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# Food Insecurity After Hurricane Maria: Perceptions and Psychological Effects Among Puerto Ricans

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**ABSTRACT:** Hurricane Maria, a category 4 hurricane, passed through Puerto Rico on September 20, 2017, leaving the island devastated. Maria directly affected the availability of nutritional food for survivors, creating an experience of food insecurity among Puerto Ricans. Using the US Adult Food Security Survey Module (Spanish Version) from the United States Department of Agriculture, Puerto Rican adult households without children (<18 years old) were assessed nine months after the hurricane with the aim of identifying specific groups of households that were food insecure and the psychological effects associated with food insecurity. Forty-six of the 85 households assessed were identified as food insecure, and 25 out of 46 of these households had a household head between 45-64 years old. Within the results from the closed and open-ended portion of the survey, effects of psychological distress were identified in association with food insecurity, along with concerns about the current availability of food, water, services, and lack of preparedness for natural disasters. This study adds an explanatory interpretation of food insecurity and psychological outcomes among Puerto Ricans after the disaster. It is recommended to expand future research through analysis on households with children in association with socioeconomic, sociocultural, sociodemographic, and health issues.

**KEYWORDS:** food insecurity, Puerto Rico, Hurricane Maria, psychological effects

## INTRODUCTION

Food insecurity refers to a lack of people's total accessibility to sufficient food (Behnassi et al., 2011). While individuals can report their own food security, it can also be analyzed at the household level for population studies (Bahn et al., 2021). Four dimensions have been described in association with food insecurity: food availability, access to food, food utilization, and food stability (United Nations' Food and Agriculture Organization [FAO] et al., 2020). Food availability refers to the quantity, quality, and diversity of food available for all people. Food access is the ability to obtain healthy food without physical or economic barriers, decreasing the possibility of malnourishment from lower quality nutrients. Food utilization refers to the way food is used to maximize its adequate nutrition and energy outcomes. Finally, food stability is the consistency of the previous three food security dimensions over time (Bahn et al., 2021; FAO et al., 2020).

Food insecurity is related to lower quality eating patterns in Americans from childhood to adulthood, leading to poor health throughout their lifespan (Champagne et al., 2007; Schroeder & Smaldone, 2015). A study made in 36 counties of the Delta region of Arkansas, Louisiana, and Mississippi found that people who reported their households as food insecure were more likely to have poor measures of physical and mental health (Stuff et al., 2004), which in turn increase the risk of cancer, stroke, cardiovascular disease, and diabetes—the four largest causes of death in the United States (Schroeder & Smaldone, 2015).

Climate change increases the frequency and severity of natural disasters which, in turn, negatively impact the four dimensions of food security (FAO et al., 2014; Mbow et al., 2019). Hence, the environment can play a crucial role in determining food security as a component of overall health.

### Food Insecurity in Puerto Rico before and after Hurricane Maria

Changes in climate and temperature affect the timing of agricultural production, food prices, and availability (USDA Caribbean Climate Hub, n.d.). In 2015, Puerto Rico was identified as noncompliant with the four dimensions of food security (Gould et al., 2015), determined by their heavy dependence on imported

food. It is estimated that 80% of the food consumed in Puerto Rico is imported (Charles, 2017) and, thus, disruptions to their food supply chain severely compromise all four dimensions of food security.

On September 20, 2017, at 6:15 a.m., Hurricane Maria, a Category 4 tropical cyclone on the Saffir-Simpson scale, made landfall in Puerto Rico's southeast. It crossed the entire island with sustained winds of 155 miles per hour, leaving a significant path of destruction (El Nuevo Día & Primera Hora, 2017). Hurricane Maria was the strongest hurricane to make landfall in Puerto Rico since 1928 (Pasch et al., 2019) and represented a major historic setback for the country, leaving 100% of the island without power, 60% of the island's people without water, as well as downing 92.7% of telecommunications on the island (El Nuevo Día & Primera Hora, 2017).

