

Mental health impact of the 2010 Haiti earthquake on the Miami Haitian population: A random-sample survey

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This study examined the mental health consequences of the January 2010 Haiti earthquake on Haitians living in Miami-Dade County, Florida, 2–3 years following the event. A random-sample household survey was conducted from October 2011 through December 2012 in Miami-Dade County, Florida. Haitian participants (N = 421) were assessed for their earthquake exposure and its impact on family, friends, and household finances; and for symptoms of post-traumatic stress disorder (PTSD), anxiety, and major depression; using standardized screening measures and thresholds. Exposure was considered as “direct” if the interviewee was in Haiti during the earthquake. Exposure was classified as “indirect” if the interviewee was not in Haiti during the earthquake but (1) family members or close friends were victims of the earthquake, and/or (2) family members were hosted in the respondent’s household, and/or (3) assets or jobs were lost because of the earthquake. Interviewees who did not qualify for either direct or indirect exposure were designated as “lower” exposure. Eight percent of respondents qualified for direct exposure, and 63% qualified for indirect exposure. Among those with direct exposure, 19% exceeded threshold for PTSD, 36% for anxiety, and 45% for depression. Corresponding percentages were 9%, 22% and 24% for respondents with indirect exposure, and 6%, 14%, and 10% for those with lower exposure. A majority of Miami Haitians were directly or indirectly exposed to the earthquake. Mental health distress among them remains considerable two to three years post-earthquake.

Introduction

On January 12, 2010, Haiti was impacted by one of the most destructive natural disasters on record: a 7.0 moment magnitude earthquake followed by dozens of strong aftershocks. Detailed accounts of the distinguishing characteristics of this earthquake and its human toll can be found elsewhere.^{1–3} More than 222,000 Haitian citizens were killed and 300,000 sustained non-fatal injuries. Among 1.9 million persons who were displaced, 1.3 million were accommodated in improvised camps close to the zones of destruction and 600,000 sought refuge in rural areas. Nevertheless, these figures do not account for additional large numbers of persons experiencing psychological distress in regions of Haiti more remote from the epicenter, and members of the Haitian Diaspora living outside Haiti. Some of these individuals were directly exposed to the earthquake, as they were visiting their homeland at the time, and many others were indirectly but powerfully exposed through death or physical harm occurring to

family members or close friends. Some households in the Haitian Diaspora provided lodging for displaced persons, experienced depletion of financial resources and material assets as they helped stricken family and friends, or lost assets due to cascading effects throughout the Haitian economy.

The literature addressing the mental health consequences of the earthquake, both within and outside Haiti, continues to grow.^{1–14} Several prior studies have specifically documented psychological effects of the earthquake among Miami Haitian-Americans, who represent the largest group of the Haitian Diaspora.^{4,9,13,14} In the immediate aftermath (February–March 2010), a survey was conducted with convenience samples of English-speaking Haitian Americans and non-Haitian Americans living in Miami to assess indirect exposure to the earthquake in relation to symptoms of major depression, generalized anxiety, and psychological distress.^{4,13} Significant psychological effects were found only in the Haitian American subsample. The survey used a detailed battery of items to assess indirect exposures to

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death, injury, displacement, and loss sustained by primary family members, extended family members, and close friends who were in Haiti at the time of the earthquake. Structural equation modeling revealed robust and predictive relationships between scales of earthquake exposure (and, independently, measures of family/community connectedness to Haiti) and symptom levels of the common mental disorders assessed. Strengths of the study included its timeliness and very detailed exploration of indirect exposures. Limitations included small sample size, English language-only self-administration of the questionnaire, and absence of a scale assessing post-traumatic stress symptoms.

Another, larger study ($n = 506$) was also fielded in the early aftermath of the earthquake recruiting individuals from Miami's historic "Little Haiti" neighborhood.⁹ Data were collected as part of a community-based participatory public health research initiative. Specially trained bilingual (English, Haitian Creole) community health workers were able to canvass the neighborhood as they enrolled participants. Eligible subjects were Haitians who were not in Haiti during the earthquake. The survey asked respondents about earthquake-related losses and coping strategies, symptoms of post-traumatic stress disorder (PTSD), and symptoms of depression. Results showed pervasive worries about the earthquake throughout the Little Haiti community, active grieving for the losses of loved ones killed in the earthquake, dependence on support from local family and friendship networks, and higher rates of endorsement of PTSD and depression symptoms by women compared with men in the sample.

