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Assessing Food Insecurity among US Adults during the COVID-19 Pandemic

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ABSTRACT

This research examines the intersection of social vulnerability, risk, and their impact on individual food insecurity odds during the COVID-19 pandemic. Data come from a national, post-stratification weighted sample of U.S. adults (n = 10,368). Logistic regression analysis confirms what we hypothesized – socially vulnerable, fearful, persons in poorer health, and those with higher levels of depressive and anxiety symptoms have higher food insecurity odds. Findings underscore the importance of redesigning food systems in the U.S. during health crises like the current one; alternative strategies to meet increased food needs in the face of a pandemic are discussed.

KEYWORDS

Food Insecurity; vulnerability; COVID-19; risk; fear

Introduction

In January 2020, the first case of the novel coronavirus (COVID-19) was confirmed in the United States (US). By early February 2020, the US recorded its first death due to COVID-19 and now over 200,000 deaths have been attributed to the virus.[1] While certainly alarming and consequential, the secondary effects of COVID-19 will likely extend well beyond the direct impact on those persons contracting/dying from the virus. For example, the US Department of Labor reported 6.6 million unemployment insurance claims in the single week ending on March 28. By the end of March, the US Bureau of Labor Statistics reported over 700,000 jobs had been lost. Thus, while the virus poses a direct public health danger with significant impact on US mortality and morbidity, the spillover effects of COVID-19 on the economy pose a significant indirect threat on the security of millions across the country.

Certainly, one consequence of the dramatic reduction in employment is an increase in those struggling to feed themselves and their families. The increased need is more than the existing patchwork system of emergency food provision can handle, as evident by recent reports of inadequate resources at food banks across the country.[2] Simply put, COVID-19 poses

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a serious threat to the nutritional health of millions. The scope of this public health crisis is slowly being documented, with an increasing number of reports highlighting not only how many people are being affected by food shortages across the country, but also who are the most vulnerable to experience food insecurity during disaster-like events similar to the current pandemic.[3–7] Preliminary work seems to indicate that food insecurity is not evenly spread across the country, nor is it evenly spread across racial and ethnic subgroups.[8] As such, we aim to add to both the "how much and who" discussion, paying special attention to the social vulnerabilities that exist prior to such events, but are exacerbated and made clearer in the event of large-scale disasters such as the COVID-19 pandemic.

Food insecurity is defined as "access by all people at all time to enough food for an active, healthy life."[9] Food insecurity is linked to a myriad of poor health and cognitive outcomes for children, adolescents, and adults. Nutritional deprivation, stunting, higher rates of adult mortality, and chronic disease morbidity make this a key marker of sustained poverty among American households.[9–15] National estimates show that food insecurity peaked at nearly 15% in 2011 following the Great Recession.[9] While the prevalence of food insecurity has declined since the previous economic crisis, it has remained as high as 11% – approximately 37 million U.S. residents were food insecure in 2018.[9]

Prior to COVID-19, wide disparities in food insecurity were stark with rates elevated above the national average for poor households, households with children, single-parent households, people living alone, and Black- and Hispanic-headed households, as well as households in principal cities.[9] Early evidence suggests that many of these disparities continue and have possibly widened within the context of the current global pandemic.[6,7] We refer to these factors as vulnerability – characteristics (variables) that collectively shape the likelihood that a person or social group will experience an adverse effect when impacted by a hazardous event, such as the COVID-19 pandemic.[16] While most U.S. residents have been "exposed" to some degree of risk due to COVID-19, not all residents are equally vulnerable – biological, economic, social, or psychological risks vary across groups. Early empirical reports have demonstrated, for example, that communities of color have had significant upswings in COVID-19-related mortality and morbidity, in part because of where people live coupled with the already increased susceptibility that is a function of their chronic disease and elevated physical and mental health risks.[17–19] We suspect these vulnerability differences would also be true for persons at risk of experiencing food insecurity during such an event.