Food insecurity was exposed in Puerto Rico during the aftermath of Hurricane Maria. Food imports increased from 80% to 95% as a direct, negative consequence of the natural disaster (Díaz Rolón, 2018). Docks were closed for more than five days, disrupting food distribution to the different municipalities, and reducing Puerto Ricans' access to necessary and nutritional food, worsening their food insecurity (Díaz Rolón, 2018). Food aid should meet the federal Dietary Guidelines for Americans, which provides the advice needed to improve health through healthy dietary patterns decreasing the chance of getting chronic diseases. One of the guidelines states to "limit foods and beverages higher in added sugars, saturated fat, and sodium," among others (USDA & HHS, 2020). However, food aid received by Puerto Ricans was reported to contain chips, candy, high sodium, added sugars, and saturated fats (Milken Institute School of Public Health, 2018).

### Psychological Effects of Food Insecurity and Hurricanes

Jones (2017) studied the association between food insecurity and mental health across 149 countries at an individual level. The study found food insecurity was associated with poorer mental health outcomes. Being insecure about acquiring and maintaining sufficient nutritious food was associated with stress that may trigger anxiety and depression. Obtaining food in a socially unacceptable way can lead to social isolation, powerlessness, shame, and guilt associated with depression (Jones, 2017).

Natural disasters like hurricanes also take a significant toll on survivors' mental health (Mental Health First Aid USA, 2017). Survivors experience the loss of material resources and social support, which increases psychological distress (Makwana, 2019). After hurricanes, people may experience anxiety as the most common psychological impact (Makwana, 2019). Other negative outcomes of these traumatic experiences may result on post-traumatic stress disorder (PTSD), sleep disturbances, alcohol or drug use and abuse, and depression (Makwana, 2019). These conditions affect daily functioning and may lead to future family or community problems.

We aim to better understand the perceptions and psychological effects of food insecurity among Puerto Rican survivors of Hurricane Maria nine months after it made landfall. Since Puerto Rico experienced a large-scale decimation of the food supply chain and agriculture after Hurricane Maria, it was hypothesized that food security among Puerto Ricans was negatively compromised.

## METHODS

### Study Design

We conducted a cross-sectional study with single-timepoint, anonymous, survey data collection among a nonprobabilistic sample of heads of households without minors in Puerto Rico's second-level administrative divisions, called municipalities, which are akin to cities within states.

### Participants

The study was actively promoted from June 11 through June 20, 2018, for a total of 10 days, through a social media link on Facebook and Instagram. Eligible participants were adult heads of households without minors who responded to the online survey. Since the measurement of food insecurity in households with minors has not been validated for the U.S. Department of Agriculture's U.S. Adult Food Security Survey Module (Spanish Version) due to the short time spent conducting the survey, households with minors were excluded from the study.

## Survey Instruments

### *Demographics*

The first four questions were intended to collect respondents' demographic information on their age range (<18, 18-24, 25-34, 35-44, 45-54, 55-64, 65-74, and ≥75 years old), their municipality of residence, the presence of a minor (<18 years old), and the number of people residing in the household.

### *Food Insecurity*

We used the U.S. Adult Food Security Survey Module (Spanish Version, U.S. Department of Agriculture, 2013). The adult stages of the survey module consisted of ten questions about experiences and behaviors indicative of food insecurity. The questionnaire's 12-month recall period was rephrased to "after Hurricane Maria," which corresponded to a nine-month recall period at the time of data collection. Five questions were dichotomous. Three questions had the choices "often true," "sometimes true," and "never true," and two questions had the frequency choices "almost every month," "sometimes but not every month," and "every 1 to 2 months." All questions included "I don't know" as an alternative.

### *Closed and Open-ended Questions*

Four additional questions were included to explore other factors that could contribute to Puerto Ricans' perception of food insecurity after the disaster. The first three closed-ended questions (see Appendix, Table 3), with "Yes" and "No" as the choices of answers, asked about receiving federal help, consuming locally sourced products before Hurricane Maria, and being prepared for the following storm season in 2018, respectively. Finally, in an open-ended question, participants were asked to leave any additional unprompted comments about their experiences after the disaster.

