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Effects of a major U.S. hurricane on mental health disorder symptoms among adolescent and young adult females

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Abstract

Objective—This study examines the effects of Hurricane Ike-related damage, job loss, injury, and mortality of friends and family on mental health symptoms among affected young women and adolescents.

Methods—Data from a cross-sectional, self-administered survey of 2,536 young women aged 16-24 years affected by Hurricane Ike was examined. Poisson regression estimated the effect of types of hurricane-related damage, job loss, injury, and mortality of family or friends on depressive and hurricane-related post traumatic stress disorder (PTSD) symptoms.

Results—Nearly half (46.3%) of the respondents suffered damage, and 13% lost jobs as a result of Ike. Hurricane-related damage, job loss, injury to self, and injury to and mortality of friends or family were associated with increased Ike-related PTSD symptoms. Damage and job loss were also associated with increased depressive symptoms.

Conclusion—Accessible mental health services and plans to reduce job loss among adolescents and those they depend on for income are needed in areas affected by hurricanes to help mitigate psychological consequences among low-income young women.

Keywords

Natural disaster; mental health symptoms; hurricane-related damage; hurricane-related job loss; women's mental health; PTSD; depression

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Implications and Contribution

Much of the current disaster-related research that focuses on mental health does not specifically address factors associated with the psychological consequences among young women from low-income households. Our study found that job loss among young women or someone they depended on and hurricane-related damages increase depressive and PTSD symptoms.

Introduction

On September 13, 2008, Hurricane Ike caused extensive damage in the Gulf Coast area as a result of 110 mph winds, a 20 foot storm surge, and unprecedented coastal flooding (Federal Emergency Management Agency, 2008). The hurricane directly caused 74 deaths, 7,700 injuries, and 31,500 household illnesses (Norris, et al., 2010; Zane, et al., 2011). Over 8,000 homes were lost with \$3.4 billion in damages, and untold thousands were left homeless (Federal Emergency Management Agency, 2008).

Previous research has shown that the psychological effects of a natural disaster are intense and can last for a long time afterwards (Leon, 2004). Women have been reported to be particularly vulnerable to developing psychological disorders in the aftermath of a disaster. Women disproportionately suffer from disaster-related disruption of public services, increased gender-related violence, food insecurity, and loss of shelter as well as feelings of insecurity and disruption of social networks (Enarson, 2000, 2012; Tobin-Gurley, et al., 2010). This may explain, at least in part, why females affected by Hurricane Katrina and other disasters around the world were more likely than males to develop mental health disorders (Fan, et al., 2011; Fothergill, et al., 1999; Galea, et al., 2008; Papadatou, et al., 2012).

This problem may be even more pronounced among poor women as low-income communities recover slower than more prosperous areas and have fewer resources, exposing affected women to traumatizing situations for a longer period of time (Fothergill, et al., 1999; Galea, et al., 2008). In addition to prolonged exposure, women may also have to cope with roles as caretakers and loss of social and monetary support that assist them with caretaking for children and elderly. However, little research is available on this topic as previous studies of the effect of hurricanes on mental health have not focused on low-income women. For example, Tracy et al.'s (2011) study on Hurricane Ike victims included respondents who mostly reported incomes >\$40,000. Thus, additional studies are needed on low-income populations.

In the aftermath of a disaster, the financial consequences of job loss can further complicate and lengthen the process of recovery. This is particularly true among low-income women, due to their limited access to other resources that could enable them to recover (Fothergill & Peek, 2004). For middle and high income individuals, the stress of a disaster may be alleviated by continuing to receive their pay checks. Low-income families who receive hourly wages, however, are not likely to get paid during a disaster, and compounding that stress with job loss may make them more vulnerable to the development of psychological disorders (Fothergill & Peek, 2004). Further, during recovery, low-income individuals find it difficult to navigate the bureaucracy related to claiming disaster relief funds to which they are entitled, and women may find this even more difficult due to their roles as caretakers of children and the elderly, as well as difficulty in finding transportation to the disaster relief sites (Fothergill & Peek, 2004). To date, however, few studies have included information on the effects of disaster-related job loss among low-income women.

Young women from low-income households are at increased risk of developing mental health conditions as a result of economic and gender-related vulnerabilities. Therefore, it is important to study the effects of natural disasters on mental health among low-income women to better understand their need for support and specialized services that can assist them with recovery. The goal of this study was to evaluate the impact of Hurricane Ike on mental health symptoms of Hispanic, white, and black young women (16-24 years old) from low-income households. More specifically, we aimed to examine the relationships between

1) exposure to hurricane-related damage, job loss, injury and death; and 2) PTSD and depressive symptoms among female adolescents and young women.

Methods

Participants and Procedure

A cross-sectional, self-administered questionnaire was completed by 2,563 out of 3,443 young women approached (74% response rate), aged 16-24 years, who visited one of the five participating publicly funded family planning clinics in south Texas after Hurricane Ike. These clinics serve low-income women within their communities. Race was self-reported as Hispanic, African American, or white. Asian, American Indian/ Alaskan Native, or Native Hawaiian, or other Pacific Islanders (n=27) were excluded because the small sample size prohibited making meaningful statistical comparisons. Thus, the total sample size used in this study was 2,536 young women.

