

Food Insecurity as a Predictor of Hurricane Exposure among Underserved Adolescents

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Abstract

Low-income populations are at increased risk for experiencing negative hurricane exposures and food insecurity. However, little is known regarding how pre-hurricane food insecurity experiences are related to youth hurricane exposure. This study examined the types of hurricane disaster exposures low-income, ethnic minority adolescents experienced during Hurricane Harvey and examined the association between food insecurity and hurricane exposure. Low-income adolescents ($n = 185$) were recruited from a Houston-area school district. Two days before the hurricane, food insecurity was assessed. Adolescents with at least one affirmative answer on the 9-item USDA Child Food Security Survey Module were classified as food insecure. Adolescents self-reported hurricane exposure three weeks post-hurricane using both the National Child Traumatic Stress Network Hurricane and Assessment Referral Tool and Survey of Hurricane Katrina Evacuees. Affirmative answers to lacking access to food, water, or medicine, being rescued, home damage, and displacement were each given a score of one and summed to create an overall hurricane exposure score. A covariate-adjusted linear regression model regressed overall hurricane exposure onto food insecurity. Separate covariate-adjusted logistic regression models were performed where each individual hurricane exposure was regressed onto food insecurity. Prior to the hurricane, 46% of adolescents experienced food insecurity and 43% experienced hurricane exposure. Pre-hurricane food insecurity ($p = 0.004$) and being foreign born ($p = 0.033$) were associated with increased hurricane exposure. Adolescents who experienced food insecurity had 132% higher odds of lacking access to fresh water ($p = 0.047$) and 105% higher odds of lacking access to food ($p = 0.034$) during the hurricane. Food insecurity and immigrant status appear to be at-risk indicators for hurricane exposure. Schools serving underserved adolescents could consider assessing food security and immigration status as part of disaster preparedness programs.

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Introduction

In August 2017 Houston-area residents experienced 50 inches of rain over five consecutive days from Hurricane Harvey. A state disaster declaration was issued immediately after the rain began and continues through the writing of this manuscript in 2019 (Office of the Texas Governor, 2019). Hurricanes pose immediate and long-term threats to life and wellbeing (Carroll & Frakt, 2017). Economic and health consequences of hurricanes can exacerbate socioeconomic disparities, making it critical to identify populations at highest risk of exposure to a hurricane. This study offers some of the only data available regarding the relationship between food security and hurricane exposure among a low socioeconomic status (SES) population.

Individuals with low SES represent an important population for hurricane aid prioritization. According to the social vulnerability perspective, those with limited resources,

little education, and low social position are particularly vulnerable to the effects of a hurricane because they are likely to have a lower capacity to prepare for, cope with, and recover from a natural disaster (Cutter, Boruff, & Shirley, 2003). This perspective has been supported by observations following previous hurricanes. For example, the socioeconomic decline following Hurricane Katrina created long-term health disparities (e.g., chronic pain and cardiometabolic events) beyond those existing prior to the hurricane and independent of the level of hurricane trauma experienced (Joseph, Matthews, & Myers, 2014). Those of low SES experience negative health impacts more intensely and for longer than those with higher SES (Substance Abuse and Mental Health Services Administration, 2017). In addition to those of low SES being more likely to incur an injury or die from a natural disaster, the lack of resources following a disaster can also necessitate money that was used for health expenses prior to the storm to be reallocated to cover day-to-day living expenses (Substance Abuse and Mental Health Services Administration, 2017).

While it is clear that those of low SES are more vulnerable to the effects of hurricanes, little is known about the characteristics among this population that increase hurricane exposure risk, especially among pediatric populations. In Harris County, the county surrounding Houston, Texas, 24% of households with children experience food insecurity compared with the national average of 18% (Feeding America, 2016). Food insecurity, or not having access to enough food for an active, healthy life (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2017), is directionally associated with income (Park et al., 2009). However, food insecurity compounds children's health risk beyond that associated with poverty (Fram, Ritchie, Rosen, & Frongillo, 2015; Robson, Lozano, Papas, & Patterson, 2017). Similarly, it is likely that the ability of youth experiencing food insecurity to prepare for, cope with, and recover from a hurricane is lower than those at the same SES level who have high food security. Although the event of a hurricane may increase the health disparity between food secure and food insecure families, to the authors' knowledge, the relationship between food security and hurricane exposure has not yet been examined.

The purpose of this study was to: 1) determine the types of hurricane disaster exposures (e.g., living conditions, access to food and water, experiences of being rescued or displaced) that low-income, ethnic minority adolescents experienced during Hurricane Harvey, and 2) examine the association between food insecurity and hurricane exposure, controlling for various sociodemographic characteristics. Consistent with the social vulnerability perspective, it was hypothesized that this population of low SES youth would be highly impacted by the hurricane and that those experiencing food insecurity prior to the hurricane would have greater hurricane exposure than those with food security.

