental health status of displaced New Orleans residents in the fall of 2006, one-year after Hurricane Katrina, using data from the Displaced New Orleans Residents Pilot Study that measured the prevalence of mild-moderate and serious mental illness among a representative sample of pre-Katrina residents of New Orleans, including people who evacuated the city but did not return. In addition, we describe and analyze disparities in mental health status by race, education, and income. Three main findings emerged from our analysis. First, there were high rates of mental illness among pre-Katrina residents of New Orleans one-year after the hurricane. Second, there were major observed disparities in mental illness by race, education, and income. Finally, the severe damage to or destruction of the individual's home in New Orleans appears to be a key factor underlying observed levels of and disparities in psychological distress among pre-Katrina residents of New Orleans.

Introduction

Hurricane Katrina struck New Orleans, Louisiana, on the morning of August 29, 2005. The city's entire population of 455,000 (U.S. Census Bureau, 2005) was displaced by the storm and the flooding that occurred in its aftermath.[1] The devastation, disruption, and despair caused by the hurricane was expected to have a significant effect on the mental health of this population, and results to date suggest that this is indeed the case (Galea et al., 2007; Kessler et al., 2006).

Early studies of the mental health effects of Hurricane Katrina suggested that displaced New Orleans residents experienced very high rates of distress in the initial period following the hurricane (Brodie et al., 2006; Elliott and Pais, 2006; Norris et al., 2006), although not all of these studies collected reliable measures of mental health status or were based on representative samples of the affected population. Little is know, however, about the intermediate- and longer-term mental health effects of Hurricane Katrina on the pre-hurricane population of New Orleans. Research on this and many related topics of scientific and policy interest continues to be hampered by a lack of appropriate data (Briggs, 2006; National Academy of Sciences, 2007).

In this paper, we use data from the Displaced New Orleans Residents Pilot Study to examine the mental health status of displaced New Orleans residents in the fall of 2006, one-year after Hurricane Katrina. We document the prevalence of mild-moderate and serious mental illness among a representative sample of pre-Katrina residents of New Orleans, including people who evacuated the city but did not return. In addition, we describe and analyze disparities in mental health status by race, education, and income. Our focus on disparities and on the population of the City of New Orleans, which experienced the greatest devastation by the

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[1] For more background information on Hurricane Katrina and its effects on New Orleans, see Comfort (2006).

hurricane of any large area, extends previous research on the mental health effects of Hurricane Katrina (Galea et al., 2007; Kessler et al., 2006).

The paper is organized as follows. In the next section, we describe the design of and fieldwork results from the Displaced New Orleans Residents Pilot Study. Next, we describe the K6 measure of mental health used in our analysis and provide an overview of the covariates. We then outline the statistical methods and present the results of our analysis, first showing descriptive findings followed by findings from our multivariate regression analysis.

Three main findings emerged from our analysis. First, there were high rates of mental illness among pre-Katrina residents of New Orleans one-year after the hurricane, with 19 percent experiencing mild-moderate mental illness and 20 percent experiencing serious mental illness. Second, there were major observed disparities in mental illness by race, education, and income, with disparities by race probably the most salient. Finally, the severe damage to or destruction of the individual's home in New Orleans appears to be by far the most important factor underlying observed levels of and disparities in psychological distress.

Data

Data for this study come from the Displaced New Orleans Residents Pilot Study (DNORPS) that was fielded in the fall of 2006, approximately one year after Hurricane Katrina (Sastry, forthcoming). Fieldwork began in mid-September 2006 and ended in November 2006. The aim of DNORPS was to determine the feasibility of collecting representative data on the current status of people who resided in New Orleans at the time of Hurricane Katrina, and to examine their the location, well-being, and plans.

DNORPS is based on a stratified, area-based probability sample of pre-Katrina dwellings in the City of New Orleans in order to provide representative information on pre-hurricane

residents of New Orleans. For sampling purposes, New Orleans was divided into three strata based on flood depth: no flooding, low-flood depth (<4 feet of flooding), and high-flood depth (4+ feet of flooding). DNORPS used an implicit stratification procedure to achieve an even distribution of the sample within each stratum by three potentially important factors: geographic location (based on Census tract), racial composition (using the percent of the population at the block level that was black), and home owners versus renters (based on the block-level proportion of dwellings that were owner-occupied). Dwelling units were the primary sampling unit and there was no geographic clustering of cases, which provides high statistical power for a given sample size because design effects are minimized.