The survey was originally developed by an interdisciplinary research team at the University of Texas Medical Branch led by Dr. Berenson (senior author) to measure reproductive and other health-related behaviors. Additional questions were added after Hurricane Ike in order to examine the hurricane's effect on: Ike-related PTSD symptoms, damage, injury, death, and job loss. The survey was administered 69- 676 days after the hurricane made landfall on September 13th, 2008. Survey completers were compensated \$5 for their time, and could take the survey only once. Informed consent was obtained, and respondents were left alone to complete the questionnaire in their exam rooms. The study was approved by the institutional review board of the University of Texas Medical Branch, Galveston, TX.

Measures

Depressive Symptoms—Depressive symptoms were measured using the Beck Depression Inventory-Primary Care (BDI-PC), which consists of seven items reflecting cognitive and affective symptoms that the patient may have experienced in the past 2 weeks. The score for each item ranges between 0-3, with possible scores ranging from 0 (no depression) to 21 (highest level of depression). The BDIPC is often used by primary care physicians to screen patients for depression. This measure has been found to have a good internal consistency, and a cutoff of 4 has good sensitivity and specificity for identifying patients who need further evaluation for major depressive disorders (Beck, et al., 1997). The measure has also been found to be moderately correlated with the Hospital Anxiety and Depression Scale (Beck, et al., 1997; Steer & Cavalieri, 1999). For this study, the BDI-PC depression scale had a good internal consistency reliability ($\alpha = 0.85$). Depressive symptoms were included in the study as a continuous variable.

Post-Ike PTSD Symptoms—The PTSD questionnaire was a version of the PTSD checklist-stressful event (PCL-S), which was modified to refer to Hurricane Ike as the stressful experience. For this study, six questions addressed whether the respondents experienced disturbing thoughts of Hurricane Ike, felt very upset when reminded of Hurricane Ike, avoided activities that reminded them of Hurricane Ike, and felt distant, irritable, or had difficulty concentrating in the past month. Responses for these items ranged from 1 (“not at all”) to 6 (“extremely”) and were summed for a total score ranging between 6 and 30. The count of symptoms was used because this abbreviated measure cannot be a substitute for a PTSD diagnosis by a medical professional. Further, few studies have examined subclinical PTSD, even though it has been shown that PTSD symptomatology may have negative health and behavioral repercussions (Hirth, et al., 2011; Mitchell, et al., 2011). This measure had high internal consistency reliability for this study ($\alpha = 0.89$). The

PCL-S has been found to be valid and reliable for acute stressful events (Blanchard, et al., 1996; Wilkins, et al., 2011).

Damage—Respondents were given a list of nine items that could have been damaged or lost as a result of Hurricane Ike. These items included: damage to residence, workplace, furniture or appliances, sentimental possessions, cars or trucks, pets, public facilities such as schools or churches, streets and highways near respondents' homes, and places for recreation such as restaurants or parks.

The damages were summed for a total count ranging between 0 and 9. Respondents that were affected by Hurricane Ike, but left damage items blank, were scored "0" for that item. Sensitivity analyses showed similar results when damage items were coded as missing compared to when they were scored with a "0." The total number of damages was used as a general indicator of the negative effects of the hurricane on a respondent's material environment. Damage items were included in the count without weights, so it is possible that damage types that are more highly associated with mental health symptoms influence observed associations more strongly than other damage items.

Negative Consequences of Hurricane Ike—Three questions included whether job loss, injury, or injury/ death of family or friends had occurred as a result of Hurricane Ike. For job loss, respondents indicated whether they, or someone they depended on, had been laid off as a direct result of Hurricane Ike. The questions each had yes/ no responses that were recoded as binary "1, 0" to evaluate their effects on depressive symptoms and hurricane-related PTSD symptoms.

Previous Psychological or Mental Disorder—One question in the survey asked, "Prior to Hurricane Ike, were you ever diagnosed by a doctor as having a mental or psychological disorder, such as anxiety or depression?" This question had a "yes/ no" response, coded as "1, 0" and was used to control for a previous diagnosis of psychological illness that occurred before Hurricane Ike.

Demographic Variables—Demographic variables in this study included: age, race/ ethnicity, marital status, education, employment status, and household income. Age at time of interview was included as a continuous variable. Race/ ethnicity were self-identified as: "black," "Hispanic," or "white," with white as the comparison category. Marital status included: "married" (the reference category), "single," "separated/ divorced/ widowed", and "living with partner." Education included four categories: "currently enrolled," "<high school," "high school," and "college," (the reference category). Employment status included four categories: "not employed," "employed part-time (1-30 hours of work each week)," the reference category "employed full-time (31-40 hours of work each week)," and "employed more than full time (41 or more hours of work each week.)" Household income was categorized as: "<\$15,000," "between \$15,000 and \$29,999," and ">\$29,999" (reference category). A "missing" category was also included because a high proportion of Hispanic young women did not report a household income. Comparison categories were chosen based on which category would be expected to have the least mental health symptoms based on the mental health literature.

Statistical Analyses

SAS version 9.2 software for Windows XP was used to conduct all data analyses. The distribution of the count of hurricane-related PTSD symptoms and symptoms from the depression measure were positively skewed. Poisson regression for generalized linear models within the GENMOD procedure were used to calculate the estimated coefficients for

the log of the expected count of depressive and PTSD symptoms. Poisson regression was used to account for the non-normal distribution of the outcomes. Correlation assessed the association between individual items from the damage variable and depressive and PTSD symptoms.