These two early studies benefited from their timeliness; both were conducted immediately post-impact. Because of their timing and sampling, these studies report only on short-term effects of indirect exposure to the earthquake. The hallmark of the smaller survey was the very detailed analysis of indirect exposure; the larger survey was notable for the close connection between the community and the study team. Limitations of both studies were the convenience sampling frames, the non-random sample selection, and the absence of participants who were in Haiti during the earthquake.

The study described here, the "Little Haiti Benchmark Survey and Post-Earthquake Needs Assessment," was conducted as part of a series of community-oriented health initiatives launched by the Florida International University (FIU) College of Medicine, in collaboration with the FIU Center for Substance Use and HIV/AIDS Research on Latinos in the United States (C-SALUD), targeting under-served populations located in North Miami-Dade County, Florida.¹⁵ This study enriches and complements findings from previous studies by examining the mental health consequences of exposure to the earthquake among Haitians living in Miami-Dade County 21 to 35 months after the event, a time frame that allows us to examine persistent psychopathology or symptoms that have appeared over time. Our study adds the methodological rigor of using a census-base sampling frame and a random selection of households. Furthermore, the study includes both directly and indirectly exposed participants and symptoms of 3 mental health outcomes: PTSD, generalized anxiety, and depression.

Material and Methods

Participant sampling

To guarantee cost-effective recruitment of Haitian households, the survey sampling frame focused on 20 census tracts in Miami-Dade County with a minimum of 30% Haitian households (based on year 2010 census data). The boundaries of these tracts were defined geographically using ArcGIS.¹⁶ With emphasis placed on enrolling subjects from the highest-density census tracts, the sampling frame did not conform precisely to the historical boundaries of the "Little Haiti" neighborhood.

Census data and the 2006 Miami-Dade County Property Layer were mapped onto the geographic boundaries of the selected census tracts to create a list of 21,140 residential addresses (single family homes and townhouses) suitable for sampling.¹⁷ From this universe, a randomly-selected sample of 1,800 addresses was generated.

Addresses were reviewed and 87 were found to be invalid addresses, vacant lots, or abandoned home sites, while 12 were businesses incorrectly classified as residential lots. These 99 invalid addresses were eliminated from the sample, but 68 of these were successfully replaced by using a random choice of a next-door, non-abandoned house. The remaining 31 households did not allow the investigators to follow the replacement methodology (e.g., corner lots, next door household already belonging to the random sample). The resulting sample therefore contained 1,769 households, of which a minimum of 530 (30% of 1,769) could be expected to be Haitian.

Interviewers

A team of 5 interviewers was hired from the targeted community. All interviewers had previous survey fieldwork experience. Interviewers received 5 weeks of intensive training on canvassing, participant recruitment, and interviewing techniques tailored to the survey questionnaire. Several training sessions were directly conducted by the investigators for the purpose of assisting interviewers to gain proficiency in the administration of the mental health instruments. These sessions incorporated extensive role-playing.

Household recruitment

To create awareness of the survey and facilitate interview acceptance, letters were mailed to all selected households, explaining the objectives of the survey and the subsequent community-oriented health initiatives. Interviews were conducted 2 to 4 weeks following the letter mailing, between October 2011 and December 2012. Interviewers were pair-teamed and canvassed the area in successive waves. A household was deemed unreachable if no interview could be completed within 11 contact attempts.

Interview data collection

Data were collected via face-to-face interviews that lasted 90 minutes on average. Participants were interviewed in Creole, French, or English, depending on their usual or preferred language. They provided an informed consent prior to interview.

Participant demographics

The household survey included a battery of demographic questions including household composition, age, gender, Haitian ethnicity, financial and housing situation, and number of years of residence in the home where the interview was conducted.

Earthquake experiences

Specific to the 2010 Haiti earthquake, the survey included a set of questions regarding participants' earthquake experiences. Respondents were asked whether they were in Haiti during the earthquake and whether direct and indirect family members or close friends had been killed or injured. Respondents were asked about earthquake-related losses of job, assets, or economic resources. One item asked whether the interviewee had hosted earthquake survivors who were displaced from Haiti in their Miami home.

Classification of earthquake exposure severity

Earthquake exposure severity was categorized as "direct" if the interviewee was in Haiti during the earthquake. Exposure was classified as "indirect" if the interviewee—who was not in Haiti during the earthquake—(1) had family members or close friends who were direct victims of the earthquake, and/or (2) hosted earthquake survivors in the Miami household, and/or (3) sustained loss of assets or jobs because of the earthquake. The residual category, "lower" exposure, was reserved for respondents who did not meet criteria for either direct or indirect exposures. Classification into a higher category took precedence over possible classification into a lower category; therefore, exposure categories were mutually exclusive.