Food During A Crisis

The food supply chain has been substantially crippled, and the shutdown of service providers and businesses primarily responsible for feeding much of

America illustrates the tenuous nature of food security for many.[20] Moreover, worldwide economic indicators suggest that the consequences of this pandemic will be widespread and time lagged. Thus, there are few guarantees of any swift return to "normal." With rising unemployment, increased SNAP enrollment, and a general economic downturn, a whole new segment of persons experiencing the consequences of poverty – and, accordingly, food insecurity – have emerged. This new reality for many has translated into a complex puzzle of how and where to get food. For many individuals across the U.S., the places they would expect to go for food are no longer open, or the food that they have long trusted to always be on the shelves has disappeared. In short, disentangling the demographic and social factors linked to food insecurity is a critical piece of the puzzle necessary for stakeholders tasked with sustaining the health and wellbeing of their communities during a public health crisis. Knowing more about who is at risk and why they are at risk may provide critical data to those needing to make informed and impactful strategic decisions when it comes to designing appropriate pathways for addressing complicated food-focused needs. Whether it means changing the way people access food, finding alternatives to how we deliver food, or even providing different types of food, doing things the way they always were done is not likely to work in an environment characterized by heightened fear, anxiety, and uncertainty.[17]

Food insecurity during natural, economic, or public health crises is nearly a forgone conclusion.[10,11,21,22] While we expect food insecurity to be elevated during these types of events, the *magnitude* of food insecurity and, in turn, *who* is most affected by it has received relatively little attention.[7] Additionally, we know very little about what types of social, economic, and health factors might be important for determining levels of self-reported food insecurity among individuals living through a pandemic or a similar crisis.[7] Moreover, the fact that COVID-19 requires us to maintain physical distance from each other which, in turn, has required many work operations to cease or at least pause, highlights a taken-for-granted feature of the existing food distributions system – the primary means of food distribution is by payment through wages earned by working.[23] Within the context of COVID-19, the flaw of this particular feature of our food systems is now more visible than ever before.

Building from the literature on natural disasters, our study identifies specific risk factors shaping the odds of adult food insecurity. Those factors capture some of the conceptual complexity of the intersection of individual, family, social group, and community-level characteristics acting as vulnerabilities and risk exposures. Certain levels of social vulnerability and individual or community risk will likely correlate with higher levels of food insecurity. Thus, we expect to find significant differences across population subgroups not unlike what earlier studies have documented in terms of these social vulnerabilities.[10–12,24]

Social Vulnerabilities

Vulnerability does not exist just because a group is exposed to a hazard; rather, vulnerability stems from a complex set of social forces (e.g. discrimination, residential segregation, limited access to resources, etc.) that occur over long periods of time and are experienced on a regular basis. While the COVID-19 pandemic may be revealing vulnerabilities to food insecurity, it is important to understand that such vulnerability is the "result of marginality, of everyday patterns of social interaction and organization, and access to resources" rather than simply exposure to a hazard such as COVID-19.[16] Given well-documented inequalities in the health risks related to natural and public health disasters,[10,12,21] we examine some of these characteristics and hypothesize about their importance for food insecurity in the context of the COVID-19 pandemic setting. For example, those who are older, racial and/or ethnic minorities, lower-income individuals, women, the unemployed, families with children, and unmarried persons experience disasters differently than their counterparts – in part because of the already difficult circumstances that many of them are living in, as well as the limited access to resources exacerbated by the circumstances of the disaster itself. As such, we *hypothesize that these socially, culturally, and economically disadvantaged groups will have higher odds of food insecurity compared to their younger, white, non-Hispanic, male, employed, families without children, higher income, and married counterparts.*

Individual Risks

Beyond social vulnerabilities, there are individual-level risks factors related to health that also impact food insecurity. Chronic conditions related to mental and physical health impact food insecurity directly by presenting additional challenges in accessing food, but also because they are related to higher medical costs, and medical debt which is uniquely associated with higher food insecurity rates.[25,26] Mental health symptomatology generally and depressive and anxiety symptoms specifically are some of the most common mental illnesses found in the general population.[27] Mental health symptomatology has been linked to both the food insecurity and natural disaster literatures, although few studies have examined them simultaneously. More specific for our purposes, the disaster literature demonstrates that depression and, to a lesser extent anxiety, are associated with experiencing a wide range of traumatic events, including food insecurity.[10,28,29] We expect this direct link between food insecurity, depression, and anxiety to emerge in this public health crisis setting like that of a natural disaster and as such hypothesize that *persons reporting more depressive or anxiety symptoms will have higher odds of food insecurity during the COVID-19 pandemic than persons who report fewer depressive or anxiety symptoms.*