Results

Most of the young women in this sample were from multiethnic backgrounds and were single (**Table 1**). They ranged in age from 16-24 years (mean age 20.7 years, standard deviation 2.5 years). These young women had a mean of 2.2 ± 3.2 depressive symptoms, and almost a quarter (24%) reported 4 or more depressive symptoms on the BDI-PC, the level at which further evaluation for major depressive disorder should take place.

The association of hurricane-related focal variables with the level of PTSD symptoms and depressive symptoms are included in tables 2 and 3. The models are shown side by side in order to compare the effects of hurricane-related variables. The first model adjusted for demographics, socioeconomic variables, and whether the respondent reported that she had been diagnosed with a psychological or mental disorder prior to the hurricane. All subsequent models added one hurricane-related variable to the first model with hurricane-related damages in the second model, hurricane-related job loss in the third model, injury to self in the fourth model, injury to family or friends in the fifth model, and death of family or friends in the sixth model.

PTSD Symptoms

In the first model (**Table 2**), young women with the lowest level of household income and less education reported a higher level of hurricane-related PTSD symptoms ($p < 0.001$) compared to those with a household income $\leq \$30,000$. Damage from Ike ($p < 0.001$), loss of employment ($p < 0.001$), injury to self ($p < 0.001$), injury to family or close friends ($p < 0.001$), and mortality of family or close friends ($p < 0.001$) were associated with increased hurricane-related PTSD symptoms.

Depression

Young women with the lowest level of income ($p < 0.01$) and who were enrolled in high school ($P < 0.001$) reported higher depressive symptoms than those from higher income households, and those with more education, respectively (**Table 3**). Hurricane-related damages ($p < 0.001$), job loss ($p < 0.01$), and injury ($p < 0.001$) were associated with increased depressive symptoms. Injury to family or friends ($p > 0.05$) and mortality of family or friends ($p > 0.05$) were not associated with depressive symptoms.

Individual Damage Items

Five types of damage associated with increased hurricane-related PTSD symptoms (**Table 4**) included damage to or loss of: pets ($p < 0.001$), cars or trucks ($p < 0.01$), sentimental possessions ($p < 0.001$), furniture or appliances ($p < 0.001$), and the workplace ($p < 0.05$). Damage to recreational spaces ($p < 0.05$), sentimental possessions ($p < 0.05$), and furniture or appliances ($p < 0.05$) were associated with an increased level of depressive symptoms.

One variable that was assessed, but not associated with hurricane-related PTSD symptoms or depressive symptoms, was the time, in days, between Hurricane Ike's landfall and the date the survey was taken. To assess this, the analyses were stratified by patients who took the survey 3-6 months after Ike compared to >6 months after Ike. We found that all of the focal variables were still significantly related to PTSD symptoms and depressive symptoms (except that family or friends injured or killed were not significantly related to

depressive symptoms in any of the models, including those stratified by the 3-6 month and the >6 month categories) in both those surveyed 3-6 months after the hurricane and those surveyed >6 months after the hurricane. Since time did not change the results of this study, it was not included in the models.

Discussion

We observed that young women from the lowest income households reported more severe hurricane-related PTSD symptoms. This contrasts with the study by Tracy et al. (2011), which did not find an association between demographic or socioeconomic variables and hurricane-related PTSD. However, their investigation included both males and females from higher-income households. The multiple economic, gender, and age disadvantages of our respondents may have resulted in a greater vulnerability to developing mental health symptoms as a result of hurricane-related events. This finding is important because PTSD symptoms are associated with poor health behaviors, such as overeating, unhealthy weight loss behaviors, substance abuse, and they may also progress to clinically diagnosable PTSD (Brewerton, 2007; Cukor, et al., 2010; Flood, et al., 2009; Hirth, et al., 2011; Mitchell, et al., 2011).

Similar to the findings of Tracy et al. (2011), damage to sentimental possessions and furniture or appliances was associated with both depressive and PTSD symptoms. Loss of these items may have increased their personal sense of loss and contributed to an increased sense of vulnerability, thus increasing mental health symptoms. Although we did not measure the severity or type of damage that occurred (i.e. wind or water), we found that damage or loss of important and irreplaceable personal items and pets was associated with increased PTSD symptoms. This is consistent with research showing that experiences perceived to directly threaten the well-being of an individual are more likely to be associated with PTSD (Giannopoulou, et al., 2006; Resnick, et al., 1993).

We also observed that damage to recreational facilities was associated with increased depressive symptoms. Although this study was not designed to determine why damage to these structures affected mental health symptoms, it does indicate that more priority should be given to rebuilding places of recreation in low-income areas after a disaster. These facilities may improve the mental health of young women by reducing feelings of isolation and help maintain a sense of community as well as contact with family and friends. This is consistent with prior research that found social support is associated with reduced mental health symptoms after a disaster (Wind, et al., 2011). For example, after Hurricane Katrina, non-Hispanic blacks and whites reported that they relied on family and friends as well as religious faith for emotional support (Elliot & Pais, 2006). It may be more difficult for young women to maintain these contacts without the help of structural facilities within their communities.