Methods

Adolescents ($n = 352$) at an independent school district serving grades 6 through 12 in Houston, Texas, were approached about participating in a larger study to evaluate a healthy lifestyle program as part of their physical education (PE) class in August 2017. Any student taking a PE class at the time of recruitment was eligible to participate in the study. This particular district was chosen because the school has a predominantly low income, ethnic minority student body (over 80% eligible for free/reduced school meals; i.e., have a family income of less than 1.85 times the poverty level). Written consent from both the adolescent and his/her guardian was obtained from 213 students. Two days prior to the hurricane, students filled

out a questionnaire regarding food insecurity and their demographics as part of the baseline measures to evaluate the healthy lifestyle program. The school provided administrative data on student participation in free or reduced school meal programs. When students returned to school three weeks after the hurricane, they completed a short questionnaire about their experiences during the hurricane. Incomplete data, due to students leaving questions blank on hurricane exposure ($n = 1$), food security ($n = 5$), and nativity ($n = 22$) resulted in an analytic sample of 185 students.

Measures

Food Security. Food security was assessed using the USDA Child Food Security Survey Module (Connell, Nord, Lofton, & Yadrick, 2004). Adolescents responded to nine items regarding how often the food situation described in the question described them in the last month. Food insecurity was classified as at least one affirmative answer.

Hurricane Exposure Index. Students' lack of access to food (1 = yes; 0 = no), fresh water (1 = yes; 0 = no), and medicines (1 = yes; 0 = no) during the hurricane were assessed using questions from the Survey of Hurricane Katrina Evacuees (Brodie, Weltzien, Altman, Blendon, & Benson, 2006). To further assess hurricane living conditions and experiences, questions were adapted from the risk categories on the National Child Traumatic Stress Network Hurricane and Assessment Referral Tool (Hansel, Osofsky, & Osofsky, 2015; The National Child Traumatic Stress Network, 2005). Participants were asked if they had to be rescued from their home by a boat or helicopter (1 = yes; 0 = no), and if their home was damaged (1 = yes; 0 = no). Participants were also asked to indicate whether they had been sleeping in their home or whether they were displaced and sleeping in a location besides their home (1 = displaced; 0 = sleeping at home). Affirmative answers to hurricane exposures were given a score of one. Like prior research that has focused on cumulative risk (Hernandez, 2015), scores were summed to create a total exposure index, ranging from a possible 0 to 6.

Demographic characteristics. Potential covariates included sex (female/male), age (years), nativity (foreign born versus U.S. born), number of biological parents living in the home (both, one, or neither), number of children in the household, number of adults in the household, race/ethnicity (Hispanic, African American, Asian, Caucasian), and free/reduced versus full price school lunch participation.

Statistical analysis

Statistical analysis was conducted with SPSS Version 25.0 (Chicago, IL). Chi-square and independent t-tests were conducted to test differences in hurricane impact variables and demographic variables by food security. A linear regression model was developed to predict overall hurricane exposure from food security status. Five separate binary logistic regression models were developed to predict each hurricane exposure (i.e., lacked access to food, water, or medicine, home damage, and displacement) from food security status. No model was developed for rescued by boat/helicopter because only three participants experienced this.

Due to their potential relationship with socioeconomic vulnerability, each of the assessed demographic variables were considered for inclusion in the model as covariates. Ethnicity was not included as a covariate because over 99% of students were of an ethnic minority and chi-square testing revealed no significant difference in hurricane impact by ethnicity. Due to

endogeneity concerns between participation in free/reduced school meal programs and food security, free/reduced school meal participation was not included as a covariate (Ishdori & Higgins, 2015). Age, gender, and the number of adults in the household did not significantly differ by any of the hurricane exposures. Therefore, only the following demographic characteristics were included as covariates based on hurricane exposure differences: nativity status (U.S. born or foreign born), the number of parents living with the student (both, one, or neither), and the number of children in the household (continuous).

Results

Students were 14.58 ± 1.78 years old on average and were primarily Hispanic (78%) or African American (17%). About half (52%) were male and 82% were eligible for free/reduced school meals. Overall 43% of students reported one or more hurricane exposures (i.e., lacked access to food, water, or medicine, home damage, or displacement). Bivariate analyses concluded that those born outside of the United States were more likely to go without fresh water ($p = 0.02$) and without medicines ($p = 0.03$) than students born in the United States (results not shown). Students living with neither or one parent were significantly more likely to go without food than those living with both parents ($p = 0.02$). Families with a greater number of children were more likely to have home damage ($p = 0.02$). Table 1 reports differences in participant characteristics and hurricane exposure by food security status.