DNORPS drew a sample of 344 pre-Katrina residences in New Orleans. Fieldwork focused on tracing the sampled cases using mail, telephone, and in-person contacts, and drawing on an extensive array of electronic database searches and state-of-the-art tracing techniques to obtain updated information on sampled respondents' whereabouts. Approximately two-thirds of the sampled cases were located, and 80 percent of the located cases were successfully contacted and asked to complete a questionnaire. A questionnaire was successfully completed for just under 90 percent of the contacted cases, which represents a very high cooperation rate.

The main reason for not completing an interview is that the case could not be located. We were unable to locate about one-third of all eligible cases (some of whom may, in fact, be ineligible). The remaining cases comprised of refusals, unable-to-contact cases, and cases on which work had stopped. It was more difficult to locate respondents in areas that had flooded because a higher fraction of these people no longer resided in the sampled dwellings. However, there was little variation across strata in contact rates, and cooperation rates did not vary greatly by stratum.

The area-based sample design of the DNORPS allowed us to conduct a multivariate logistic regression analysis of fieldwork outcomes, with covariates based on area-characteristics at the block and block-group level from the 2000 Census (see Sastry, forthcoming). There were few systematic differences in fieldwork outcomes across any of the fieldwork stages—with the exception of locating sampled cases. The rate of locating cases was higher for cases in blocks with a higher median age of residents and in tracts with a lower fraction of non-family households. None of the covariates describing race or socioeconomic status were statistically significant.

The DNORPS sample includes a total of 144 respondents. Each respondent was administered a short paper-and-pencil interview by mail, by telephone, or in person. It took respondents approximately 15 minutes, on average, to complete the ten-page questionnaire. The DNORPS questionnaire obtained a roster of all pre-Katrina household residents and collected information on their evacuation and resettlement experience, current location, plans to return to or remain in New Orleans, and health and well-being. Information was also collected on residents' basic demographic and socioeconomic characteristics and on housing characteristics and damage. The sample was geocoded which allowed us to append neighborhood-level characteristics to individual records.

Measures

The survey respondent was administered the K6 scale of non-specific psychological distress (Kessler et al, 2002; Kessler et al., 2003a), which screens for anxiety and mood disorders in the previous 30 days. The K6 is widely used in the U.S. as a screener for mental illness, and has been used previously to examine the psychological effects of Hurricane Katrina (Galea et al.,

2007; Kessler et al., 2006). It has been shown to provide good validity in predicted mental illness (Kessler et al, 2002; Kessler et al., 2003a).

The K6 is based on answers to six questions, which ask about how often during the past 30 days the respondent felt nervous, hopeless, restless or fidgety, depressed, that everything was an effort, and worthless. Answer categories capture the proportion of time that respondents experienced these symptoms: none, a little, some, most, or all of the time. Table 1 summarizes respondent reports to the six symptom questions in DNORPS. The results in this table show that the majority of respondents had symptoms of nervousness and found everything to be an effort at least some of the time in the past 30 days. In contrast, less than a quarter of respondents reported feelings of worthlessness and a majority reported never feeling hopeless or depressed.

To create the K6 scale, answer categories were coded from zero (none of the time) to four (all of the time) and summed. The resulting K6 score is used to classify respondents into three categories: no distress (K6 score of 0–7); probably mild-moderate mental illness (K6 score of 8–12); and probable serious mental illness (K6 score of 13–24). We considered it important to examine mild-moderate mental illness because of its high prevalence and the high rates of subsequent serious mental illness among this group (Kessler et al., 2003b).