Involuntary job loss may contribute to depression among women (Dew, et al., 1992), thus mental health can be affected by the duality of experiencing a stressful life event, such as job loss, after a traumatic event (Maes, et al., 2001). Thus, our finding that job loss was associated with depressive and PTSD symptoms was not unexpected. Furthermore, job loss may be particularly difficult for low-income young women because they often have other concerns, such as responsibility for the caretaking of children or the elderly.

Hurricane-related injury was also associated with increased levels of depressive and PTSD symptoms. In contrast, Tracy et al. (2011) found that hurricane-related injury was associated with an increased likelihood of screening positive for PTSD, but not depression. The discrepancy between the two studies was likely due to our study methods, which examined

depressive symptoms, and not a clinically-diagnosable level of depression. In both studies, however, injury or death of family or close friends was not associated with depression (Tracy, et al., 2011). Other studies have observed an association between disaster-related loss and depression, although disasters with a greater number of casualties have been found to be more highly associated with greater levels of psychopathology than those with few casualties (Giannopoulou, et al., 2006; Kristensen, et al., 2012). The low number of total casualties directly caused by Hurricane Ike may have contributed to the lack of association between injury and death of family or friends with depressive symptoms.

Health disaster planning tends to focus on issues related to physical health (Meredith et al., 2011). Yet, the high levels of PTSD symptoms and the high proportion of young women who met the criteria for needing further evaluation for depression demonstrate that it is also important to consider their mental health, especially if they are from low-income households. These young women may be more likely to visit publically funded clinics, so adequate staffing, resources, and interventions for mental health assistance could be focused on patients at those clinics. For those unable to access public clinics, we suggest supplying mental health services via mobile units, or through community sites such as churches. This is crucial because research suggests that receiving assistance and support after a natural disaster reduces depression (Armenian, et al., 2002).

Limitations of this study include a lack of data on all three domains of PTSD symptoms. The hurricane-related PTSD questionnaire included symptoms from two of three domains required to diagnose PTSD. It could not evaluate whether a respondent had developed PTSD, but rather was a general indicator of the severity of the hurricane-related PTSD symptoms available on the survey. Likewise, depression could not be diagnosed using the BDI-PC questionnaire, which is a general indicator of depressive symptoms. In addition, the depression screener was not specific to Hurricane Ike, so the depressive symptoms we detected may not have been related to the storm. However, it is likely that the hurricane contributed to depressive symptoms, and the events may have increased symptoms in young women who already had depression. We did attempt to control for preexisting depression and other psychological disorders by including a self-report of preexisting psychological conditions in all models, but the low proportion of females who responded positively (6.7%) suggests that this figure was an underestimate. We were also unable to determine whether other traumatic or stressful events occurred between the date of the hurricane and the survey that could have affected our results. Last, recall bias cannot be ruled out as some respondents reported information on the effects of Hurricane Ike up to two years after the storm.

In conclusion, this study shows that several types of hurricane-related damage, job loss, and injury to self are associated with an increase in PTSD and depressive symptoms. Low-income women may face an even higher mental health burden due to their lack of resources, and especially if they experience job loss. Knowing the risks that are associated with poor mental health among low-income young women will allow disaster planners to take these factors into account when developing response plans for low-income areas. Further, plans could be developed to help provide care for the dependents of young women in affected communities so that they can focus more on recovery and finding employment. One example of such plans would be to designate structures that would be less likely to be damaged (such as a school) as a place to obtain care for children and older adults. Women who already work in hourly paid positions and work with these groups already, such as teachers' aides and daycare workers, could be encouraged to work there in a disaster if they are not able to work in their normal occupations due to damaged facilities. Optimally, these plans would be put in place before a disaster occurs in prone areas so that young women can

find employment and return to work with a minimum of delay to improve mental health outcomes.

