



Master of Public Health

Master international de Santé Publique

Mental Illness and Resilience following the Haiti Earthquake: An Initial Assessment

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EHESP MPH M2, 2010

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ACKNOWLEDGEMENTS

The work for this practicum was completed at the Columbia University Mailman School of Public Health in New York, NY, and in Port-au-Prince, Haiti, under the supervision of Dr. Moïse Desvarieux.

Dr. Moïse Desvarieux and Dr. Sandro Galea are the co-Principal Investigators of this study. Co-Investigators include Dr. Claude Péan, Medical Director of Institut Fame Pereo, and Magdalena Paczkowski, from the Department of Epidemiology, Columbia University. This study was funded by the Columbia University Mailman School of Public Health.

This practicum was completed as part of the M2 year of my Master of Public Health degree at École des Hautes Études en Santé Publique, in Paris, France.

For the duration of my Master of Public Health degree, I have been funded by the University of Alberta, Canada, as a resident physician in Emergency Medicine.

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ABSTRACT

INTRODUCTION

The magnitude 7.0 earthquake which struck Haiti on January 12, 2010, left more than 3 million people directly affected in its aftermath.¹ More than 200 000 were killed, and injury and displacement were common among survivors.³ Levels of Posttraumatic Stress Disorder (PTSD) and Major Depressive Disorder (MDD) are elevated amongst survivors of disasters.¹⁷ However, the majority do not develop disease- they are known as “resilient.”⁶⁹ We assessed (1) the prevalence of PTSD, MDD and resilience and (2) the factors predictive of these outcomes, in a population-based sample in Port-au-Prince starting 2 months post-earthquake.

METHODS

A structured interview, which included the PTSD Checklist (PCL) and Patient Health Questionnaire-9 (PHQ9), was administered to a randomly selected sample of 1323 survivors in 3 frames: community, camp and clinic. Data analysis (not conducted by the MPH student) assessed the prevalence of PTSD, MDD, and resilience. Bivariate analysis was used to identify risk and protective factors associated with PTSD and MDD.

RESULTS

PTSD and MDD were found in 14.2% and 16.2% of the sample, respectively. Greater than 98% of the sample endorsed subthreshold symptoms. Resilience to PTSD was found in 24.4% and to MDD in 18.4%. Several demographic and pre-, peri- and post-earthquake factors were associated with increased or decreased resilience to PTSD and MDD.

DISCUSSION

The prevalences of PTSD and MDD were found to be consistent with the post-disaster literature.¹⁷ The prevalence of resilience was relatively low. The level of subthreshold mental illness was high in this sample, which may reflect the underlying vulnerability of the population, the widespread earthquake-related exposure, and the difficult post-earthquake environment. Risk and protective factors identified here provide valuable insight for future research and for the planning of population-wide interventions designed to support resilience and recovery in affected Haitians over time.

EXTRAIT

INTRODUCTION

Le tremblement de terre d'une magnitude de 7.0 qui a frappé Haïti le 12 janvier 2010 a directement affecté une population de plus de 3 millions d'individus. Plus de 200 000 personnes sont mortes, et de nombreux survivants ont été blessés ou déplacés. Le niveau de stress post-traumatique (SPT) et de troubles dépressifs majeurs (TDM) est élevé dans les populations confrontées à des désastres. Toutefois, la majorité des populations touchées ne développent aucun trouble. Ces populations sont dites « résilientes ». Cette étude évalue la prévalence du SPT, la prévalence des TDM, le niveau de résilience, et les facteurs pouvant prédire ces résultats. Elle porte sur un échantillon randomisé de population basée à Port-au-Prince, étudié entre deux et trois mois après le tremblement de terre (soit du 12 mars au 20 avril 2010).

METHODES

Un questionnaire structuré incluant la checklist PTSD (PCL) et le questionnaire de la santé du patient (PHQ9) a été utilisé sur un échantillon de 1 323 personnes choisies au hasard dans trois contextes différents : communautés, camps, établissements de santé. Les données ont été analysées (non-réalisée par l'étudiant du MPH) afin d'évaluer la prévalence du SPT, des TDM et de la résilience. Une analyse bivariée a été utilisée pour identifier les facteurs de risque et les facteurs protecteurs associés au SPT et aux TDM.

RESUTATS

Un SPT et des TDM ont été identifiés pour, respectivement, 14.2% et 16.2% de l'échantillon. Plus de 98% de l'échantillon présente des symptômes proches du seuil de maladie. La résilience au SPT a été observée dans 24.4% des cas, et dans 18.4% des cas pour les TDM. Plusieurs facteurs démographiques, ainsi que plusieurs effets pré-péri- et post- tremblement de terre ont été associés à des variations – à la hausse et à la baisse – du niveau de résilience au SPT et aux TDM.

DISCUSSION

Les prévalences de SPT et de TDM observées sont cohérentes avec les éléments de littérature portant sur les réactions post-catastrophes. La prévalence de la résilience est relativement basse. Le volume de la population présentant des symptômes proche du

niveau de maladie mentale est élevée dans cet échantillon ce qui peut souligner la vulnérabilité globale de la population étudiée, l'étendue de l'impact du tremblement de terre sur l'île et les difficultés rencontrées dans l'environnement post-catastrophe. Les facteurs de risque et les facteurs protecteurs listés dans cette étude constituent des axes pouvant orienter de futures recherches sur le sujet et pouvant appuyer l'organisation des interventions auprès des populations d'Haïti afin de renforcer le niveau de résilience et d'accélérer les guérisons.

KEYWORDS

Haiti, Earthquake, Disaster, Posttraumatic Stress Disorder (PTSD), Major Depressive Disorder (MDD), Mental Health, Resilience.