The covariates in our analysis include the respondent's age, sex, race, education, place of birth, and pre-Katrina marital status and employment status. We also examine housing characteristics, including the type of dwelling, whether the unit was owned or rented, and the extent of damage from Hurricane Katrina and the subsequent flooding. Summary statistics for the covariates are presented in Table 2. Over half of the respondents (56 percent) were black, with the remainder being white or another race (there were very few respondents in the "other" race category and this group was therefore combined with whites). Only about one-third of

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respondents (35 percent) had at least some college education, while almost two-thirds (65

percent) had a high school diploma or less education. Almost half of respondents were aged 20–

49 years, about one-third were adults less than 40 years of age, and about one-fifth were 65 years

of age or older. Female respondents make up somewhat more than half the sample. Three-fifths

of respondents (59 percent) were unmarried. In the month prior to Hurricane Katrina, almost

three-quarters of respondents were employed, with nine percent unemployed and 17 percent out

of the labor force (mostly retirees or students). Three out of five respondents owned their homes

prior to Hurricane Katrina while the remaining two-fifths of respondents were renters. About

two-thirds of respondents' homes were badly damaged or rendered uninhabitable by Hurricane

Katrina.

Analysis Methods

Our analysis of psychological distress among displaced New Orleans residents proceeds

in two steps. We first examine weighted cross-tabulations of mental health status by each of the

covariates and assess the statistical significance of observed differences based on Rao-Scott

(1984) sample design-based F-tests. Next, we estimate ordered logistic regression models to

control for race, education, and economic status simultaneously and to examine the background

factors that may account for the observed disparities.

The ordered logistic model is appropriate because the outcome variable takes three

categorical values that can be ordered from better to worse. This model is a generalization of the

standard two-outcome logistic regression model to multiple outcomes and is fit to the cumulative

probabilities of the outcome variable. In particular, the model compares the first outcome to the

second two outcomes combined and, at the same time, compares the first and second outcomes

combined to the third outcome. The estimated parameters include the covariate effects and two

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cutpoints that together define the three outcome categories. The constant is absorbed into the cutpoints and is not estimated separately. We estimated the models with sample weights and an adjustment for the stratified sampling scheme and we calculated design-based standard errors using jackknife estimation.

The ordered logistic regression model is also known as the proportional odds model (McCullagh, 1980), and the exponentiated coefficients from the ordered logistic regression model that we report are interpreted as proportional odds ratios. In other words, covariate effects reflect the odds of being in the probable serious mental illness group, compared to being in the combined no-distress/probable mild-moderate mental illness group, relative to the omitted reference category (because all of the covariates in the model are categorical). The proportional odds assumption means that this covariate effect is the same for the odds of being in the combined probable serious/mild-moderate mental illness group compared to being in the no-distress group. Less formally, the exponentiated covariates represent the likelihood of having a worse mental health status outcome. Note that the proportional odds assumption can be tested and relaxed by estimating generalized ordered logistic regression models (e.g., Clogg and Shihadeh, 1994).

Results

We begin this section by describing the results of the K6 scale of 30-day nonspecific psychological distress. Next, we examine cross-tabulations of the mental health measure by each of the covariates. Finally, we present results from the ordered logistic regression analysis.

Figure 1 shows the distribution of K6 scores in the DNORPS sample as well as the three outcome categories. Three-fifths of the DNORPS sample (61 percent) was classified as having no psychological distress. About one-fifth of the sample (19 percent) experienced mild-

moderate mental illness and another one-fifth (20 percent) were classified as experiencing serious mental illness. Thus, a total of 40 percent of the DNORPS sample was classified as having probable mild-moderate or severe psychological distress one year after Hurricane Katrina struck.

In Table 3 we present cross-tabulations of the three-category psychological distress indicator with each of the covariates. There are large and statistically significant disparities in mental health status by race, employment status, and housing damage. Blacks have substantially higher rates of serious psychological distress compared to whites/others: almost one-third of blacks (31 percent) were classified in the high-distress category compared to only six percent of whites/others. Interestingly, blacks and whites/others had similar levels of mild-moderate psychological distress, with about 20 percent of each group falling into this category. Unemployed individuals had extremely high rates of psychological distress, with only 11 percent classified as a non-case but almost half classified as having mild-moderate psychological distress and 39 percent as having serious distress. In contrast, individuals out of the labor force had very low rates of serious psychological distress. Finally, individuals whose home was badly damaged, including those whose homes were completely destroyed, had high rates of both mild-moderate (23 percent) and serious (27 percent) psychological distress. In contrast, over four-fifths of individuals whose homes were undamaged, or damaged but habitable, were classified as having no psychological distress.