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References

- Armenian HK, Morikawa M, Melkonian AK, Hovanesian A, Akiskal K, Akiskal HS. Risk Factors for Depression in the Survivors of the 1988 Earthquake in Armenia. *Journal of Urban Health*. 2002; 79(3):373–382. doi: 10.1093/jurban/79.3.373. [PubMed: 12200506]
- Beck AT, Guth D, Steer RA, Ball R. Screening for Major Depression Disorders in Medical Inpatients with the Beck Depression Inventory for Primary Care. *Behaviour Research and Therapy*. 1997; 35(8):785–791. doi: 10.1016/S0005-7967(97)00025-9. [PubMed: 9256522]
- Blanchard EB, Jones-Alexander J, Buckley TC, Forneris CA. Psychometric Properties of the PTSD Checklist (PCL). *Behaviour Research and Therapy*. 1996; 34(8):669–673. [PubMed: 8870294]
- Brewerton TD. Eating Disorders, Trauma, and Comorbidity: Focus on PTSD. *Eating Disorders*. 2007; 15(4):285–304. doi: 10.1080/10640260701454311. [PubMed: 17710567]
- Cukor J, Wyka K, Jayasinghe N, Difede J. The Nature and Course of Subthreshold PTSD. *Journal of Anxiety Disorders*. 2010; 24(8):918–923. doi: 10.1016/j.janxdis.2010.06.017. [PubMed: 20655169]
- Dew MA, Bromet EJ, Penkower L. Mental Health Effects of Job Loss in Women. *Psychological Medicine*. 1992; 22(4):751–764. [PubMed: 1410099]
- Elliot JR, Pais J. Race, Class, and Hurricane Katrina: Social Differences in Human Responses to Disaster. *Social Science Research*. 2006; 35:295–321. doi: 10.1016/j.ssresearch.2006.02.003.
- Enarson, E. Gender and natural disasters Infocus Programme on Crisis Response and Reconstruction. Recovery and Reconstruction Department; Geneva: 2000.
- Enarson, E. Women confronting natural disaster from vulnerability to resilience. Lynne Reinner Publishers; Boulder: 2012.
- Fan F, Zhang Y, Yang Y, Mo L, Liu X. Symptoms of Posttraumatic Stress Disorder, Depression, and Anxiety among Adolescents Following the 2008 Wenchuan Earthquake in China. *Journal of Traumatic Stress*. 2011; 24(1):44–53. [PubMed: 21351164]
- Federal Emergency Management Agency. [April 12, 2012] Hurricane Ike Impact Report. 2008. from http://www.fema.gov/pdf/hazard/hurricane/2008/ike/impact_report.pdf
- Flood AM, McDevitt-Murphy ME, Weathers FW, Eakin DE, Benson TA. Substance Use Behaviors as a Mediator between Posttraumatic Stress Disorder and Physical Health in Trauma-Exposed College Students. *Journal of Behavioral Medicine*. 2009; 32(3):234–243. doi: 10.1007/s10865-008-9195-y. [PubMed: 19139987]
- Fothergill A, Maestas EGM, Darlington JD. Race, Ethnicity and Disasters in the United States: A Review of the Literature. *Disasters*. 1999; 23(2):156–173. doi: 10.1111/1467-7717.00111. [PubMed: 10379098]
- Fothergill A, Peek LA. Poverty and Disasters in the United States: A Review of Recent Sociological Findings. *Natural Hazards*. 2004; 32:89–110. doi: 10.1111/1467-7717.00111.
- Galea S, Tracy M, Norris FH, Coffey SF. Financial and Social Circumstances and the Incidence and Course of PTSD in Mississippi During the First Two Years After Hurricane Katrina. *Journal of Traumatic Stress*. 2008; 21(4):357–368. doi: 10.1002/jts.20355. [PubMed: 18720399]

- Giannopoulou I, Strouthos M, Smith P, Dikaiakou A, Galanopoulou V, Yule W. Post-traumatic stress reactions of children and adolescents exposed to the Athens 1999 earthquake. *European Psychiatry*. 2006; 21:160–166. [PubMed: 16529912]
- Hirth JM, Rahman M, Berenson AB. The Association of Posttraumatic Stress Disorder with Fast Food and Soda Consumption and Unhealthy Weight Loss Behaviors among Young Women. *Journal of Women's Health*. 2011; 20(8):1141–1149. doi: 10.1089/jwh.2010.2675.
- Kristensen P, Weisaeth L, Heir T. Bereavement and mental health after sudden and violent losses: a review. *Psychiatry*. 2012; 75(1):76–97. [PubMed: 22397543]
- Leon GR. Overview of the Psychosocial Impact of Disasters. *Prehospital and Disaster Medicine*. 2004; 19(1):4–9. [PubMed: 15453154]
- Maes M, Mylle J, Delmeire L, Janca A. Pre- and post-disaster negative life events in relation to the incidence and severity of post-traumatic stress disorder. *Psychiatry Research*. 2001; 105:1–12. doi: 10.1016/S0165-1781(01)00325-0. [PubMed: 11740970]
- Mitchell KS, Mazzeo SE, Schlesinger MR, Brewerton TD, Smith BN. Comorbidity of Partial and Subthreshold PTSD among Men and Women with Eating Disorders in the National Comorbidity Survey-Replication Study. *International Journal of Eating Disorders*. 2011; 45(3):307–315. doi: 10.1002/eat.20965. [PubMed: 22009722]
- Norris FH, Sherrieb K, Galea S. Prevalence and Consequences of Disaster-Related Illness and Injury from Hurricane Ike. *Rehabilitation Psychology*. 2010; 55(3):221–230. doi: 10.1037/a0020195. [PubMed: 20804265]
- Papadatou D, Giannopoulou I, Bitsakou P, Bellali T, Talias MA, Tselepi K. Adolescents' Reactions After a Wildfire Disaster in Greece. *Journal of Traumatic Stress*. 2012; 25(1):57–63. [PubMed: 22298431]
- Rensnick HS, Kilpatrick DG, Dansky BS, Saunders BE, Best CL. Prevalence of Civilian Trauma and Posttraumatic Stress Disorder in a Representative National Sample of Women. *Journal of Consulting and Clinical Psychology*. 1993; 61(6):984–991. [PubMed: 8113499]
- Steer RA, Cavalieri TA. Use of the Beck Depression Inventory for Primary Care to Screen for Major Depression Disorders. *General Hospital Psychiatry*. 1999; 21(2):106–111. doi: 10.1016/S0163-8343(98)00070X. [PubMed: 10228890]
- Tobin-Gurley J, Peek L, Loomis J. Displaced Single Mothers in the Aftermath of Hurricane Katrina: Resource Needs and Resource Acquisition. *International Journal of Mass Emergencies and Disasters*. 2010; 28(2):170–206.
- Tracy M, Norris FH, Galea S. Differences in the Determinants of Posttraumatic Stress Disorder and Depression after a Mass Traumatic Event. *Depression and Anxiety*. 2011; 28:666–675. doi: 10.1002/da.20838/. [PubMed: 21618672]
- Wilkins KC, Lang AJ, Norman SB. Synthesis of the Psychometric Properties of the PTSD Checklist (PCL) Military, Civilian, and Specific Versions. *Depression and Anxiety*. 2011; 28(7):596–606. [PubMed: 21681864]
- Wind TR, Fordham M, Komprou IH. Social Capital and Post-Disaster Mental Health. *Global Health Action*. 2011; 4 DOI: 10.3402/gha.v3404i3400.6351.
- Zane DF, Bayleyegn TM, Hellsten J, Beal R, Beasley C, Haywood T, et al. Tracking Deaths Related to Hurricane Ike, Texas, 2008. *Disaster Medicine and Public Health Preparedness*. 2011; 5(1):23–28. [PubMed: 21402823]