ABBREVIATIONS

ASD	Acute Stress Disorder
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders (Version IV)
IFP	Institut Fame Pereo
IRB	Institutional Review Board
MDD	Major Depressive Disorder
PCL	PTSD Checklist
PHQ9	Patient Health Questionnaire 9
PTSD	Posttraumatic Stress Disorder
SCID-IV-R	Structured Clinical Interview for DSM-IV Research Version
WFP	World Food Programme
WHO	World Health Organization

INTRODUCTION

The Earthquake and its Immediate Aftermath

January 12th, 2010, Haiti was struck by an earthquake with a magnitude of 7.0. Since the initial event, at least 59 aftershocks of a magnitude of 5.0 or greater have been recorded.¹

Haiti has a land area of roughly 14000 square miles and a population of roughly 9.8 million persons. The majority of this population is densely concentrated in coastal and urban areas, with an estimated 1.9 million people living in the 15-square-mile Port-au-Prince metropolitan region.² The epicenter of the earthquake was only 15 miles southwest of Port-au-Prince¹, meaning that more than 3 million persons were directly affected. The current death toll exceeds 200 000 and more than 300 000 have suffered significant physical injury.³ Structural collapse was widespread. Some neighbourhoods of the capital suffered near-total destruction. Of the estimated 411 000 homes in the region², 97 000 homes were destroyed, and a further 189 000 damaged.¹ More than 2 million persons have been displaced from their homes. Of these, roughly 1.7 million have taken shelter in an estimated 1300 local camp settlements, and 600 000 persons have departed the Port-au-Prince area.⁴

This earthquake, the worst to hit Haiti in over 200 years⁵, is one of the most devastating natural disasters of the past century. Health facilities, both those pre-existing and those set-up as part of a multiagency, multinational relief effort, were overwhelmed by the hundreds of thousands who needed acute care for serious.^{6,7} Over time, medical needs have transitioned to those related to gastrointestinal, respiratory, vector-borne and vaccine-preventable diseases.^{7,8} To date there still remain unmet needs for even the most basic of entities, including shelter, food and food security, potable water, sanitation, and protection from violence.⁸

Haiti before the Earthquake

Prior to the earthquake, Haiti's population was already considered highly vulnerable and at-risk. Haiti is the poorest country in the Western Hemisphere. Most Haitians lived on

less than \$2 per day, and half lived below the extreme poverty line (less than \$1 per day).⁹ Approximately 18% of the population had no schooling at all, and while 20% had some secondary education only 2% completed post-secondary training.² Among those of working age, 58% of females and 36% of males were unemployed.²

Haiti ranked 138th among countries in the 2006 WHO health system rankings. The relative rates of HIV/AIDS, tuberculosis and malaria are significantly higher than those in other countries in the region. Life expectancy, prior to the earthquake, was estimated at 61 years.¹⁰ Mortality before age of 5 was high at 76 per 100 000.¹¹ Only 40-60% of Haitians had access to basic health care¹², and less than 25% reported that they would be able to access hospital care in the event of severe illness or accident.²

Lack of housing was a significant issue even before the earthquake: 31.4% of individuals lived in households with more than 7-10 people, and 46% of families lived in single room dwellings.¹² Further, 70% of the urban population lived in slum conditions¹³ and 50% had no direct access to running water or sanitation facilities.²

Such deplorable living conditions and alarming health crises are the result of both natural and human causes that have brutalized the country for years.^{9,12,13} Because of its geographical location, Haiti experiences yearly tropical storms and hurricanes that often leave many dead or displaced. In addition, political unrest, violence and human rights abuses have crippled the Haitian population.¹⁴

Disaster and Mental Health: Background Science

Between 1991 and 2005, natural disasters affected 3.5 billion and killed more than 960 000 persons worldwide. Natural disasters are distributed globally, but the burden of death and destruction is borne disproportionately by developing countries.¹⁵ Since the beginning of the twentieth century, earthquakes have killed more than 2.7 million people. Of these, roughly 75% of the earthquakes and 85% of the associated deaths occurred in developing nations.¹⁶

Disasters, by their very nature, are acute and unexpected events. Those affected are confronted with a threat to their life and well-being, and as such are likely to experience

fear, horror and helplessness. As evidenced by the earthquake in Haiti, loss of life can be widespread. In those who survive, loss of loved ones is extremely common, as are injury and a host of other traumatic experiences. Resources such as homes, jobs, and social networks are lost. In the aftermath, survivors are forced to adapt to a seemingly unsafe and unpredictable environment in which they are confronted by a multitude of secondary stressors including displacement, lack of access to food and water, and exposure to violence.¹⁷

Given the traumatic nature of the experience, it is not surprising that natural disasters cause psychological morbidity and, in fact, have contributed significantly to the global burden of mental illness.¹⁸ Grief and behavioural changes are common and are expected in the immediate aftermath and the short-term thereafter.¹⁹ Research suggests, however, that disaster-related morbidity carries over to affect lifetime pathology in roughly 34% of individuals.^{20,21} This is significantly higher than the background prevalence of 25% in unaffected populations.²²

Over the past several decades, a growing body of research has focused on describing and quantifying mental illness in the aftermath of disasters.¹⁷ Post Traumatic Stress Disorder (PTSD) and Major Depressive Disorder (MDD), are felt to be the most prevalent disorders arising in the post-disaster setting, and as such have been studied most frequently.^{20,21,23}

Both PTSD and MDD are formal Diagnostic and Statistical Manual of Mental Disorders IV (DSM IV)²⁴ diagnoses. Those who develop PTSD have suffered a traumatic experience and exhibit symptoms from three primary symptom clusters: re-experiencing, avoidance or numbing, and hyperarousal. These symptoms must persist for more than one month and cause significant distress or functional impairment.²⁴ Background estimates for PTSD are 3% over 12 months and 6-9% lifetime.²⁵ PTSD is the most commonly diagnosed mental illness in the disaster-affected population, but rates of PTSD vary across studies.¹⁷

Major Depressive Disorder is the second most common mental health disorder in the post disaster setting.²⁰ Intense sadness is common among survivors of any major disaster, especially among those who are bereaved. However, what differentiates those

with Major Depressive Disorder from those exhibiting a response within the normal spectrum is that their symptoms persist and are function-impairing.²⁴ Evidence suggests that the one-year prevalence of MDD is roughly 7%.²⁶ In post-disaster settings, however, the prevalence has been shown to be much higher.²⁰

Many risk factors have been described for the development of PTSD and MDD in the post-disaster setting.¹⁷ These factors can be categorized as pre-event, peri-event and post-event. Pre-event factors found to increase risk for both MDD and PTSD include prior personal or family history of a mental health disorder, and history of exposure to traumatic events and life stressors.^{27,28} Peri-event factors correlated with development of PTSD and MDD are related to the intensity of the exposure itself. Examples of such exposures include loss of family members or close friends²⁹, difficulty in contacting loved ones³⁰, degree of injury³¹ and witnessing of dead bodies.³² Post-event factors related to development of PTSD and MDD are associated with loss of financial and social support resources.^{33,34} In addition, specific groups have been widely found to be at higher risk for PTSD and MDD post-disaster, including women, marginalized populations (for example, those of low socioeconomic status and racial/ethnic minorities), and those with cognitive or physical disabilities.^{20,35} Children and the elderly have been inconsistently found to be at greater risk.¹⁷