Regression models are reported in Table 2. The linear regression model significantly predicted hurricane exposures ($F_{(5, 179)} = 4.11, p = 0.001, R^2 = 0.10$). Experiencing food insecurity was significantly positively associated with greater overall hurricane exposure ($\beta = 0.21; p = 0.004$). Being foreign born was also positively associated with greater hurricane exposure ($\beta = 0.15; p = 0.033$).

Only the logistic regression models developed to predict going without food and going without water were significant (respectively, $\chi^2 = 14.63, p = 0.012; \chi^2 = 14.02, p = 0.015$). Controlling for nativity status, the number of parents living with the student, and the number children in the household, participants with food insecurity were at 105% higher odds of going without food during the hurricane ($p = 0.047$), and 132% higher odds of going without fresh water during the hurricane ($p = 0.034$). Those born outside the United States were at 251% higher odds of going without fresh water during the hurricane ($p = 0.006$).

Discussion

This study investigated the impact of Hurricane Harvey on a sample of low-income, ethnic minority youth. The findings of this study are consistent with other studies that have found a high prevalence of disaster exposure among low-income populations. Consistent with our hypothesis, among this population of highly vulnerable youth (82% received free/reduced school meals, 98% ethnic minority), food insecurity significantly predicted greater hurricane exposure. Additionally, greater hurricane exposure was experienced by youth not born in the United States. To the authors' knowledge this is the first study to explore the relationship between food security status and the impact of a natural disaster.

There are a number of study limitations that should be noted. The analysis is limited by the use of child's nativity as a marker for family documentation status. It is likely that although children were born in the United States, parents or other relatives were not, which would likely

Table 1

Demographic and Hurricane Impact Characteristics by Food Security Status, Mean (SD) or n (%)

	Overall	Food Secure	Food Insecure
Overall	185 (100%)	99 (53.5%)	86 (46.5%)
Hurricane exposures			
Total exposures	1.13 (1.47)	0.84 (1.25)	1.47 (1.63)**
Lacked access to food	49 (26.5%)	20 (20.2%)	29 (33.7%)*
Lacked access to water	39 (21.1%)	15 (15.2%)	24 (27.9%)*
Lacked access to medicine	36 (19.5%)	17 (17.2%)	19 (22.1%)
Rescued by boat/helicopter	3 (1.6%)	1 (1.0%)	2 (2.3%)
Home damage	19 (10.3%)	8 (8.1%)	11 (12.8%)
Displaced	20 (10.8%)	6 (6.1%)	14 (16.3%)*
Sex			
Female	88 (47.6%)	51 (51.5%)	37 (43%)
Male	97 (52.4%)	48 (48.5%)	49 (57%)
Age	14.58 (1.78)	14.68 (1.72)	14.47 (1.85)
Nativity			
Foreign born	29 (15.7%)	18 (18.2%)	11 (12.8%)
U.S. born	156 (84.3%)	81 (81.8%)	75 (87.2%)
Number of parents child lives with			
Both parents	114 (61.6%)	65 (65.7%)	49 (57.0%)
One parent	65 (35.1%)	34 (34.3%)	31 (36.0%)
Neither parent	6 (3.2%)	0 (0.0%)	6 (7.0%)**
Number of individuals in the household			
Adults (≥18 years old)	2.25 (1.02)	2.25 (0.97)	2.26 (1.08)
Children (<18 years old)	2.46 (1.32)	2.42 (1.29)	2.50 (1.36)
Race/ethnicity			
Hispanic	145 (78.4%)	76 (76.8%)	69 (80.2%)
African American	31 (16.8%)	17 (17.2%)	14 (16.3%)
Asian	6 (3.2%)	5 (5.1%)	1 (1.2%)
Caucasian	1 (0.5%)	0 (0.0%)	1 (1.2%)
Did not specify	2 (1.1%)	1 (1.0%)	1 (1.2%)
School meal participation			
Free/reduced price	151 (81.6%)	80 (80.8%)	71 (82.6%)
Full price	34 (18.4%)	19 (19.2%)	15 (17.4%)

Note. Significantly different from food security at * $p < 0.05$ or ** $p < 0.01$

increase families' hesitancy to search for and accept aid. Furthermore, this study relies on self-report of adolescents from one school who were enrolled in a PE class, which limits the generalizability to other schools in Houston and nationally. Similarly, experiences during Hurricane Harvey cannot be generalized to all other hurricanes or natural disasters. The factors included in this study are not comprehensive. Other, unmeasured, factors may play a role in the link between food security and hurricane exposure (e.g., mental health, community/built environment factors). Lastly, this study focused on understanding how food security predicted who was a greatest risk for hurricane exposure. Future research in which food security is