## Data Analysis

Demographic responses and the three questions regarding factors contributing to the perception of food insecurity were analyzed using descriptive statistics (frequencies). From the end of the U.S. Household Food Security Survey Module, a subsection called *Coding Responses and Assessing Household Food Security Status* were used to classify the food security

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of each household. The sum of affirmative responses to a specified set of items is referred to as the household's raw score on the scale (US Department of Agriculture, 2013). Interpretation of the raw scores for adults are as follows:

- **High food security** (raw score = 0): no reported indications of food-access problems or limitations.
- **Marginal food security** (raw score = 1 or 2): one or two reported indications typically caused by anxiety over food sufficiency or shortage of food in the house.
- **Low food security** (raw score = 3, 4, or 5): reduced quality, variety, or desirability of diet
- **Very low food security** (raw score >5): multiple indications of disrupted eating patterns and reduced food intake.

Food-secure households reported high or marginal food-secure raw scores (i.e., <3). Conversely, food-insecure households reported low or very-low food security raw scores descriptions (i.e., ≥3).

Lastly, closed and open-ended questions and comments were analyzed to identify themes in association with food insecurity. We used applied thematic analysis (Guest et al., 2012) to group text responses into three categories: perceptions of psychological distress, concerns about food supplies, and preparedness for future hurricane seasons.

**RESULTS**

A total of 150 responses were obtained during the survey period, 63 (42%) of which were excluded due to the presence of minors in the household. Two additional responses were excluded because the responses were provided by minors, leaving an analytic sample of 85 responses. On average, participants completed the questionnaire in less than 5 minutes, and most participants took time to answer the open-ended question.

Most respondents lived in the northeast and south of the island (see Appendix, Figure 1). Table 1 (see Appendix) presents the household data collected, showing food insecurity in 46 (54%) of them. Overall, respondents' ages ranged from 18 to 75 and older. Table 2 (see Appendix) summarizes household food security by age groups, showing that the most food insecure heads of the household were between 45 and 64 years old.

**Open-Ended Questions**

Participants reported symptoms of psychological distress such as anxiety, depression, bad memories, and sadness, that, according to them, have marked their lives, as illustrated by the following quotes:

I feel scared, anxious, and worried. (65-74 y.o.)

I am shocked thinking about what happened to us. We lost the joy and the enthusiasm. I am different after the hurricane. (65-74 y.o.)

Hurricane Maria affected me emotionally. I fell into a deep depression to see how the hurricane raged rife on my island. I passed Hurricanes Hugo and George, but never saw so much devastation that Maria did. There were many deaths due to the lack of power for dialysis patients, and long lines to buy food, and when you get there, they told you the food ran out. We had to go back the next day to see if we could reach something many times; we had the money and there was no food. This marked my life forever. I had 7 months without power. I could say more, but it affects me a lot to remember! (55-64 y.o.)

Participants also reported concerns about lack of food and water supplies, power, and economic assistance of emergency services, as illustrated by the following quotes:

The lack of agility in providing needed services since Hurricane Maria has claimed many lives. The aid was extremely slow, and the first meal of help that we received was from a US aid group almost a month or a month and a half later. It was all between neighbors helping each other. There are bedridden and seriously ill people who do not have power yet or enough help. Just a few days ago, the power came to some neighborhoods in my town, Yabucoa. (25-34 y.o.)

I had been 8 months without power. (18-24 y.o.)

Up to this day, I haven't got my stuff fixed at my apartment, to the point, that I had to move out of there and find something much safer and reliable just in case something else happen. (35 to 44 y.o.)

The little food available in supermarkets worried me after Hurricane Maria. (55-64 y.o.)

There was no federal or national (Puerto Rico) economic assistance for our family. Only on two



occasions, we received rations boxes of military food and two water packs of 35 bottles. In the period from September to December 2017. That was it. It should be noted that the military rations were high in sodium, potassium, cholesterol, trans fat, sugar, and spiciness, which are outside of the diet of our families. We lost a lot of body weight. Altogether, we lost 30 pounds in 3 months. (45 to 54 y.o.)