Assessment of symptoms of common mental disorders

Validated screening measures were used to assess the participant—at time of interview—for symptoms of posttraumatic stress disorder (PTSD), generalized anxiety, and depression. The Post-traumatic Checklist – Civilian (PCL-C) was used to assess symptoms of PTSD.^{18–20} Symptoms of generalized anxiety were assessed using the Beck Anxiety Inventory (BAI).^{21–23} Symptoms of depression were measured using the Center for Epidemiologic Studies – Depression scale (CES-D).^{24,25} The threshold criteria used to designate elevated symptoms levels were the following: PCL-C ≥ 44 , BAI ≥ 26 , and CES-D ≥ 16 . Fulfillment of DSM-5 criterion A for PTSD²⁶ was derived from earthquake exposure variable; the criterion was considered as fulfilled if the participant was in at least one of the following situations: (1) in Haiti during the earthquake, within 20 km of Port-au-Prince (epicenter); (2) having been physically harmed by the earthquake; (3) having family member(s) who were victims (killed or harmed) of the earthquake; (3) having close friend(s) who were victims of the earthquake.

Data analysis

Proportions of participants above the thresholds (PCL-C ≥ 44 , BAI ≥ 26 , and CES-D ≥ 16) were examined as a function of exposure level using test for trends (Spearman non-parametric correlation coefficient). Logistic regressions were used to adjust for confounding factors. Analyses were performed using SPSS

(Statistical Package for the Social Sciences) version 19.0²⁷ and the R statistical software.²⁸

Results

Survey respondents

From the 1,769 households comprising the random sample, 634 (35.8%) declined to participate and 184 (10.4%) could not be reached and interviewed within 11 contact attempts, resulting in 951 completed surveys (53.8%). Ethnicity of household could be ascertained only after the interview had started. Among the 951 completed surveys, 421 (44.3%) were conducted in Haitian-American households. Surveys from these 421 households comprise the sample analyzed in this article. Within these households, 78% of interviews were conducted in Haitian Creole, 20% in English, and 2% in French.

Respondent demographics

The mean age was 47 y and the majority of participants (61%) were women (Table 1). About half (55%) of respondents were married or living with a partner and less than half (43%) had completed education beyond high school. Fifty-nine percent were employed full or part time; however, 64% had household incomes below \$30,000 USD per year. Half (53%) had been living in their current home for at least 10 y

Earthquake exposure status

Information was available to determine exposure status for 410 of 421 participants (97%). Among these, 31 (7.6%) were classified as having direct exposure, 257 (62.7%) had indirect exposure, and the remaining 122 (29.8%) had lower exposure. Increasing intensity of exposure was significantly associated with younger age and fewer years of residence in the current home, and approached significance for higher likelihood of being married or living with a partner (Table 1). Of the 257 participants with indirect exposure, 248 (97%) met DSM-5 criterion A for PTSD. Among the 31 participants who were in Haiti during the earthquake (Direct exposure group), 20 were within 20 km of Port-au-Prince, and 11 were farther away, but all met criterion A for PTSD.

Symptoms of common mental disorders

Table 2 displays consistent findings of increasing percentages of respondents exceeding threshold for symptoms of PTSD (PCL-C ≥ 44), generalized anxiety (BAI ≥ 26), and depression (CES-D ≥ 16) with increasing intensity of exposure (from lower to indirect to direct). Tests for trend were significant for each of the 3 measures examined individually. When considering participants having symptom elevations for at least one of the 3 common mental disorders, the gradient in percentages by exposure category (lower: 18%; indirect: 31%; direct: 55%), and the corresponding test for trend ($P < .000$), were particularly strong. For participants with indirect exposure, performing these analyses with restriction to fulfillment of DSM-5 PTSD criterion A, did not change the results (data not shown).

Table 1. Sample Demographic Characteristics by Exposure Status (Column Percents Except for Age, and Test for Trends *P*-values)

	Exposure Status			Test for trend <i>p</i>	TOTAL N = 410 %
	Lower N = 122 %	Indirect N = 257 %	Direct N = 31 %		
Age (Mean)	50	45	45	.023	47
Gender					
Male	39	39	48	.600	39
Female	61	61	52		61
Marital Status					
Married/Living with Someone	51	54	80		55
Single	28	25	10	.051	25
Separated, Divorced, or Widowed	21	20	10		20
Educational Attainment					
Less than High School	34	21	33		25
High School or Equivalent	30	32	40	.304	32
Above High School	36	47	27		43
Household income					
Less than \$30,000	70	60	83		64
\$30,000 – \$49,999	19	31	11	.909	26
\$50,000 and over	11	9	6		10
Employment					
Full time	40	49	39		45
Part time	12	13	19	.139	14
Not Employed	30	23	36		26
Retired	18	15	6		15
Duration of living in USA					
Less than 10 years	37	48	77		47
10–19 years	39	31	13	.002	32
20 y and over	24	21	10		21
Language elected for the survey					
Creole	93	78	77		78
English	7	20	21	.162	20
French	0	2	2		2