While the factors listed above are felt to contribute differentially to the development of PTSD and MDD³⁶, there seems to be considerable overlap in instigating factors and symptoms. A high degree of comorbidity exists between PTSD and MDD. In one sample, 50% of those with PTSD were found to meet criteria for MDD.²⁵ Those with multiple conditions are more likely to have a chronic course and worse overall outcomes.³⁷

While many develop psychopathology as a result of a traumatic exposure, the majority does not. These people are described, in the literature, as being *resilient*.³⁸ Resilient individuals may develop some symptoms, but these symptoms are generally transient and do not interfere significantly with daily function.³⁹ In disaster studies, the proportion of the population found to be resilient is generally at least 50%.¹⁷ Resilience likely represents a healthy course of adjustment, and those resilient to PTSD are also unlikely to develop other mental health disorders.³⁸ Although previous research on disaster

mental health has focused on risk factors for the development of mental illness, a growing body of research has begun to focus on resilience and its determinants. Understanding resilience may allow psychological intervention to better mitigate the mental health consequences in the post-disaster setting.

Many differences in the rates of mental illness seen post disaster are also related to the pre-disaster prevalence of (1) mental illness and (2) previous traumatic exposures.⁴⁰ As such, the situation in Haiti is particularly worrisome. Poverty, insecurity, violence, political unrest and human rights abuses have been among the traumatic exposures faced by the vulnerable Port-au-Prince population over the past decade.¹⁴ In recent surveys, 40% and 70% of Haitian youth and women, respectively, have been exposed to violence.⁴¹ Given this high exposure, there is reason to expect that the prevalence of mental illness could be high. However, the prevalence of pre-disaster psychiatric illness in Haiti is not clear.⁴² This is not surprising given that only 2 hospitals and 10-15 psychiatrists in the whole of the country offered psychiatric services prior to the earthquake.⁴¹

Given what is known about mental illness after disasters, the massive impact of the earthquake in Haiti, and the vulnerability of the population that was affected, it is predicted that the ongoing mental health needs of the population will be significant.

The aims of this study were to design and administer a rapid mental-health assessment to (1) elucidate the prevalence of PTSD, MDD and resilience and (2) to determine the risk and protective factors associated with illness or resilience. This study was conducted as a cross sectional mental health survey administered in a representative population-based sample of survivors in the third and fourth post-earthquake months.

METHODS

As an MPH practicum student, I was invited to participate in this study, and contributed to its design and implementation as part of a larger study team (see Appendix A for specific roles). This included working as the liaison between the Haitian study team, headed by the director of the Institut Fame Pereo (IFP) health clinic, and the principal investigators at Columbia University in New York, to oversee the administration of the project in Haiti. Statistical analysis was carried out by the team in New York to facilitate expedited submission for publication.

This study was approved by the Institutional Review Board (IRB) at Columbia University. The protocol was reviewed by the administration of Institut Fame Pereo and the Haitian Ministry of Health.

Sampling Methods

The sampling area chosen was the previously-delineated catchment region for Institut Fame Pereo, a community health clinic in the BelAir-Nazon neighbourhood of Port-au-Prince (Appendix B). Over the course of 6 weeks (beginning March 12), a population-based, random sample of survivors was obtained in 3 sampling frames: (1) displaced survivors living in official displacement camp sites, (2) undisplaced survivors living within the community, and (3) clinic-going survivors at a local health clinic. 1250 participants were sought, with a minimum of 500 from camps, 500 from the community, and 250 from the clinic. Based on available data and information, this sample was estimated to represent approximately 5% of the post-earthquake adult population within the area. Data from previous studies suggested a response rate of 95% should be anticipated.⁴³ Eligible individuals included those 18 years of age and older who were present in the earthquake-affected zone at the time of the event and for at least the preceding one month. Written consent was obtained using an IRB-approved consent form translated into Haitian Creole.

To obtain the community sample, an attempt was made to identify previously existing primary sampling units within the IFP catchment area. However, adequate maps and census data for this area were limited prior to the earthquake, and access to available

information could not be obtained in the post-earthquake environment. As such, a comprehensive map of the area was compiled by merging preexisting open-source maps and conducting an on-ground assessment. Existing neighbourhoods within the defined urban catchment area were block-listed, and primary sampling units were created by dividing the catchment area map into a grid comprising 32 zones, each of roughly 500 square meters. Of these zones, 16 were randomly selected using ProcSurvey select in SAS.⁴⁴ The sampling proportion was equal across all zones with 32 persons sampled from each. From a predetermined starting point within each of the selected zones, interviewers approached a candidate to interview at each 7th extant dwelling on their left hand side (temporary shelters were included). If the dwelling was destroyed, or if there were no eligible persons within, the adjacent dwelling was selected. In cases where more than one eligible respondent existed in a particular dwelling, the individual with the birthday closest to the date of interview was selected.

The displaced persons camp sample was obtained by randomly selecting 4 of the 8 official displacement sites within the IFP catchment area as recognized by the World Food Programme (WFP). The number of respondents sampled from each camp was weighted based on the published camp census.⁴⁵ Interviewers chose a central starting point within each camp, and approached an individual to interview at each 3rd shelter on their left hand side. If there was not an eligible person at this location, a person was approached at the adjacent shelter. Again, in cases where more than one eligible respondent was present in a particular dwelling, the closest birthday method was used. Sampling in both community and camp frames was conducted 7 days per week, during varying times of the day.

A systematic clinic sample was obtained by approaching every 3rd patient to register for care at Institut Fame Pereo (IFP). IFP sees three patient populations in roughly equal proportions with a random, drop-in visit pattern: general community medicine, dermatology, and HIV (Dr. Claude Péan, personal communication). Sampling from the clinic took place on all weekdays and during all operating hours.

Survey Instrument

A structured questionnaire, based on previously used and validated measures, was designed and used to conduct in-person interviews. This instrument aimed to assess key measures and constructs relevant to post-disaster mental illness, including: (a) demographic and socioeconomic variables, (b) experiences during and after the earthquake, (c) post-earthquake social support, (d) lifetime traumatic events, (e) earthquake related PTSD, and (f) earthquake-related MDD.