Moreover, chronic physical health conditions have been found to be a strong predictor of who tends to experience greater and more sustained

levels of food insecurity.[30–32] Symptoms of poor physical health or impairment can impact individual's ability to access food, particularly in built environments where there is little consideration for physical impairment or other symptoms of poor physical health. Given this documented link between health and access to food, we expect that *persons reporting more physical symptoms will have higher odds of food insecurity than those persons who report fewer physical symptoms.*

Finally, we examine the role played by fear of the novel coronavirus (COVID-19) as a risk factor for food insecurity. Fear is manifested in a number of different ways across a variety of population subgroups.[33] Some individuals are impacted more than others and we anticipate that fear, as it relates to the COVID-19 pandemic, will be an important risk factor to consider in determining how people come to view their current circumstances in general, and as it relates to food.[17] If people are fearful about transmission, about the virus' impact, and about their particular vulnerability, this perception may be an important correlate of food insecurity in this type of setting. Those who are more fearful may avoid food stores or other face-to-face means of food acquisition (e.g. food banks or other emergency food provision services) that they might utilize if they had less fear of the virus itself. Given the already limited means of food acquisition open to a large proportion of individuals across the U.S., fear may undermine already tenuous food situations. While there is little or no substantive, empirical literature to guide our expectation, we nevertheless expect that *persons reporting higher levels of fear of the novel coronavirus will have higher odds of food insecurity than those persons reporting less fear.*

Data and Methods

A sample of 10,368 adults (ages 18 and over) provides the data for the current analysis. An online survey was released on March 23, 2020 through Qualtrics Inc. to a national panel of U.S. residents who participated in an IRB-approved survey. Questions range from general fear and anxiety related to COVID-19 to social and behavioral health changes, and physical/mental health assessments on a number of different indicators. The final sample of 10,368 was post-stratification weighted by gender, age, race, income, and geography (state) in order to ensure the equitable contribution to respondents across their individual demographic and geographic strata relative to their representation in the overall population of the United States. National-level estimates of weighting criteria were taken from the United States Census Bureau's American Community Survey (5-year) estimates as of 2018, the most current year available. As is standard when using survey data, this post-stratification weighting schema is applied to our descriptive and inferential analyses.

Measurement

The focus of this study and the dependent variable of interest is *food insecurity*, measured *using the standard, 10-item*, USDA Adult Food Security Module.[9] The food insecurity module begins with the following prompt: "Thinking about your experience with food over the last 3 months." We recognize the importance of this difference from the standard last 12 months or last 30 days assessment, but we are specifically interested in the impact of the COVID-19 pandemic. Given that, globally, the first COVID-19-related deaths were reported in January, and the survey was administered in late March, a 3-month window was appropriate for capturing food insecurity that coincided with the onset and exacerbated consequences of the pandemic. Respondents were provided a series of statements to which they could respond with "often true," "sometimes true," "never true." They responded to the following statements: 1) I worried whether my food would run out before I got money to buy more; 2) The food that I bought just didn't last and I didn't have money to get more; 3) I couldn't afford to feed myself or family a balanced meal because I couldn't afford it; 4) I relied on only a few kinds of lost-cost food to feed myself or family because I was running out of money to buy food. The remaining questions could be responded to with "yes," "no," including the following: 5) cut the size of your meals because there wasn't enough money for food; 6) eaten less than you felt you should because there wasn't enough money for food; 7) skipped meals because there wasn't enough money for food; 8) been hungry but didn't eat because there wasn't enough money for food; 9) lost weight because there wasn't enough money for food; and 10) did not eat for a whole day because there wasn't enough money for food. All affirmative responses were coded as 1. Consistent with previous use of this measure, respondents who answered in the affirmative to 3 or more items were considered food insecure, while those who answered in the affirmative to 2 or fewer items were considered food secure.[9] The recoded scale was reliable with a α = .92.