Other statistically significant disparities in psychological distress occurred by income, education, and place of birth. Individuals living in tracts in the bottom quartile of the distribution for the sample had substantially higher rates of serious psychological distress than those in the top three quartiles. Individuals with a high school education or less had rates of mild-moderate

and serious psychological distress that were roughly twice as high as rates for individuals with more than a high school education (27 percent versus 15 percent for mild-moderate psychological distress and 30 percent versus 15 percent for serious psychological distress). The 71 percent of individuals who were born in Louisiana had substantially higher rates of serious psychological distress, but similar rates of mild-moderate psychological distress, compared to pre-Katrina residents who were born outside of the state.

Finally, disparities in psychological distress that were statistically significant at the .10 level occurred by age, with middle-aged individuals exhibiting the highest levels of serious psychological distress of any age group; by sex, with females experiencing higher levels of serious psychological distress than males; and by marital status, with unmarried individuals having higher rates of serious psychological distress but unmarried individuals having higher rates of mild-moderate psychological distress. There were no observed disparities in psychological distress by whether the individual owned or rented a house in New Orleans prior to Hurricane Katrina.

The ordered logistic regression results are based on five separate models. The first three models include each of the three main socioeconomic variables—race, income, and education—on its own. The fourth model includes these three variables simultaneously, while the final model adds all of the other covariates to the fourth model. The regression results reveal large and statistically significant disparities in psychological distress for each socioeconomic measure when it is examined on its own. For all three socioeconomic variables, disadvantaged individuals experienced odds of being in the next-higher category of psychological distress that were roughly three-to-four times higher than non-disadvantaged individuals. For instance, blacks had an odds ratio of 3.63 for being classified as having serious psychological distress

compared to having mild-moderate or no psychological distress and as having any psychological distress compared to having no distress.

After controlling for all three socioeconomic measures simultaneously, in Model 3, the only variable that retained a statistically significant effect was race—with blacks continuing to have a substantially higher likelihood of experiencing psychological distress. The estimated effects for income and education are substantially smaller in Model 3 than when these variables were considered on their own, indicating that higher levels of distress among disadvantaged members of these two groups is in large part because they are comprised of disproportionately high numbers of blacks.

In the final model, which includes the full set of variables, none of the three socioeconomic variables are statistically significant. Only a single variable is statistically significant in Model 5 at the .05 levels—housing damage. There is a major deleterious effect for psychological distress of an individual having his or her dwelling in New Orleans severely damaged or destroyed by Hurricane Katrina or its aftermath. Specifically, the odds of being classified as having serious psychological distress (compared to having mild-moderate or no psychological distress) or as having any psychological distress (compared to having no distress) was over five times higher for individuals who lost their home in the disaster. The effect of adding the housing damage variable—as well as the other variables in the model—was to reduce the odds ratio for psychological distress between blacks and whites to less than one. Thus, a major reason for the higher levels of psychological distress among blacks in New Orleans in the aftermath of Hurricane Katina is that they were much more likely to have their dwelling in the city severely damaged or destroyed. There is also some evidence in Model 5 that middle-aged

individuals had higher psychological distress than either younger or older individuals, although this effect is statistically significant only at the .10 level.

Conclusions

Our results reveal very high levels of psychological distress among pre-Katrina residents of New Orleans. Nearly 40 percent of pre-Katrina New Orleans residents experienced psychological distress one-year after the storm, with half of these individuals experiencing serious psychological distress. A previous study, conducted between January and March of 2006, estimated that among residents of the New Orleans metropolitan area, nearly half (49 percent) experienced psychological distress with 17 percent having experienced serious psychological distress (Galea et al. 2007). Our results are not directly comparable to these earlier estimates because our study is focused on the City of New Orleans—rather than the entire New Orleans metropolitan area. The City of New Orleans accounted for about one-third of the metropolitan areas' total population prior to Hurricane Katrina (U.S. Census Bureau, 2005), but a substantially smaller proportion after the storm. Nevertheless, comparing these two sets of results suggest that rates of serious psychological distress may not have changed much over the six-to-seven month period between the two surveys conducted in early and late 2006, but that rates of mild-moderate psychological distress may have declined substantially—from 32 percent of pre-Katrina residents in January-March 2006 to 19 percent in September-November 2006. These rates are both are substantially higher than rates of psychological distress prior to Hurricane Katrina in the region affected by the storm, which were estimated at 6 percent for serious and 10 percent for mild-moderate psychological distress, and 16 percent for any psychological distress (Kessler et al., 2006).