Demographics included: age, sex, marital status, education and pre- and post-earthquake employment status. Age was divided into a binary variable based on the youngest tertile, while a binary education variable was created based on completing secondary education or not. A binary employment variable was created based on the employment status of the respondent or their head of household prior to and after the earthquake (if the respondent or head of household was employed prior to the earthquake but not after, he/she was coded as having lost income as a result).

Information on earthquake-related experiences, including damage to home, length of separation from love ones, injuries to self, injuries and deaths of relatives and close friends, witnessing of dead bodies, and involvement in rescue/recovery effort was collected. Damage to the home was then dichotomized as uninhabitable (destroyed or severe damage) or habitable. Death of relatives and close friends was assessed in four separate questions, and responses were combined to create four categories of univariable response-type statistics.

Post-earthquake social support was assessed using 4 items from the Inventory of Post-Disaster Social Support. This instrument assesses the emotional, informational, and tangible help received from family and friends post-earthquake.⁴⁶ Specifically, respondents assessed how often they were in contact with family members they did not live with and how often family members lent money, gave comfort or affection, or provided information on how to do something. A binary variable of post earthquake social support was created by designating the lowest tertile of the summed support scores as representative of low post-disaster social support.

Lifetime trauma was assessed by asking about lifetime history of 15 DSM-IV category A traumas.^{24,47} The scale was modified by the addition of history of having been kidnapped as a response type, as this was reported to have been a relatively common past trauma in this population.⁴¹ Traumatic experiences were summed and a binary measure of lifetime trauma was created by taking the top quartile (history of five or more traumatic experiences) as being indicative of high lifetime trauma.

PTSD was assessed using the 17-item PTSD Checklist (PCL). In this checklist respondents indicate, on a 5-point scale, the degree to which they have been bothered by each of the 17 DSM-IV PTSD symptoms in the past month. PTSD cases were defined by using a PCL symptom cut-off of 3 or greater for each question, and then applying DSM criteria A through F.²⁴ The PCL has been shown to have high validity, internal consistency and test-retest validity, and research supports its use in diverse populations.^{48,49}

Major Depression was assessed using the 9-item Patient Health Questionnaire 9 (PHQ-9). Respondents rate their severity of each of the 9 DSM-IV depression symptoms on a 4-point scale over 2 weeks in the past month. MDD cases were defined by applying DSM-IV criteria²⁴, but we modified the criteria by increasing the number of symptoms required from five to seven, as population psychopathology was high. Although relatively new, this instrument has been well validated and has good one-to-one correspondence with the DSM-IV diagnosis of Major Depression.^{50,51}

We defined Resilience to PTSD as having no more than five PCL symptoms (with a severity cut-off of 3 or greater) and having neither psychological distress nor functional impairment. We defined resilience to MDD as having no more than four PHQ-9 symptoms and no functional impairment.

Clinical Reappraisal

In order to validate the survey instrument in its ability to diagnose PTSD and MDD, a random subset of 56 previously interviewed study participants were independently assessed in a blinded fashion by a professional psychologist. A structured diagnostic interview was conducted using the PTSD and MDD modules of the Structured Clinical

Interview for DSM-IV-R (SCID-IV-R).⁵² A sensitivity and specificity analysis was conducted . For PTSD the measure was highly specific (0.95) but only moderately sensitive (0.43). For MDD, using the modified DSM-IV criteria applied to the DSM-IV-TR criteria, moderate sensitivity and specificity (0.66 and 0.69, respectively) were found. Internal consistency was good ($\alpha=0.84$).

Translation and Revision and of the Survey Document and Team Recruitment

The survey instrument was developed in English and translated to Haitian Creole using the committee method.⁵³ It was then administered in a pilot interview by a Haitian psychologist and study physician both fluent in English and Haitian Creole. Modifications were made and submitted to the translator and study investigators for review. A team of 15 Haitian interviewers were recruited and trained on the sampling frame, field methods and survey administration.

Data Entry and Quality Control

Variables were coded and survey data was entered into a database. Validity checks and database cleaning were performed throughout the entry process. Data quality, survey instrument proficiency and sampling frame adherence were monitored routinely and used in providing feedback and remedial training to interviewers where necessary.

Statistical Analysis

Statistical analysis was performed by a member of team at Columbia University. Univariable statistics for demographic characteristics, peri-earthquake experiences, social support, earthquake-related PTSD and earthquake-related MDD were calculated. Bivariable associations between demographic factors and earthquake related experiences, and resilience, were explored. At the time of writing, multivariable models were being used to test relations and interactions between the above measures, but are not presently available.

RESULTS

Of the 1328 individuals approached to participate in this study, 1323 consented, giving a response rate of 99.6%. Of the 1323, 8 respondents did not meet inclusion criteria and were excluded from the analysis. 522 (39.6%), 524 (39.8%) and 269 (20.4%) of respondents were sampled from IDP camps, the community, and the clinic, respectively. Table 1 shows the demographic characteristics, earthquake-related experiences, lifetime traumatic experiences, and post-earthquake social support of the individuals sampled.

70% of the sample was female. While this is slightly higher than the proportion of females found in the 2006 census², it is consistent with the IFP patient census and felt to represent the distribution in the catchment area (Dr. Claude Péan, personal communication). 30.8% of the sample was younger than 30, representing a slightly older population than that found in the census.² 70.9% of the sample was unmarried, and 20.1% had completed secondary school, both consistent with previously reported statistics.²

90.6% of respondents reported at least one relative or close friend injured or killed as a result of the earthquake. 50.8% lost income as a result of the earthquake and 63.5% reported that their homes were either completely destroyed or uninhabitable. 17.4% of respondents were physically injured in the initial event. 33.0% reported being involved in spontaneous rescue or recovery efforts and 93.0% witnessed dead bodies in the aftermath.

35.3% of respondents had low post-earthquake social support. 32.3% had high levels of lifetime trauma. 6.9% reported having a family member with a mental illness.

Figures 1a and 1b show the number of symptoms of PTSD and MDD endorsed by respondents. The majority endorsed experiencing one or more symptoms of PTSD and MDD. Only 1.4% and 0.4% did not endorse symptoms of PTSD and MDD, respectively.

Current PTSD with impairment and distress was present in 14.2% of the overall sample. The site-specific values were 11.5%, 15.8% and 16.5% for community, camp and clinic respondents, respectively. These differences approached significance ($p=0.0703$).