Social Vulnerability Variables

We include a number of sociodemographic variables related to food insecurity amidst disasters among adult survivors. The variables included in the analysis are: *age in years*; gender (female = 1); *race*, coded as a series of dummy variables (Black = 1; Asian = 1 Native American = 1; and Other Races = 1), with white as the reference category; *Hispanic status* (Hispanic = 1); *income* (amount earned in 2019 coded across seven categories); *families with children* (Yes = 1); *employment status (unemployed = 1); nativity* (foreign born = 1); and *marital status* (unmarried = 1).

Individual Risk Variables

A measure of *depressive symptoms* was included as a potential risk factor for food insecurity. This variable was measured with a shortened version of the 20-item Center for Epidemiological Studies for Depression (CES-D) Scale,[34] and has been used extensively to measure depressive symptoms.[35–38] For our purposes, eleven items from the CES-D scale were used to assess affect and somatic symptomatology in our sample. The weighted scale was reliable (α = .94). Survivors were asked how often over the past couple weeks they felt sad, lonely, worrisome, or had trouble sleeping, getting up in the morning, etc. Possible responses ranged from 0 (less than 1 day) to 3 (5 to 7 days) for each item. The shortened CES-D scale used here was weighted by 1.8 (the number of items in the original measure divided by the number of items in our shortened measure) in order for us to be able to make comparisons with other studies in disaster/public health crises, as well as the general population using the full 20-item questionnaire.

Generalized anxiety symptoms are measured using the GAD-7 item scale with 7 items that assess frequency of symptoms over the past 2 weeks from the time the instrument was administered in early March 2020.[39,40] The responses are scored on a 4-point Likert scale ranging from 0 = never to 3 = nearly every day. Total score when summed can range from 0 to 21. The scale was reliable (α = .94).

Physical symptoms are measured using a standard collection of physical ailments typically reported by persons experiencing both acute and chronic illness. Respondents were asked if they experienced any one of the 23 health symptoms in the last month prior to the interview. Health symptoms included: frequent headaches, sore throat/repeated cough, dizziness, shortness of breath/difficulty breathing, coughing up blood, frequent backaches, stomach problems, broken bones, skin problems, etc.[41] Respondents answered yes = 1 or no = 0 and the items were summed into a symptoms scale that was reliable (α = .77).

The final risk variable was a *subjective assessment of fear*. While there are a number of strategies used to assess generalized fear and anxiety in individuals,[42,43] these measurement strategies often utilize single items that could be a useful screening tool to further examine what is at the root of the fear and its manifestations. In the current study, our interest is in giving as little guidance as possible to the respondent as to how they should think about it or frame it; rather, we simply ask respondents to numerically rate on a sliding scale of 0–10 "how they would currently rate their fear about COVID-19." The average response was nearly 7 with a S.D. = 2.8.

Statistical Methods

Descriptive statistics are presented to help the reader orient to the sample characteristics that we report. Additionally, we provide a descriptive table that

examines the bivariate relationships between varying levels of food insecurity, social vulnerabilities, and individual risk factors. In the case of categorical vulnerabilities, percentages across food insecurity categories are presented along with X^2 values that assess the statistical significance of those categorical relationships ($p < .01$). In the case where vulnerabilities/risks are continuous level variables, we present one-way ANOVA with F values that assess statistical significance ($p < .01$). The primary focus of the analysis is an examination of the relationships between social vulnerabilities, individual risks, and food insecurity. Model significance, odds ratios, and model fit statistics are included in the logistic regression tables that examine these relationships with our focal dichotomous dependent variable (1 = moderate to high food insecurity).

Results

Table 1 provides a descriptive overview of the variables that are being used in the current individual-level analysis. Means, standard deviations, and percentages, where appropriate, are presented. More than one-third of respondents report either moderate or high food insecurity. The sample is nearly evenly split in terms of gender, though a slightly older sample, with approximately 28% nonwhite, nearly 50% earning less than 50,000 USD per year in a household, nearly 90% are native-born, approximately 18% are of Hispanic

Table 1. Descriptive statistics for model variables (n = 10,368).