Table 1

Demographic and descriptive characteristics of young women affected by Hurricane Ike

	<u>n (%)</u>
Race/ ethnicity	
Black	684 (27.0)
Hispanic	1100 (43.4)
White	752 (29.6)
Marital status	
Single	1533 (60.9)
Living Together	516 (20.5)
Married	349 (13.9)
Separated/ Widowed/ Divorced	120 (4.7)
Household income	
< \$15,000	1292 (51.0)
\$15,000-\$29,999	594 (23.4)
>\$29,999	342 (13.5)
Missing	308 (12.1)
Education	
Currently enrolled in high school	506 (20.3)
< High school	462 (18.6)
High school degree or equivalent	805 (32.3)
College	718 (28.8)
Work status	
None	1389 (55.2)
Part-time	556 (22.1)
Full-time	466 (18.5)
Overtime	106 (4.2)
Previous mental or psychological disorder	
Yes	154 (6.7)
No	2155 (93.3)
Damage from Ike	
Yes	1175 (46.3)
No	1361 (53.7)
Lost job as a result of Ike	
Yes	298 (13.1)
No	1980 (86.9)
Injured as result of Ike	
Yes	27 (1.2)
No	2262 (98.8)
Family/ close friends injured as result of Ike	
Yes	50 (2.2)
No	2229 (97.8)

	<u>n (%)</u>
Family/ close friends killed as result of Ike	
Yes	31 (1.4)
No	2253 (98.6)
Hurricane Ike-related PTSD symptoms	
0 symptoms	1463 (65.2)
1 or more symptoms	782 (34.8)
Depressive symptoms	
0 symptoms	1143 (49.6)
1-3 symptoms	609 (26.4)
4+ symptoms	554 (24.0)

Table 2

PTSD Symptoms Related to Hurricane Ike Events (N=2,536)

	Model 1		Model 2		Model 3	
	Coefficient (SE)	p-value	Coefficient (SE)	p-value	Coefficient (SE)	p-value
Intercept	1.69 (0.104)	<0.001	1.540 (0.102)	<0.001	1.660 (0.102)	<0.001
Demographics						
Age	0.009 (0.004)	0.4	0.009 (0.004)	0.02	0.007 (0.004)	0.09
Race/Ethnicity						
White	reference		reference		reference	
Black	0.175 (0.020)	<0.001	0.171 (0.020)	<0.001	0.170 (0.020)	<0.001
Hispanic	0.030 (0.019)	0.12	0.059 (0.020)	0.002	0.037 (0.020)	0.06
Marital Status						
Single	-0.011 (0.026)	0.67	-0.007 (0.041)	0.87	-0.004 (0.026)	0.86
Living Together	-0.003 (0.028)	0.93	0.006 (0.026)	0.82	-0.010 (0.028)	0.72
Married	reference		reference		reference	
Separated/ Widowed/ Divorced	0.002 (0.041)	0.97	0.004 (0.028)	0.90	0.003 (0.041)	0.94
Household Income						
<\$15,000	0.098 (0.024)	<0.001	0.106 (0.032)	0.001	0.088 (0.024)	<0.001
\$15,000-\$29,999	0.065 (0.026)	0.01	0.094 (0.024)	<0.001	0.046 (0.027)	0.08
>\$29,999	reference		reference		reference	
Missing	0.102 (0.032)	0.001	0.058 (0.027)	0.03	0.086 (0.032)	0.007
Education						
Currently enrolled in high school	0.162 (0.029)	<0.001	0.155 (0.029)	<0.001	0.154 (0.029)	<0.001
< High school	0.148 (0.025)	<0.001	0.135 (0.025)	<0.001	0.127 (0.025)	<0.001
High school degree or equivalent	0.077 (0.020)	<0.001	0.077 (0.020)	<0.001	0.068 (0.020)	0.001
College	reference		reference		reference	
Work Status						
None	0.008 (0.022)	0.70	0.012 (0.022)	0.57	0.015 (0.022)	0.48
Part-time	-0.031 (0.024)	0.20	-0.028 (0.024)	0.25	-0.024 (0.024)	0.32
Full-time	reference		reference		reference	
Overtime	0.056 (0.040)	0.17	0.044 (0.040)	0.28	0.048 (0.040)	0.24