These trends by exposure status were confirmed by the logistic regression analyses adjusted for age (Table 3). Neither living with a partner nor having lived in the current home for more than 10 y was significantly associated with symptom elevations for any of the common mental disorders once age was entered into the models. The same was true for language. Language was not an effect modifier when tested as such in these models.

Significant differences were found between the lower and direct exposure groups for each of the 3 symptom scales (and for exceeding threshold on at least one measure). Significant differences were found between the lower and indirect exposure groups for the generalized anxiety and depression symptom scales (and for exceeding threshold on at least one measure)—but not for PTSD symptoms. Significant

differences were found between the direct and indirect exposure groups for depression symptoms and for exceeding threshold on at least one of the 3 measures.

Discussion

Significance of survey findings

The study findings demonstrate the pervasiveness of exposure to the 2010 Haiti earthquake among Miami Haitians accessed through a community-based survey with a census-based sampling frame. To find that 71% of respondents, enrolled using a representative sample of households, experienced indirect (63%) or direct (8%) exposure to the earthquake is a testament to both the

Table 2. Health Status by Exposure

	Exposure Status			Test for trend <i>p</i>	TOTAL N = 410 %
	Lower N = 122 %	Indirect N = 257 %	Direct N = 31 %		
PCL-C \geq 44	6	9	19	.043	9
BAI \geq 26	14	22	36	.005	21
CESD \geq 16	10	24	45	.000	21
At least one above condition	18	31	55	.000	29

Table 3. Logistic Regression Analysis of Health Status by Exposure, Adjusted for Age: Odds Ratios (OR), 95% Confidence Intervals (CI), and *P*-values

	Exposure Status			<i>p</i> -values		
	1 Lower N = 122 (ref. group)	2 Indirect N = 257 OR [95% CI]	3 Direct N = 31 OR [95% CI]	2 vs. 1	3 vs. 2	3 vs. 1
PCL-C ≥ 44	1 (ref.)	1.6 [0.7–4.9]	4.0 [1.3–13.2]	.295	.070	.021
BAI ≥ 26	1 (ref.)	2.0 [1.1–3.8]	4.1 [1.6–10.2]	.024	.096	.003
CESD ≥ 16	1 (ref.)	2.9 [1.5–5.7]	7.8 [3.1–20.0]	.002	.011	.000
At least one above condition	1 (ref.)	2.3 [1.3–4.0]	6.8 [2.8–16.3]	.004	.007	.000

severity of the disaster and the degree of connectedness of the Miami Haitian Diaspora to its homeland in Haiti. Indeed, one-third of indirectly-exposed respondents, and more than half of directly-exposed interviewees, had elevated symptom levels for at least one of the 3 common mental disorders assessed (PTSD, generalized anxiety, depression).

Our findings regarding the proportions of persons with PTSD symptoms (9% overall, based on 6% of lower exposure, 9% of indirect exposure, and 19% of direct exposure interviewees) are consistent with other studies conducted 2–3 y following a natural disaster.^{29,30} While PTSD is the most commonly studied mental disorder in the post-disaster context,^{30,31} psychiatric co-morbidities are commonly documented in the aftermath of a psychological trauma.^{30–40} In this study, substantial proportions of interviewed participants exceeded threshold values for generalized anxiety and depression symptoms as well as for PTSD.

The study effectively examined the relationship between severity of exposure to the earthquake and a range of psychopathological consequences, documenting a robust dose-response relationship. This dose-effect relationship between exposure and symptoms of common mental disorders aligns well with the consistent finding across a broad spectrum of disasters that the likelihood of adverse mental health effects increases with intensity of exposure.^{30,32,33,36,40–48}

Of particular interest was the finding that both direct and indirect exposures were strongly predictive of elevated symptom levels in the logistic regression analysis. Therefore, indirect exposure alone, reflecting the experience of the majority of the members of the Miami Haitian Diaspora community, was sufficiently powerful to elevate symptom levels of multiple common mental disorders above threshold and these elevations persisted for 2–3 y post-impact in many cases. This is in line with other studies and commentaries suggesting that indirect exposure is indeed an important contributor to post-disaster mental health disorders.^{30,49–52}

Survey strengths

The present study contributes a longer time perspective and considerable methodological rigor to the understanding of the mental health of Miami Haitian-Americans following the 2010 Haiti earthquake. Importantly, the sampling frame for this study was defined by objective census-based data, with random selection of households. It was developed before, and independent of, the earthquake event. The timing of the survey, conducted 2–3 y post-earthquake, allowed investigators to examine mental health issues of more protracted duration. A unique feature that

distinguished this survey from those conducted in the immediate aftermath^{4,9,13} was the inclusion of a subgroup of participants who had been in Haiti during the earthquake.