The results from estimating ordered logistic regression models suggest that observed socioeconomic disparities in psychological distress—especially the disparity between blacks and whites—are largely accounted for other factors. Our findings suggest that a particularly important factor underlying the observed socioeconomic disparities in psychological distress—and, possibly, underlying the levels of psychological distress—is the effect of severe damage to individuals' homes in New Orleans. This effect may be economic, because, for most families who own their home, equity in their property represents their largest wealth component (McCarthy et al., 2006). Uninsured property losses due to flooding are therefore potentially devastating. Although New Orleans had among the highest participation rates in the flood insurance program in the country (Swenson 2006), even among the insured the average policy coverage in New Orleans ($152,000) was only equal to the median house price. This means that, for many New Orleanians, flood insurance was unlikely to be sufficient to cover the household contents or the loss of use of a home. Nearly half of the housing units in New Orleans were rental units, according to the 2000 Census. Renters may not have faced the same financial losses as homeowners, but individuals whose rented dwellings were severely damaged or destroyed were forced to find new housing and likely had major personal property losses. Apart from the financial losses, severely damaged or destroyed housing may preclude individuals who want to return to New Orleans from doing so because they lack a place to live. This may, in turn, affect individuals' social ties, employment, and other factors—even for individuals who are able to return. Finally, the magnitude and permanence of a housing loss suggests that the psychological consequences of this experience may be profound and lasting.

Our finding that property loss was a major covariate of psychological distress in New Orleans contrasts to previous findings by Galea et al. (2007) who found that for metropolitan

New Orleans the effects of property loss were less important than the effects of physical illness/injury and physical adversity (which we did not measure). Galea et al. consider this finding of theirs to be highly unexpected. However, they did find similar results to ours—but only for areas outside of metropolitan New Orleans.

Limitations to this study include modest sample sizes, which affects the overall statistical power of the analysis as well as the ability to accurately identify the effects of certain less-common situations—such as pre-Katrina unemployment. Although cooperation rates were very high, low contact rates and possibly selective overall response rates in the DNORPS may affect the results in unknown ways. The results may also be affected by the use of the K6 psychological distress screening scale, rather than a diagnostic instrument, even though the K6 scale has been validated and widely used in previous research (Kessler et al., 2002; Kessler et al., 2003a). Finally, the mental health effects ascribed to housing loss may instead be accounted for other closely-associated—but unmeasured—factors caused by Hurricane Katina and its aftermath, such as a physical injury to the individual or a friend or family member or other adverse experiences. These limitations will likely be ameliorated in subsequent analyses based on new survey data now being designed that build on our experiences and results from DNORPS.

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Table 1. Summary of K6 Measure of Serious Mental Illness for DNORPS

Symptom	Time experienced symptom in past 30 days					
	None	A little	Some	Most	All	
Nervous	32%	15%	34%	9%	9%	100%
Hopeless	56%	13%	18%	7%	7%	100%
Restless/fidgety	42%	12%	24%	9%	13%	100%
Depressed	57%	15%	18%	5%	5%	100%
Everything an effort	29%	16%	33%	8%	14%	100%
Worthless	76%	7%	10%	2%	5%	100%

Table 2. Weighted Summary Statistics of
DNORPS Respondent Characteristics

Variable	Percent in category
Race	
Black	56%
White/other	44%
Education	
High school or below	65%
More than high school	35%
Age	
20–40 years	34%
40–64 years	47%
65+ years	19%
Sex	
Female	59%
Male	41%
Place of birth	
Louisiana	71%
Elsewhere	29%
Marital status (in 2005)	
Unmarried	59%
Married	41%
Employment status (in 2005)	
Employed	73%
Unemployed	9%
Out of labor force	17%
Housing tenure (in 2005)	
Owned	60%
Rented	40%
Housing damage	
Undamaged/livable	34%
Badly damaged/unlivable	66%
Number of observations	144