In our case, the crisis was the water. When living in a rural area, water arrives through pumps and electricity took 4 months to recover. Therefore, all our supplies were gone. I had to search for home and for my parents, who are aging. The municipality took a month and a half to supply water in tank trucks to the neighborhood. They parked it in a place where people had to go looking for it, and people who did not have access to get it were left without water. Another option was an oasis of a water pump from the AAA that was in another municipality, and they only filled 10 gallons per family, and if more was requested, you had to pay for it. It was a frustrating and challenging experience. In my case, we all lost weight, but it was not due to the lack of food, it was because of all the trips that had to be made every day to look for water. (55-64 y.o.)

Last, participants also reported concerns about preparedness for the possibility of future hurricanes and other natural disasters, as illustrated by the following quotes:

We are not prepared for another hurricane.  
(25-34 y.o.)

The government should be more prepared.  
(35-44 y.o.)

I am worried that Puerto Rico is not prepared to face another atmospheric phenomenon.  
(55-64 y.o.)

## DISCUSSION

This study hypothesized that food security among Puerto Ricans was compromised nine months after the catastrophe. Eighty-five households were included in this study, more than half (n=46, 54%) of which were deemed food insecure. People between 18 to 44 years old (n=17, 37%) reported having less food insecurity than people between 45 and older (n=29, 63%). Contrasting these

findings, a study from Clay and Ross' 2020 assessed the factors related to food insecurity after Hurricane Harvey in Texas. It found participants 45 years and older were less likely to report food insecurity than respondents 18 to 44 years old (Clay & Ross, 2020). It suggests that previous experiences with hurricanes helped prepare the elderly residents to deal with food insecurity better than younger residents who lacked the same experiences. This difference might be related to socioeconomic factors such as education, income, and/or residence area.

A similar amount of people (n=47, 55%) who reported being insecure also reported that they had not received food supplies or economic assistance. At the household level, factors contributing to food insecurity can be associated with financial instability (Clay & Ross, 2020).

The eating patterns for Puerto Ricans were altered, exhibiting a changed relationship with food security. 91% of the households surveyed consumed locally produced foods, and during Maria, they lost access to these resources. People who experienced low or very low food security reported having some anxiety about food sufficiency as well as multiple indications of disrupted eating patterns and reduced food intake. Food and military supplies sent by emergency agencies were not nutritionally sound and may have caused negative alterations in participants' daily regimen diet. Ultimately, the quality, quantity, and availability of food were negatively impacted.

Poor mental health is an important outcome stemming from the aftermath of a natural disaster and the resulting food insecurity. The post-hurricane psychological effects reported by participants included behaviors compatible with anxiety, depression, and distress, contributing to the fear of being unprepared for another catastrophic event. Most participants who expressed these feelings of anxiety, depression, and distress were between 55 and 74 years old. This might be an explanation of the forty-seven percent of the respondents who reported not being prepared for the following year's storm season. These mental health outcome findings are consistent with a Clay et al. (2018) study conducted in Louisiana and Mississippi. It found mental health outcomes such as depression and anxiety in vulnerable female-headed households with a higher risk of exposure to natural disasters contributed to food insecurity during a long-term recovery phase after Hurricane Katrina. Although our study was not explicitly focused on people's sex (male or female), a comparison may be made between the

mental health outcomes after hurricanes in areas highly exposed to natural disasters like Puerto Rico, Louisiana, and Mississippi.

Participants of all age groups, on the other hand, reported concerns about lack of food, economic assistance and doubts about preparedness for the next hurricane season.

### **Study Limitations**

This study has some limitations worth noting. The survey was open during a short 10-day period, yielding a relatively small sample size that is not necessarily representative of Puerto Rico's population. People from the same household may have answered the survey more than once; therefore, duplicated surveys cannot be ruled out. Self-reported data may also prompt recall and social desirability biases (Althubaiti, 2016, p. 212). Particularly stressful events in association with natural disasters may also prompt recall bias. Although the survey was available six months after Hurricane Maria hit, electrical power, internet, and cellular coverage were still not fully available in all of Puerto Rico, potentially denying people access to it.