Current MDD with impairment was present in 16.2% of the overall sample. Site-specific values were 9.4%, 14.8% and 32.0% for community, camp and clinic respondents, respectively ($p < 0.0001$). (Table 2)

Resilience to PTSD and MDD was found in 24.4% and 18.4% of respondents, respectively (results not shown). Table 3 shows the bivariable associations between demographic characteristics, earthquake related experiences, and resilience to PTSD and MDD. Resilience to PTSD was associated with: age less than 30, completion of secondary education and involvement in rescue/recovery efforts. Risk factors for low resilience to PTSD included: female gender, major damage to house, being trapped by rubble, having a family history of mental illness, low social support, high lifetime trauma, and loss of 6 or more loved ones (see Appendix C for relationship between loss of loved ones and resilience to PTSD and MDD). Resilience to MDD was associated with: completion of secondary education. Risk factors for low resilience to MDD included: female gender, income loss, major damage to house, loss of 6 or more loved ones, high lifetime trauma, and living within a displacement camp.

DISCUSSION

As could be predicted by the scale of this natural disaster and the vulnerability of the affected population, the findings of this study suggest that the impact on mental health has been significant.

Within the limitations of this study, 4 key observations can be made: (1) exposure to pre-earthquake and earthquake-related stressors was high in this sample. (2) There is a significant burden of PTSD and MDD in this population. (3) Nearly the entire population sampled at 2 months after the January 12th earthquake exhibited some symptoms of PTSD and Major Depression and (4) resilience to PTSD and Major Depression is low. In addition, this study identifies factors that have an impact on resilience. Thus, this study illuminates potential areas of focus for mental health interventions designed for the post-earthquake environment in Haiti.

Levels of exposure to earthquake-related stressors were high in our population.

The prevalence of injury in this study (17.4%) was higher than that reported after similar magnitude earthquakes in Armenia (14.5%)⁵⁸ and Peru (11.5%).⁵⁹ The degree of destruction of homes reported here, however, was similar to figures reported following other major earthquakes in developing countries.^{58,60,61} Consistent with other studies comparing stressors in displaced versus non-displaced persons^{62,63}, our sample living in camps experienced increased levels of several earthquake-related stressors compared with those living in the community. Consistent with the available pre-earthquake literature⁴², roughly one third of respondents in this sample reported high lifetime exposure to traumatic events. Interesting, and perhaps not surprising, is that the proportion of those reporting low social support and high lifetime traumatic exposure was higher in the treatment-seeking sample.

There was a high burden of PTSD and MDD in this sample, consistent with estimates obtained in other population-based post-disaster studies.²⁰ 14.2% of individuals met criteria for PTSD, consistent with the known range of estimates for prevalence in developing countries following earthquakes (3.3-50%).^{17,64} Recent examples include earthquakes in Peru 2007 (20.2%)⁵⁹, Taiwan 1999 (10.9%)⁶⁵, and China 2008 (24.2%)⁶⁶. 16.2% of respondents met criteria for MDD in our sample, consistent with the range of 8-52% reported in the literature.¹⁷ Recent examples include prevalences of 22.6% and 27.3% after the 2005 Kashmir⁶⁴ and 1999 Marmara, Turkey⁶⁷ earthquakes, respectively.

Nearly the entire population sampled in this study exhibited at least some symptoms of PTSD and MDD (Figure 1). This is not surprising, in light of other examples in history: 74% of a sample of survivors of the 1999 Marmara, Turkey earthquake endorsed symptoms of PTSD.⁶⁸ It seems, however, that there has to exist a “normal” response to stress which permits some symptoms. Only those with multiple symptoms, distress, and dysfunction are those diagnosed with psychopathology.⁶⁹ **In our sample, despite a relatively lenient definition¹⁷, comparatively few survivors surveyed proved to be resilient to PTSD and MDD.** As noted in the introduction, in most post-disaster settings, 30-50% of people will demonstrate resilience.¹⁷ Although only 24.4% and 18.4% met criteria to be considered resilient to PTSD and MDD, respectively, the prevalence of PTSD and MDD was within the expected range. One way to reconcile these findings is to consider the possibility that a large portion of the

Haitian population is presently suffering subthreshold levels of mental disorder. This subset of the population has neither the level of symptoms nor the impairment for formal diagnosis, but also is not well enough to meet criteria for resilience. Given what is known about mental illness trajectories post-disaster^{17,70}, a proportion of those with subthreshold symptoms can be expected to progress to develop criteria-meeting disease, and as such, will be at higher subsequent risk for long-term impairment. Ongoing traumatic experiences and life stressors will likely contribute to this progression.⁷¹ The value in knowing this and in recognizing those with subthreshold disease is in the capacity to intervene.

Several limitations must be considered in interpreting the results of this study.

First, cross-sectional design does not allow for assessment of temporality or causality. Due to the difficult post disaster environment, this design and its limitations are shared by roughly 75% of the post-disaster literature.²¹ Specifically, the reporting of experiences as having occurred before or after a specific event is affected by recall bias. To counter this, the PCL and PHQ-9 questions were altered in our survey instrument in an attempt to establish PTSD and MDD symptoms as earthquake-related. The PCL and PHQ-9 are not diagnostic instruments, but are well-validated and have been previously shown to have comparable sensitivity and specificity in translated versions.^{56,57} In fact, results from longitudinal studies have shown reports of acute stress exposure to be reliable and relatively free of recall bias.⁵⁵ Despite this, the baseline prevalence of PTSD and MDD were not known in this population.⁴² This prevents us from establishing incidence versus prevalence, and therefore we still cannot assume that the temporal association between earthquake and symptom onset is true. Given that this study took place in the early post-earthquake period, it is also possible that the time criterion for PTSD and MDD were not actually met. Acute Stress Disorder (ASD) and normal bereavement have considerable overlap with PTSD and MDD, respectively, with the notable exception that they occur over a shorter period of time.²⁴ However, the survey questions reflected the necessary diagnostic time interval, and even in the case where stringent time criteria were not met, considerable proportions of those with ASD and grief reactions go on to develop PTSD and MDD.⁵⁴

Second, the representativeness of any population-based sample in the post-disaster setting requires scrutiny. Although our sample demographics were relatively consistent

with the 2006 census², post-disaster populations are likely to be in flux due to migration, displacement, and relocation. We expect two groups of people are underrepresented: those severely injured (who were likely still receiving treatment in the hospital setting) and those who left Port-au-Prince in the aftermath of the earthquake. In addition, the treatment-seeking population in the clinic sample adds a layer of selection bias. However, most if not all of the patients registering for care at the clinic did so for medical reasons and not because of mental health symptoms, and were selected randomly and systematically. Finally, we can only report bivariate associations here. Therefore, associations between exposure and mental illness cannot be fully known until important confounders are adjusted for the potential for interaction is explored through further statistical analysis.