	%	Mean	S.D.
Dependent Variable			
Food Insecurity (1 = Moderate to High Food Insecurity)	38.3%		
Social Vulnerabilities			
Gender (Female)	51.0%	–	–
Race White	60.8%	–	–
Black	12.4%	–	–
Asian	5.5%	–	–
Nat. Am.	0.6%	–	–
Other Race	0.3%	–	–
Hispanic Status	18.2%		
Marital Status (Unmarried)	54.7%	–	–
Work Status (Unemployed/Not Working)	19.6%	–	–
Families w/Children	25.0%	–	–
Foreign Born	10.6%	–	–
Age	–	47.4	17.7
Individual Risks			
Subjective Fear (0–10)	–	6.6	2.8
Physical Symptoms (0–23)	–	1.7	2.5
CES-D Symptomatology (0–60)	–	16.9	15.7
Generalized Anxiety Symptomatology (0–21)	–	6.1	6.4
Income <$25 k	23.9%	–	–
Income $25 k-$35 k	13.3%	–	–
Income $35 k-$50 k	13.4%	–	–
Income $50 k-$75 k	17.5%	–	–
Income $75 k-$100 k	12.9%	–	–
Income $100 k-$150 k	11.6%	–	–
Income >$150 k	7.4%	–	–

origin, and the majority of the sample (55%) are unmarried. While there are some slight differences comparing this sample to what we know as true population estimates, the sample is representative and, in many ways, mirrors the current U.S. adult population.

Table 2 provides a bivariate assessment of statistically significant relationships using either a difference in means test (X^2 of proportional differences test) or a one-way ANOVA (F-test). We report statistical differences ($p < .01$) between groups of food insecurity (no, low, moderate, and high) and categorical and continuous measures of social vulnerability and risk. Food insecurity varies significantly across every variable of social vulnerability in the table; however, some differences are small, while others are more substantial. Among Black respondents, less than a third report no food insecurity. Less than a quarter of Native American respondents could say they have experienced no food insecurity. Similarly, barely over a quarter of unemployed respondents report no food insecurity. Less than a third of the lowest income group report no food insecurity. Further, there are stark differences in the average levels of physical and mental health reported across food insecurity groups, with those in the higher categories of insecurity reporting more symptomatology across all three measures. Thus, the primary finding from Table 2 is food insecurity differs across individual social characteristics, particularly race, ethnicity, gender, income category, employment status, as well as risk-related factors including mental/physical health, and expressed fear.

Table 3 presents logistic regression that examines the independent and collective odds of food insecurity across social vulnerabilities and individual risks as a series of combined characteristics. Reference categories for all variables are listed in the footnote of Table 3. The table presents odd ratios, 95% confidence intervals, along with descriptive measures of overall model significance (X^2 and Nagelkerke R^2). All of the social vulnerability variables are significantly associated with food insecurity except for marital status. Women are less likely than men to experience food insecurity. All racial groups are more likely to experience food insecurity when compared to whites, except for Asians who have lower odds. Black and Native American respondents are nearly twice as likely to be food insecure compared to whites. Hispanic respondents are 30% more likely to be food insecure than non-Hispanics. Surprisingly, the unemployed are only slightly more likely to be food insecure than the employed, controlling for other key individual vulnerabilities. Additionally, families with children, foreign-born respondents, those reporting more subjective fear, physical health symptoms, depressive symptoms, and generalized anxiety symptoms, all experience higher odds of food insecurity. As age increases, the odds of food insecurity are slightly lower. Those in the lowest two income categories are between two and three times as likely to be food insecure than the reference income group. Overall, the model is statistically significant ($p < .000$) and the Nagelkerke R^2 is approximately 36%.

Table 2. Bivariate associations among model variables and food insecurity categories (n = 10,368) food insecurity categories (# of cases).