Table 3. Weighted Cross-Tabulations of Psychological Distress
by DNORPS Respondent Characteristics

| | Psychological Distress | | | | Design-based |
Variable	Non-case	Mild-moderate	Serious	Total	F-test statistic
Race					
Black	49%	19%	31%	100%	7.47***
White/other	75%	19%	6%	100%	
Income quartile					
Bottom quartile	40%	22%	38%	100%	3.54**
Top three quartiles	67%	18%	15%	100%	
Education					
High school or below	43%	27%	30%	100%	3.87**
More than high school	70%	15%	15%	100%	
Age					
20–40 years	70%	16%	14%	100%	2.07*
40–64 years	50%	19%	31%	100%	
65+ years	69%	25%	6%	100%	
Sex					
Female	54%	19%	27%	100%	2.94*
Male	71%	20%	9%	100%	
Place of birth					
Louisiana	55%	19%	26%	100%	3.09**
Elsewhere	74%	20%	6%	100%	
Marital status (in 2005)					
Unmarried	59%	15%	26%	100%	2.45*
Married	63%	26%	11%	100%	
Employment status (in 2005)					
Employed	66%	13%	22%	100%	5.86***
Unemployed	11%	49%	39%	100%	
Out of labor force	66%	31%	3%	100%	
Housing tenure (in 2005)					
Owned	61%	21%	18%	100%	0.25
Rented	60%	17%	23%	100%	
Housing damage					
Undamaged/livable	81%	11%	7%	100%	8.16***
Badly damaged/unlivable	50%	23%	27%	100%	
Full sample	61%	19%	20%	100%	

Table 4. Ordered Logistic Regression Estimates of Psychological
Distress Among DNORPS Respondents

Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
Race										
Black	3.63	(1.51)***	.	.	.	.	2.43	(1.09)**	0.85	(0.60)
White/other[†]	.	.	.	.	.	.	.	.	.	.
Income quartile										
Bottom quartile	.	.	3.15	(1.61)**	.	.	2.02	(1.13)	1.90	(1.28)
Top three quartiles[†]	.	.	.	.	.	.	.	.	.	.
Education										
High school or below	.	.	.	.	2.95	(1.25)**	1.82	(0.89)	2.66	(1.76)
More than high school[†]	.	.	.	.	.	.	.	.	.	.
Age										
20–40 years[†]	.	.	.	.	.	.	.	.	.	.
40–64 years	.	.	.	.	.	.	.	.	2.90	(1.63)*
65+ years[†]	.	.	.	.	.	.	.	.	.	.
Sex										
Female[†]	.	.	.	.	.	.	.	.	.	.
Male	.	.	.	.	.	.	.	.	0.50	(0.24)
Place of birth										
Louisiana	.	.	.	.	.	.	.	.	1.27	(0.85)
Elsewhere[†]	.	.	.	.	.	.	.	.	.	.
Marital status (in 2005)										
Unmarried[†]	.	.	.	.	.	.	.	.	.	.
Married	.	.	.	.	.	.	.	.	0.90	(0.51)
Employment status (in 2005)										
Employed[†]	.	.	.	.	.	.	.	.	.	.
Unemployed	.	.	.	.	.	.	.	.	1.86	(1.70)
Out of labor force	.	.	.	.	.	.	.	.	0.75	(0.54)
Housing tenure (in 2005)										
Owned[†]	.	.	.	.	.	.	.	.	.	.
Rented	.	.	.	.	.	.	.	.	0.83	(0.48)
Housing damage										
Undamaged/livable[†]	.	.	.	.	.	.	.	.	.	.
Badly damaged/unlivable	.	.	.	.	.	.	.	.	5.53	(3.19)***
Categories										
Cut 1	1.18	(0.33)***	0.71	(0.24)***	0.84	(0.27)***	1.34	(0.35)***	2.36	(0.79)***
Cut 2	2.20	(0.31)***	1.71	(0.27)***	1.85	(0.32)***	2.40	(0.35)***	3.62	(0.85)***
Model F-test (df)	9.67***	(1)	5.06**	(1)	6.59**	(1)	3.48**	(3)	2.79***	(11)

Notes: Dependent variable is has three ordered categories: (1) no psychological distress; (2) mild/moderate psychological
distress; (3) serious psychological distress
Jackknife standard errors in parentheses
† Reference category
*$p<.10$; **$p<.05$; ***$p<.01$

Figure 1. K6 Scores for DNORPS sample by Psychological Distress Categories