### **CONCLUSION**

This study offers insight on food insecurity in Puerto Rico after Hurricane Maria, assessing the perception of food insecurity alongside its psychological effects. Based on a household level of adults' heads without children, people from younger ages showed a higher perception of food insecurity than older people. Although many people perceived food security, interventions should be made to educate and prepare young people to combat food insecurity during and after natural disasters. Recommendations of government nutrition assistance programs during storm seasons also might help to address this issue. Lastly, the government should continue preparing the Puerto Rico population for future hurricanes providing guidelines for having access to sufficient and nutritional food during these disasters.

Future research is recommended to collect more data on households with children around the island. Other factors recommended for investigation in future studies should include more data about participants' sex, age, race, employment status, income, and/or physical and mental health status. In addition to that, geographic areas, government disaster assistance programs, and/or home structural damage might help to analyze the food insecurity perceptions and psychological effects among Puerto Ricans deeply.

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**APPENDIX**



**Figure 1.** Responses by Municipalities Surveyed.

Note. Adapted from 2019 Puerto Rico, by Moon Travel Guides, 2019 ([https://i2.wp.com/www.hachettebookgroup.com/wp-content/uploads/2019/01/08\\_01\\_PuertoRicoMunicipali.jpg?ssl=1](https://i2.wp.com/www.hachettebookgroup.com/wp-content/uploads/2019/01/08_01_PuertoRicoMunicipali.jpg?ssl=1)). Copyright 2019 by original owners.

Municipality	Households included (n=85)	Food Security (US Department of Agriculture, 2019)			
		High (n=20)	Marginal (n=19)	Low (n=21)	Very Low (n=25)
Humacao	12	1	3	3	5
San Juan	11	3	4	—	4
Maunabo	6	2	2	1	1
Las Piedras	7	2	1	3	1
Yabucoa	10	2	1	3	4
Bayamón	6	1	—	3	2
Carolina	7	2	4	1	—
Naguabo	2	1	—	1	—
Guaynabo	3	1	—	—	2
Toa Alta	2	1	—	1	—
Juncos	1	—	—	1	—
Cataño	3	—	2	—	1
Canóvanas	2	—	—	2	—
Dorado	2	—	—	1	1
Fajardo	2	1	—	1	—
Trujillo Alto	2	—	1	—	1
Coamo	1	—	—	—	1
Juana Díaz	1	1	—	—	—
Luquillo	1	—	—	—	1
Mayagüez	1	1	—	—	—
San Lorenzo	1	—	1	—	—
Toa Baja	1	—	—	—	1
Vega Alta	1	1	—	—	—

**Table 1.** Households surveyed in Puerto Rico.

Age Ranges (years)	High Food Security	Marginal Food Security	Low Food Security	Very Low Food Security	Total of Food Secure Households	Total of Food Insecure Households	Total
18-24	1	2	5	6	3	11	14
25-34	2	—	1	2	2	3	5
35-44	—	2	1	2	2	3	5
45-54	4	3	3	6	7	9	16
55-64	10	9	7	9	19	16	35
65-74	2	3	3	—	5	3	8
≥75	1	—	1	—	1	1	2
Total	20	19	21	25	39	46	85

**Table 2.** Food Security by Age Groups in the Study Sample.

	Yes		No	
	Total responses (n=)	Percentage	Total responses (n=)	Percentage
Did you or your family receive any federal help after Hurricane Maria? (Examples: foods and/or economic help)	38	45%	47	55%
Did you or your family consume local food or products before Hurricane Maria? (Examples: avocados, plantains, coffee, etc.)	77	91%	8	9%
Are you prepared for this new storm season 2018?	41	48%	44	52%

**Table 3.** Closed-Ended Questions (as stated on the survey).