Despite the above limitations, **the results of this study (and the multivariable associations yet to be reported) are important because they allow researchers, health care workers, and planners to know which factors are associated with resilience.** Focusing on modifiable factors could permit an ecological approach through the development community-wide interventions designed to bolster those factors that increase resilience and to counter those that hinder resilience.⁷² This would preserve resilience where it exists, and promote recovery, rather than progression, in those with subthreshold disease. Focusing on modifiable risk factors is also important in the Haitian setting because focused psychiatric screening and treatment on a large scale is not currently feasible given the available resources. Wider-reaching, population-based interventions could help, however, by sustaining and improving factors which promote resilience at the community level. While intervention planning is not within the scope of this paper, some basic recommendations can be made based on our findings. Improved access to resources, employment, home-rebuilding programs and community support coupled with the protection of women and displaced persons would reduce those ongoing stressors shown to compromise resilience.

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Table 1: Demographic characteristics and earthquake related experiences in a cohort of Haitians in the BelAir-Nazon area of Port-au-Prince exposed to the January 12th earthquake, by sampling site¹

Characteristics	Total (n=1315) n (%) ³	Camp (n=522) n (%) ³	Community (n=524) n (%) ³	Clinic (n=269) n (%) ³	p-value ²
Younger than 30	399 (30.8)	197 (38.4)	147 (28.5)	55 (20.7)	< 0.01
Female	933 (71.1)	371 (71.1)	346 (66.3)	216 (80.3)	< 0.01
Married	286 (21.7)	77 (14.8)	167 (31.9)	42 (15.6)	< 0.01
Secondary education completed	258 (20.1)	56 (10.9)	159 (31.5)	43 (16.2)	< 0.01
Lost income as a result of earthquake ⁴	667 (50.8)	291 (55.9)	258 (49.3)	118 (43.9)	< 0.01
Major damage to house ⁵	758 (57.8)	360 (69.1)	237 (45.4)	161 (59.8)	< 0.01
Trapped by rubble	82 (6.3)	43 (8.3)	25 (4.8)	14 (5.2)	0.049
Physically injured	228 (17.4)	99 (19)	86 (16.5)	43 (16)	> 0.05
Saw dead bodies	1212 (93)	500 (96.5)	467 (90.5)	245 (91.1)	< 0.01
Involved in rescue/recovery efforts	429 (33)	159 (31)	187 (36)	83 (31)	> 0.05
Number relatives/close friends killed/injured					
None	123 (9.4)	67 (13)	37 (7.2)	19 (7.1)	< 0.01
Between 1 and 5	583 (44.8)	237 (45.8)	238 (46)	108 (40.3)	
Between 6 and 10	307 (23.6)	111 (21.5)	124 (24)	72 (26.9)	
Greater than 10	289 (22.2)	102 (19.7)	118 (22.8)	69 (25.7)	
Family member has mental illness	91 (6.9)	16 (3.1)	47 (9)	28 (10.4)	< 0.01
Low social support ⁶	462 (35.3)	188 (36.2)	160 (30.8)	114 (42.4)	< 0.01
Number of lifetime traumas > 5	423 (32.3)	160 (30.7)	151 (29)	112 (41.6)	< 0.01

¹ We recruited a representative sample of participants from three sampling frame: official internally displaced person's camps in the area, participants who were still in their residence, and participants from a large community clinic in the middle of the catchment area.

² X² p-value

³ Totals may not add up to missing data

⁴ Respondent lost job or head of household lost job

⁵ Major damage refers to houses that were uninhabitable or demolished as a result of the earthquake; referent is no damage or some damage but still habitable.

⁶ Lowest social support tertile; social support was measured by summing responses to four questions regarding support from family and friends measured on a likert type scale

Table 2: Prevalence of Posttraumatic Stress Disorder (PTSD) and Major Depressive Disorder (MDD) in a cohort of Haitians in the BelAir-Nazon area of Port-au-Prince exposed to the January 12th earthquake, by sampling site¹

	Total (n=1315) n (%) ³	Camp (n=522) n (%) ³	Community (n=524) n (%) ³	Clinic (n=269) n (%) ³	p-value ²
Post-Traumatic Stress Disorder (PTSD)	187(14.2)	82(15.8)	60(11.5)	45(16.5)	0.0703
Major Depressive Disorder (MDD)	212(16.2)	77(14.8)	49(9.4)	86(32.0)	<0.001

¹ We recruited a representative sample of participants from three sampling frame: official internally displaced person's camps in the area, participants who were still in their residence, and participants from a large community clinic in the middle of the catchment area.