	Model 1			Model 2			Model 3		
	Coefficient (SE)	p-value		Coefficient (SE)	p-value		Coefficient (SE)	p-value	
Diagnosed with psychological or mental disorder before hurricane	0.194 (0.029)	<0.001		0.181 (0.029)	<0.001		0.183 (0.029)	<0.001	
Hurricane Ike Consequences									
Damage sustained from Ike				0.053 (0.004)	<0.001		0.230 (0.021)	<0.001	
Lost job as result of Ike									
Injured as result of Ike									
Family or friends injured									
Family or friends killed									
Intercept	2.095 (0.121)	<0.001		1.915 (0.11)	<0.001		1.889 (0.115)	<0.001	
Demographics									
Age	0.008 (0.004)	0.06		0.008 (0.004)	0.04		0.009 (0.004)	0.04	
Race/Ethnicity									
White	reference			reference			reference		
Black	0.177 (0.020)	<0.001		0.176 (0.020)	<0.001		0.171 (0.020)	<0.001	
Hispanic	0.036 (0.020)	0.06		0.033 (0.020)	0.09		0.033 (0.020)	0.09	
Marital Status									
Single	-0.019 (0.026)	0.47		-0.018 (0.026)	0.48		-0.012 (0.026)	0.63	
Living Together	-0.006 (0.028)	0.84		-0.007 (0.028)	0.79		-0.004 (0.028)	0.88	
Married	reference			reference			reference		
Separated/ Widowed/ Divorced	-0.008 (0.041)	0.84		-0.009 (0.041)	0.83		0.001 (0.041)	0.98	
Household Income									
< \$15,000	0.097 (0.024)	<0.001		0.098 (0.024)	<0.001		0.096 (0.024)	<0.001	
\$15,000-\$29,999	0.060 (0.027)	0.02		0.066 (0.027)	0.01		0.065 (0.027)	0.01	
>\$29,999	reference			reference			reference		
Missing	0.097 (0.032)	0.003		0.102 (0.032)	0.002		0.097 (0.032)	0.003	
Education									
Currently enrolled in high school	0.158 (0.029)	<0.001		0.159 (0.029)	<0.001		0.160 (0.029)	<0.001	
< High school	0.132 (0.025)	<0.001		0.143 (0.025)	<0.001		0.143 (0.025)	<0.001	
High school degree or equivalent	0.075 (0.020)	<0.001		0.078 (0.020)	<0.001		0.077 (0.020)	<0.001	
College	reference			reference			reference		
Work Status									

	Model 1		Model 2		Model 3	
	Coefficient (SE)	p-value	Coefficient (SE)	p-value	Coefficient (SE)	p-value
None	0.002 (0.022)	0.94	0.004 (0.022)	0.86	0.006 (0.022)	0.77
Part-time	-0.037 (0.024)	0.12	-0.033 (0.024)	0.17	-0.032 (0.024)	0.19
Full-time	reference		reference		reference	
Overtime	0.043 (0.040)	0.29	0.052 (0.040)	0.20	0.055 (0.040)	0.18
Diagnosed with psychological or mental disorder before hurricane	0.198 (0.029)	<0.001	0.187 (0.029)	<0.001	0.189 (0.029)	<0.001
Hurricane Ike Consequences						
Damage sustained from Ike						
Lost job as result of Ike						
Injured as result of Ike	0.419 (0.060)	<0.001				
Family or friends injured			0.259 (0.046)	<0.001		
Family or friends killed					0.240 (0.057)	<0.001

Table 3

Beck Depression Inventory-Primary Care (BDI-PC) Depression Among Women Exposed to Hurricane Ike (N=2,536)

	Model 1			Model 2			Model 3		
	Coefficient (SE)	p-value		Coefficient (SE)	p-value		Coefficient (SE)	p-value	
Intercept	0.315 (0.194)	0.10		0.244 (0.194)	0.21		0.254 (0.196)	0.20	
Demographics									
Age	0.000 (0.008)	0.97		0.000 (0.008)	0.96		0.001 (0.008)	0.86	
Race/Ethnicity									
White	reference			reference			reference		
Black	-0.040 (0.039)	0.31		-0.043 (0.039)	0.27		-0.048 (0.039)	0.22	
Hispanic	-0.102 (0.076)	0.04		-0.081 (0.036)	0.03		-0.101 (0.036)	0.005	
Marital Status									
Single	0.118 (0.052)	0.02		0.131 (0.053)	0.01		0.125 (0.053)	0.02	
Living Together	0.302 (0.055)	<0.001		0.305 (0.055)	<0.001		0.301 (0.056)	<0.001	
Married	reference			reference			reference		
Separated/ Widowed/ Divorced	0.693 (0.068)	<0.001		0.683 (0.068)	<0.001		0.665 (0.069)	<0.001	
Household Income									
<\$15,000	0.135 (0.046)	0.003		0.131 (0.046)	0.004		0.126 (0.046)	0.007	
\$15,000-\$29,999	0.059 (0.051)	0.25		0.054 (0.051)	0.29		0.036 (0.052)	0.48	
>\$29,999	reference			reference			reference		
Missing	0.016 (0.063)	0.80		0.017 (0.063)	0.78		0.002 (0.064)	0.98	
Education									
Currently enrolled in high school	0.206 (0.054)	<0.001		0.203 (0.054)	<0.001		0.209 (0.055)	<0.001	
< High school	0.077 (0.047)	0.10		0.072 (0.047)	0.13		0.041 (0.048)	0.39	
High school degree or equivalent	-0.013 (0.038)	0.73		-0.011 (0.038)	0.77		-0.016 (0.039)	0.67	
College	reference			reference			reference		
Work Status									
None	0.160 (0.042)	<0.001		0.161 (0.042)	<0.001		0.172 (0.043)	<0.001	
Part-time	0.009 (0.048)	0.86		0.009 (0.08)	0.86		0.032 (0.048)	0.50	
Full-time	reference			reference			reference		
Overtime	0.263 (0.075)	<0.001		0.252 (0.075)	0.001		0.260 (0.075)	<0.001	