	No	Low	Moderate	High	X^2/F[a]
	(4915)	(1483)	(1639)	(2331)	p
Social Vulnerabilities					
Gender, Female	46.1%	14.9%	17.5%	21.5%	X^2 = 33.6
Male	48.9%	14.7%	14.0%	23.5%	.000
Race White	52.7%	12.8%	13.1%	21.3%	X^2 = 482.3
Black	28.9%	16.4%	23.9%	30.8%	.000
Asian	49.8%	16.7%	15.8%	17.7%	
Nat. Am.	22.1%	32.8%	13.9%	31.1%	
Other Race	32.5%	20.4%	26.8%	20.4%	
Hispanic Status	28.1%	18.5%	24.2%	29.2%	X^2 = 360.1
Non-Hispanic Status	51.7%	13.4%	13.9%	21.0%	.000
Marital Status Unmarried	38.8%	15.7%	19.5%	26.1%	X^2 = 392.4
Married	57.8%	12.6%	11.4%	18.1%	.000
Work Status Unemployed/Not Working	26.1%	16.5%	24.4%	33.0%	X^2 = 491.8
Employed	52.6%	13.8%	13.7%	19.9%	.000
Families w/Children	33.4%	17.1%	19.9%	29.7%	X^2 = 276.5
w/o Children	52.1%	13.4%	14.5%	20.1%	.000
Foreign Born	35.0%	17.5%	23.2%	24.3%	X^2 = 92.2
U.S. Born	48.9%	13.9%	14.9%	22.3%	.000
Age	54.5	45.6	39.1	40.2	F = 611.2
Individual Risks					.000
Subjective Fear (0–10)	6.2	6.8	6.9	6.8	F = 59.0
					.000
Physical Health Symptoms (0–23)	1.1	1.5	1.8	2.4	F = 182.3
					.000
CES-D Symptoms (0–60)	10.0	16.5	23.1	27.6	F = 974.1
					.000
Generalized Anxiety Symptoms (0–21)	3.6	6.0	8.3	10.0	F = 706.8
					.000
Income < $25 k	29.9%	15.9%	22.4%	31.8%	X^2 = 872.3
Income $25 k-$35 k	34.3%	19.4%	18.5%	27.8%	.000
Income $35 k-$50 k	44.4%	16.0%	17.7%	21.9%	
Income $50 k-$75 k	54.5%	15.8%	13.8%	15.9%	
Income $75 k-$100 k	60.7%	11.0%	12.0%	16.3%	
Income $100 k-$150 k	62.1%	9.8%	10.1%	18.3%	
Income > $150 k	70.4%	6.0%	6.6%	17.0%	

[a]X^2 and One-way Anova (F) tests for differences between food insecurity categories and vulnerabilities.

Table 3. Food insecurity logistic regressions (n = 10,368).

Model variables		
	OR	95% CI
Social vulnerabilities and risks		
Gender (Female = 1)	.80	.72 to.88**
Race (Black = 1)	1.8	1.5 to 2.0**
(Asian = 1)	.83	.66 to 1.1**
(Native American = 1)	1.9	1.1 to 3.4**
(Other = 1)	1.5	1.2 to 2.5**
Hispanic Status (Hispanic = 1)	1.3	1.2 to 1.5**
Marital Status (Unmarried = 1)	1.0	.94–1.1
Employment Status (Unemployed = 1)	1.1	1.0 to 1.2**
Families with Children (Yes = 1)	1.4	1.2 to 1.5**
Nativity (Foreign Born = 1)	1.3	1.1 to 1.5**
Age	.98	.97 to.99**
Subjective Fear	1.1	1.0 to 1.1**
Physical Health Symptoms	1.1	1.0 to 1.1**
CES-D Symptomatology	1.1	1.0 to 1.1**
Generalized Anxiety	1.1	1.0 to 1.1**
Income <$25 k	3.0	2.4 to 3.7**
Income $25 k-$35 k	2.3	1.8 to 3.0**
Income $35 k-$50 k	1.9	1.5 to 2.4**
Income $50 k-$75 k	1.3	1.0 to 1.6**
Income $75 k-$100 k	1.2	.94 to 1.3
Income $100 k-$150 k	1.1	.88 to 1.5
Constant	−1.56	
X^2	3217.2	
Nagelkerke R^2	.363	

p <.01*; p <.000**.
Reference groups = male, non-Hispanic, married, employed, families without children, U.S. born, Income >$150 k.