² X² p-value

³ Totals may not add up to missing data

Figure 1a: Percentage of respondents with symptoms of PTSD

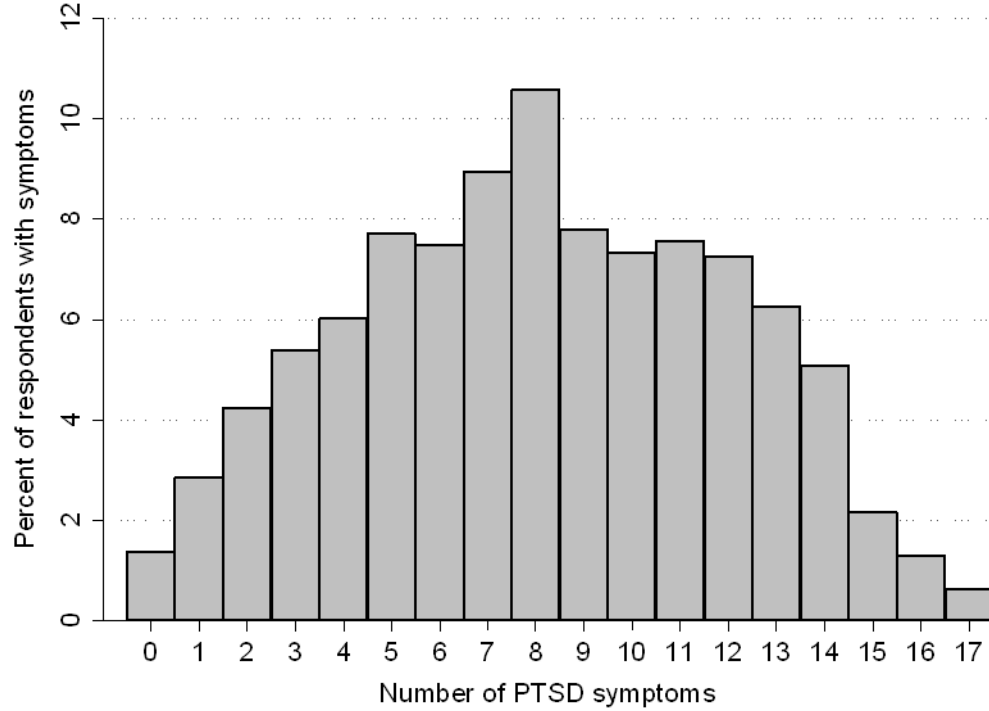


Figure 1b: Percent of respondents with symptoms of Major Depressive Disorder

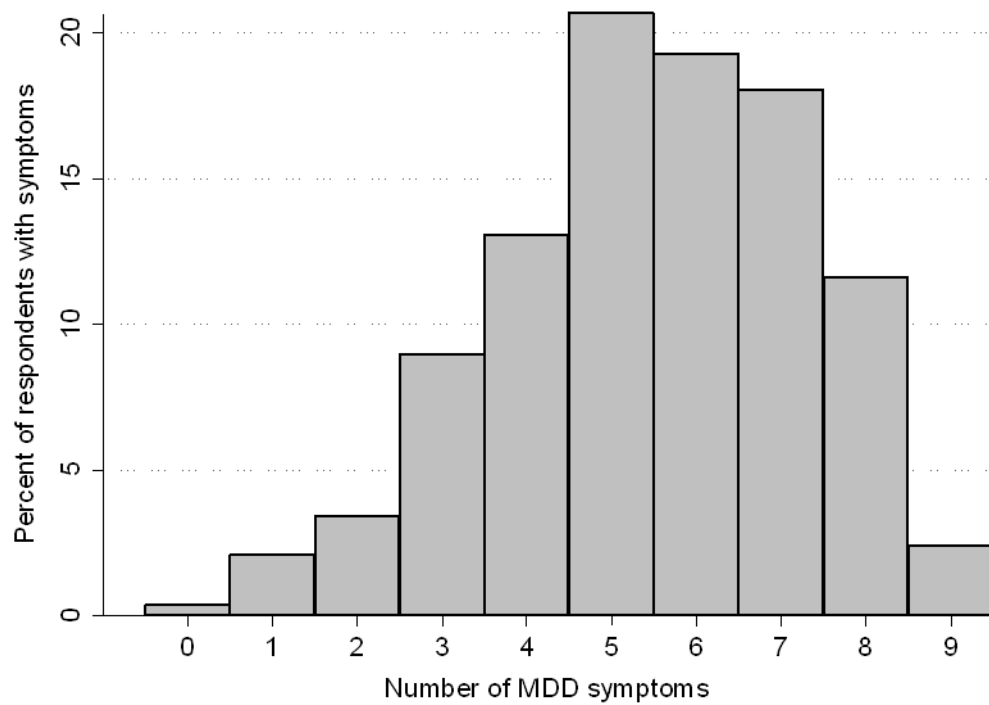


Table 3: Bivariable associations between demographic characteristics and earthquake related experiences and resilience to post-traumatic stress (PTSD)¹ and major depressive disorder (MDD)² in cohort of Haitians in the BelAir-Nazon area of Port-au-Prince exposed to the January 12th earthquake

	Resilient to PTSD	Resilient to MDD
	OR (Lower 95%, Upper 95%)	OR (Lower 95%, Upper 95%)
Younger than 30	1.3 (1.0, 1.7)	0.88 (0.64, 1.2)
Female	0.49 (0.37, 0.64)	0.69 (0.51, 0.93)
Married	1.1 (0.83, 1.5)	0.96 (0.68, 1.4)
Secondary education completed	1.5 (1.1, 2.0)	1.7 (1.2, 2.4)
Lost income due to earthquake ³	0.88 (0.68, 1.1)	0.57 (0.43, 0.77)
Major damage to house ⁴	0.64 (0.49, 0.83)	0.42 (0.31, 0.56)
Trapped under rubble	0.41 (0.21, 0.81)	0.68 (0.35, 1.3)
Physically injured	0.76 (0.54, 1.1)	0.74 (0.50, 1.1)
Saw dead bodies	1.1 (0.64, 1.8)	0.66 (0.40, 1.1)
Involved in rescue/recovery	1.3 (1.02, 1.7)	1.2 (0.85, 1.6)
Number of relatives and close friends killed or injured		
None	1	1
Between 1 and 5	0.85 (0.55, 1.3)	0.71 (0.45, 1.1)
Between 6 and 10	0.56 (0.34, 0.90)	0.46 (0.27, 0.78)
Greater than 10	0.49 (0.30, 0.80)	0.52 (0.30, 0.88)
Family member has mental illness	0.41 (0.22, 0.78)	0.68 (0.37, 1.3)
Low social support ⁵	0.72 (0.55, 0.96)	1.1 (0.83, 1.5)
High lifetime trauma	0.26 (0.18, 0.36)	0.33 (0.22, 0.48)
Sampling site		
Clinic	1	1
Camp	0.91 (0.64, 1.3)	0.69 (0.46, 1.0)
Community	1.2 (0.82, 1.6)	1.6 (1.1, 2.3)

¹ To be considered resilient to PTSD, respondents could have no more than 5 symptoms of PTSD could not have impairment or distress

² To be considered resilient to MDD, respondents could have no more than 4 symptoms of MDD and could not have impairment

³ Respondent lost job or head of household lost job

⁴ Major damage refers to houses that were uninhabitable or demolished as a result of the earthquake; referent is no damage or some damage but still habitable.