As part of a larger community-based research enterprise, questionnaires were available in multiple languages in order to obviate the common selection bias due to language barrier that is inherent in many community surveys. Surveys were conducted in Creole, French, and English for participants included in this special analysis, allowing interview respondents to participate in the language of their choice.

Survey limitations

As an add-on to a large-scale community population survey process, an important limitation was the restricted number of earthquake exposure items that were included in the questionnaire. Furthermore, the exposure categories (direct, indirect, lower) were based on information collected several years after the event, leaving room for memory bias and possible influence of mental condition (PTSD, anxiety, depression) on the recollection process. The limitation for the direct exposure category is its small size (N = 31). The limitation for the indirect exposure category was the joining of several distinct and disparate types of experiences (death or harm to family or friends, hosting an earthquake survivor in the home, financial losses) into a single exposure category; however, almost all participants classified as indirect (97%) met the exposure criterion A for PTSD.

Because Haitians have culture-specific ways of living through and expressing mental pain,^{11,12,53–63} it is important to consider whether the western instruments used were appropriate. These instruments have not been validated in Haitian populations or any Creole-speaking community, although PCL-C and CES-D have already been used in adult Haitians.^{5,6,64} For example, because Haiti has few mental health services, and mental illness is stigmatized, psychological symptoms are likely to be underreported by participants. Likewise, the central role of religion within all spheres of life in the Haitian culture, including health, emotional, and psychological problems,^{1,11,12,53} might diminish the likelihood that respondents would speak openly about their psychological pain with a lay interviewer who is grounded on a western, academic approach to mental health matters. This possibility may have been partially offset by the purposeful selection of interviewers of Haitian origin and by the duration of US residence of the participants (more than half had been living in their current US home for at least 10 years). Language of administration was neither a confounder nor an effect modifier in our multivariate analyses.

Another study limitation was the non-random selection of respondents within each household. This survey was inserted into an ongoing series of household surveys; as such, and in efforts to maintain survey comparability and keep costs at expected levels, it was not possible to alter the methodology. However, because the present analysis focused on classification by exposure category—and exposure was likely to be shared by all members of a given household—the within-household selection bias was minimized. Moreover, the survey was described as a general health survey without mention of the earthquake or mental health questions. Still, self-selection of respondents cannot be excluded; for example, the over-representation of women in our study might have yielded higher rates of symptoms of PTSD, generalized anxiety, and depression, because women (Haitian and non-Haitian) tend to report higher levels of these symptoms than men.^{5,6,9,14,31,41} Likewise, we cannot exclude selection bias introduced by non-responding households: 36% declined to participate and 10% were unreachable. Both rates of non-participation are in the low end of the range of recent health surveys,⁶⁵⁻⁶⁹ and empirical evidence has shown that response rate is a weak predictor of non-response bias.^{65,70-75} Because ethnicity of households was assessed once the interview had started, we could not determine these rates among Haitians only.

The survey was conducted in Miami-Dade County of Florida, home to the largest Haitian immigrant population in the United States.^{4,76,77} The sampling frame was limited to areas with a high population density of Haitian-Americans ($\geq 30\%$). Although study findings may not generalize precisely to the remainder of the Haitian Diaspora, the importance of studying the Miami Haitian community, representing the largest concentration of Haitians outside Haiti, is apparent.

Conclusions

This representative population survey elucidated the pervasive nature of both direct and indirect exposure of Miami Haitians to

the 2010 Haiti earthquake and documented a robust dose-response relationship between intensity of exposure and symptom levels for common mental disorders. Even 2–3 y post-disaster, the mental health needs throughout the Miami Haitian community are compelling, suggesting the necessity for provision of mental health services and dedicated research that evaluates treatment needs and efficacy, as well as longer-term consequences of the earthquake.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

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Ethical standards

The study was approved by Florida International University (FIU) Internal Review Board. All participants gave informed consent prior to their inclusion in the study.

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