Table 2

Standardized Beta or Odds Ratios (95% Confidence Intervals) for Associations between Food Security and Hurricane Exposure, N = 185^a

	Model 1: Total hurricane exposures β (SE of β)	Model 2: Lacked access to food OR (95% CI)	Model 3: Lacked access to water OR (95% CI)	Model 4: Lacked access to medicine ^b OR (95% CI)	Model 5: House damage ^c OR (95% CI)	Model 6: Displaced ^d OR (95% CI)
Food insecurity	0.21 (0.20, 1.04)**	2.05 (1.01, 4.16)*	2.32 (1.06, 5.04)*	1.59 (0.74, 3.44)	1.58 (0.57, 4.38)	3.00 (1.08, 8.34)*
Foreign born	0.15 (0.05, 1.18)*	2.38 (1.00, 5.68)	3.51 (1.44, 8.59)**	2.88 (1.17, 7.09)*	1.85 (0.55, 6.28)	1.03 (0.27, 3.91)
Lives with one parent	-0.13 (-0.82, 0.05)	0.51 (0.24, 1.10)	0.65 (0.28, 1.47)	0.50 (0.21, 1.18)	0.90 (0.31, 2.61)	1.26 (0.47, 3.36)
Lives with neither parent	0.10 (-0.42, 1.98)	3.50 (0.58, 21.27)	2.80 (0.50, 15.74)	0.63 (0.07, 5.94)	3.18 (0.45, 22.25)	1.09 (0.11, 10.77)
Number of children in the household	-0.09 (-0.25, 0.06)	0.87 (0.66, 1.14)	0.95 (0.71, 1.26)	0.97 (0.73, 1.30)	0.70 (0.45, 1.07)	0.95 (0.66, 1.36)

Note. Significantly associated with outcome at * $p < 0.05$ or ** $p < 0.01$

^a No model was developed for being rescued by boat/helicopter because only 3 individuals experienced this exposure

^b Overall model not significant, $\chi^2 = 8.20$, $p = 0.15$

^c Overall model not significant, $\chi^2 = 6.82$, $p = 0.24$

^d Overall model not significant, $\chi^2 = 5.35$, $p = 0.38$

assessed longitudinally is needed to determine the impact of a hurricane on food security over time. Despite these limitations, to the authors' knowledge, this is the first study to examine food security status as a predictor of hurricane exposure and does so among a highly vulnerable population. As such, this study offers some of the only evidence available to inform school and policy decisions regarding aid distribution.

Implications for Health Behavior Practice

As focal points of the community, schools play a critical role in helping students and their families prepare for, cope with, and recover from natural disasters. The results of this study indicate that this may be particularly important for immigrant families. There is a long history of immigrants not applying for public benefits for fear that they may be labeled as “public charge,” which limits their ability to become legal permanent residents (Fremstad, 2000). In Houston, 7.4% of residents are undocumented immigrants (Passel & Cohn, 2019). While declaration of immigration status was not a requirement to access shelters and food distributions following Hurricane Harvey, fear of identification or family separation prevented families from traveling to obtain assistance (Tobia, 2017). However, schools may be perceived differently than shelters or food distribution events because they cannot deny children an education based on their immigration status (United States Courts, 1982, “Plyler v. Doe,” para.1). Schools can declare themselves as “safe havens.” This means that the school will not provide federal authorities the immigration status of the students or parents, and that the school will not allow federal authorities to enter school grounds without a warrant, subpoena, or court order. It is important that school districts remind families that schools are safe havens. During times of natural disasters, utilizing schools as shelters and to distribute aid relief aid may be important strategies to provide assistance to immigrant families. Although the entire school community is likely in need of assistance following a hurricane, this study indicates that immigrant families with food insecurity may have an increased need. Gathering information regarding students' food security status and country of birth at the beginning of the year would enable schools to follow-up with the families likely at highest risk to ensure their wellbeing following a disaster. Schools may be able to help with the provision and distribution of supplies as well as helping families navigate other aid resources.

Discussion Questions

1. Our findings indicate that among an underserved population, youth experiencing food insecurity were more likely to experience negative exposures during Hurricane Harvey. How can this finding be applied to disaster preparedness programs?
2. We found that among this underserved, primarily Hispanic population, those who were foreign born were more likely to experience negative exposures during the hurricane. While this study was not designed to specifically investigate the impact the current immigration political climate had on foreign born families' receipt of aid, it is possible that families may not have sought aid if they were fearful of deportation. How can future disaster preparedness and relief programming be developed to help mitigate this fear and make aid accessible to all individuals during a disaster?

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