⁵ Lowest social support tertile; social support was measured by summing responses to four questions regarding support from family and friends measured on a likert type scale

APPENDIX A: Specific Role of the MPH Practicum Student

Pre-Study Phase

- I worked with the Principal Investigators to conduct a literature review and to gather background information on the earthquake and the post earthquake environment, and to determine background prevalence of mental illness in Haiti.
- I contributed to the drafting of an NIH grant proposal.
- I contributed to Institutional Review Board ethics submission at Columbia University.
- I compiled a map based on a description of the Institut Fame Pereo(IFP) catchment area.
- Using this and other existing maps, I conducted an on-ground assessment to identify and confirm IDP camps and community blocks within the study area. Current IDP camp populations were determined using World Food Programme census data.
- Using the above information, I worked with the Principal Investigators to design the sampling frame and survey collection procedures.
- I contributed to the development and refinement of the survey instrument working with both the principal investigators, the Haitian study team, and an official translator.

Training and Data Collection

- I worked directly with the director of the Haitian study team to oversee the following:
 - The training of IFP health workers in survey administration.
 - The recruitment and training of additional census workers.
 - The adherence of the survey team to the sampling frame and data collection methods, and quality control in survey administration. This included observing survey implementation, conducting data quality and logic checks, and providing feedback and remediation where necessary.
 - The implementation of the clinical reappraisal by the clinical psychologist
 - The completion of any logistical and administrative needs of the study during the data collection phase in Haiti

Post Data Collection

- I assisted with the creation of a database and provided input for variable creation. I then input all data into the database, administered quality checks and cleaned data.
- I contributed to manuscript preparation for submission for publication.

APPENDIX B: Sampling Area within Port-au-Prince



Figure B1 – Map of the Port-au-Prince metropolitan area with study area delineated. Map adapted from MapAction.org

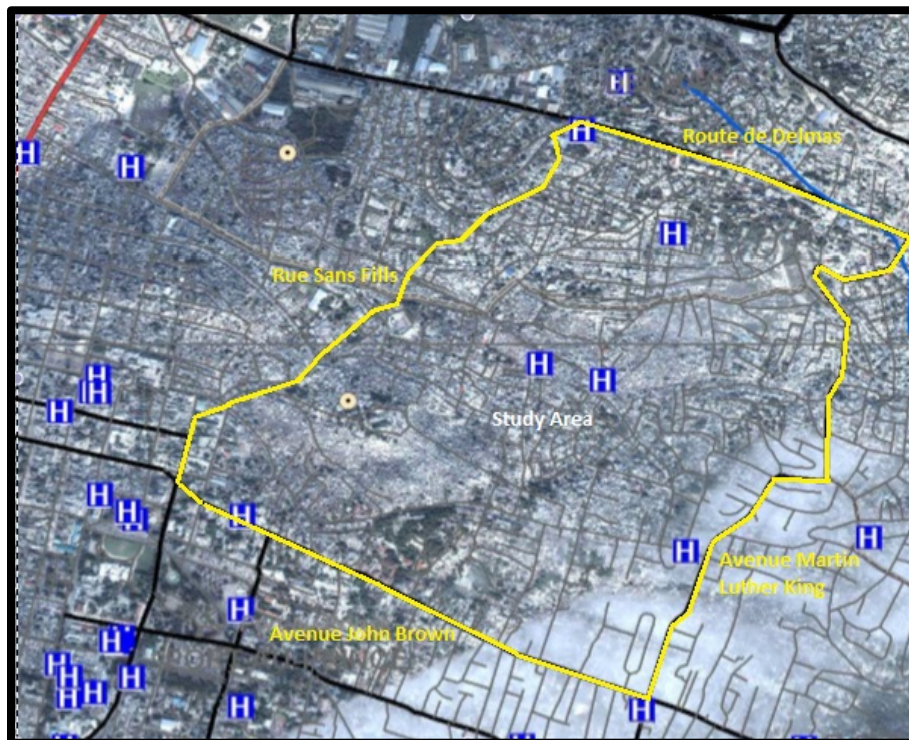


Figure B2 – Study area in detail. The area is bounded to the north by Route de Delmas, to the east by Avenue Martin Luther King, to the south by Avenue John Brown and to the west by Rue Sans Fills. Map adapted from MapAction.org

APPENDIX C

Figure C1: Probability of resilience to PTSD and the number of relatives or friends injured or killed

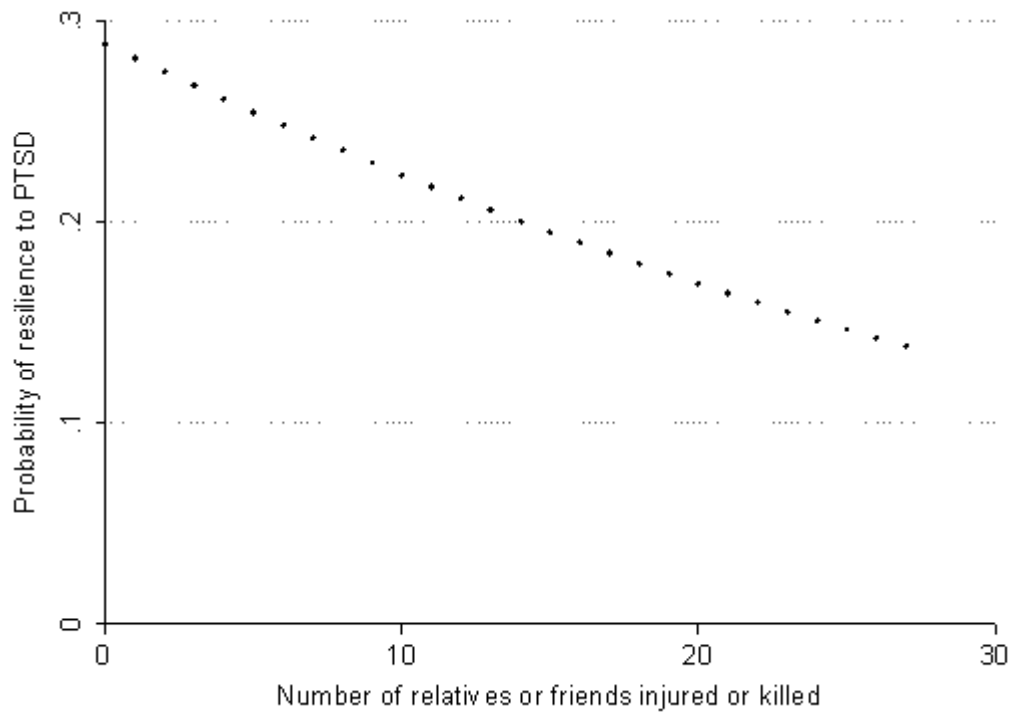


Figure C2: Probability of resilience to MDD and the number of relatives or friends injured or killed