	Model 1		Model 2		Model 3	
	Coefficient (SE)	p-value	Coefficient (SE)	p-value	Coefficient (SE)	p-value
Diagnosed with psychological or mental disorder before hurricane	0.804 (0.043)	<0.001	0.796 (0.043)	<0.001	0.804 (0.043)	<0.001
Hurricane Ike Consequences						
Damage sustained from Ike			0.038 (0.008)	<0.001		
Lost job as result of Ike					0.232 (0.040)	0.008
Injured as result of Ike						
Family or friends injured						
Family or friends killed						
Intercept	0.722 (0.230)	0.002	0.205 (0.218)	0.35	0.095 (0.233)	0.68
Demographics						
Age	0.002 (0.008)	0.76	0.003 (0.008)	0.73	0.002 (0.008)	0.77
Race/Ethnicity						
White	reference		reference		reference	
Black	-0.046 (0.039)	0.25	-0.033 (0.039)	0.41	-0.044 (0.039)	0.26
Hispanic	-0.105 (0.036)	0.004	-0.092 (0.036)	0.01	-0.108 (0.036)	0.003
Marital Status						
Single	0.111 (0.053)	0.04	0.145 (0.054)	0.007	0.118 (0.053)	0.03
Living Together	0.301 (0.056)	<0.001	0.334 (0.056)	<0.001	0.303 (0.056)	<0.001
Married	reference		reference		reference	
Separated/ Widowed/ Divorced	0.652 (0.070)	<0.001	0.690 (0.070)	<0.001	0.667 (0.069)	<0.001
Household Income						
< \$15,000	0.133 (0.046)	0.004	0.127 (0.046)	0.006	0.135 (0.046)	0.004
\$15,000-\$29,999	0.046 (0.052)	0.37	0.050 (0.051)	0.33	0.051 (0.051)	0.32
>\$29,999	reference		reference		reference	
Missing	0.011 (0.064)	0.86	0.009 (0.064)	0.88	0.011 (0.064)	0.87
Education						
Currently enrolled in high school	0.215 (0.055)	<0.001	0.216 (0.055)	<0.001	0.222 (0.055)	<0.001
< High school	0.054 (0.08)	0.26	0.057 (0.048)	0.23	0.063 (0.048)	0.19
High school degree or equivalent	-0.014 (0.039)	0.72	-0.008 (0.039)	0.82	-0.008 (0.039)	0.83
College	reference		reference		reference	
Work Status						

	Model 1		Model 2		Model 3	
	Coefficient (SE)	p-value	Coefficient (SE)	p-value	Coefficient (SE)	p-value
None	0.168 (0.043)	<0.001	0.165 (0.042)	<0.001	0.162 (0.042)	<0.001
Part-time	0.025 (0.048)	0.61	0.026 (0.048)	0.59	0.022 (0.048)	0.64
Full-time	reference		reference		reference	
Overtime	0.262 (0.075)	<0.001	0.263 (0.075)	<0.001	0.263 (0.075)	<0.001
Diagnosed with psychological or mental disorder before hurricane	0.818 (0.043)	<0.001	0.820 (0.043)	<0.001	0.820 (0.043)	<0.001
Hurricane Ike Consequences						
Damage sustained from Ike						
Lost job as result of Ike						
Injured as result of Ike	0.465 (0.110)	<0.001				
Family or friends injured			0.016 (0.094)	0.86		
Family or friends killed					0.165 (0.129)	0.20

Table 4

Correlation between Damage Items and Mental Health (N=2,536)

Damage to...	PTSD Symptoms		BDI-PC Depressive Symptoms	
	CC ^I	p-value	CC ^I	p-value
Places of recreation	0.0208	p = 0.47	0.0716	p = 0.013
Local streets/ highways	-0.0092	p = 0.75	0.0318	p = 0.27
Schools, hospitals, churches	0.0156	p = 0.59	0.0257	p = 0.37
Pets	0.1322	p < 0.001	0.0062	p = 0.83
Cars/ trucks	0.0871	p = 0.002	0.0295	p = 0.31
Sentimental possessions	0.2162	p < 0.001	0.0658	p = 0.02
Furniture or appliances	0.1790	p < 0.001	0.0584	p = 0.04
Workplace	0.0731	p = 0.011	0.0089	p = 0.76
Home	0.0068	p = 0.81	-0.0098	p = 0.74
Total damages	0.1489	p < 0.001	0.0674	p = 0.02

^ICC = correlation coefficient