Discussion

Food insecurity is an important indicator of a nation's public nutritional health, and its disparate impact is a telling measure of that nation's unequal vulnerability to health risks. The latest report, generated from researchers at Tufts and Harvard (Conference on Food, Nutrition, and Health), identifies poor diet as "the leading cause of poor health in the United States," accounting for more than half a million deaths per year.[44] As is clear from our findings, adult food insecurity in the United States has become significantly elevated during the COVID-19 pandemic. While not particularly surprising, our data reflect a trend reported by others among the general population, as well as higher risk populations comprised low-income, minority populations.[6,7] The social vulnerabilities to food insecurity during a pandemic largely mirror those that existed prior to the pandemic. Similar to the USDA reports for US household food insecurity in 2018, we find that individuals who are low-income, parents, and Black and/or Hispanic respondents, all had a higher prevalence and higher odds of food insecurity than their counterparts. Furthermore, we find that Native Americans – a group not reported in the yearly USDA report – have double the odds of food insecurity compared to white respondents. We also find high rates of food insecurity among foreign-born respondents. The elevated food insecurity among Native Americans as

well as the foreign born are findings consistent with other studies who have shown elevated food insecurity among these groups.[45–47] Unlike the findings from the USDA report, we do not find differences across marital status; however, we do not analyze marital status for parents specifically as they do. Our findings are also consistent with a wealth of research that links food insecurity to negative physical and mental health symptoms, such as depressive symptoms and generalized anxiety.[13–15,17,18,32,37,48–50]

Race, ethnicity, and income remain important factors in helping account for food insecurity variability in the U.S. Additionally, mental health symptoms and the uncertainty or generalized anxiety manifested as fear of COVID-19 matter, as well, highlighting how different these times are and how important it is that we are better prepared for the emotional uncertainty that can impact individual's sustained access to food. Many states are reporting large increases in demand for food among service providers feeding low-income, food insecure populations in America. Their established clientele continues to show up, but now some service providers in the hardest hit regions of the country are reporting 50–75% increase in new clientele. While millions were food insecure before the pandemic, this disaster reveals the fragility of the US food system and the precariousness of those who have slipped from secure to insecure in their access to food. Our analysis suggests that there were many significant social vulnerabilities to food insecurity that are now being amplified during this public health crisis, as well as some vulnerabilities specific to this crisis (e.g. fear).[17]

To our knowledge, only a limited number of studies currently document the heightened and uneven vulnerabilities to food insecurity during the COVID-19 pandemic.[4,7] As such, there remains a significant gap in our collective understanding of what exactly happens with food insecurity during public health crises that, in turn, how this food insecurity impacts the health and wellbeing of individuals and their communities during and after the crisis. We recognize that this research, while somewhat unique, is not without limitations. For one, it is a cross-sectional study that prevents us from causal modeling using longitudinal data to sort out changes in risks and resources amidst the social and economic fluidity of the pandemic. Additionally, there are a number of risk and resource variables that may lack breadth and/or depth. To get into the field as quickly as possible during the COVID-19 pandemic meant that we had to make some sacrifices regarding the inclusion of specific variables and/or indices/scales. While the scales that are used here have been externally validated and shown to be reliable, there are still questions that arise around utility and additional strategies for measurement. Finally, we recognize that online surveys are biased in their selection and likely systematically eliminate respondents with limited access to smart technology hardware and/or Internet connectivity. Thus, our data are probably

over-representing computer users living in urban areas, and underrepresenting low-income, rural residents.

Despite these and other limitations, our work adds to the important burgeoning conversation around health risks and disparities during the COVID-19 pandemic. This work is both distinguishable and important because of what we do not know at this time. We believe our data provides insight into a growing problem that has been magnified during the current health crisis. While we provide important early observations regarding the general population's unequal exposure to the effects of this global pandemic and food insecurity, additional health complications muddy the response picture for what will become known as "vulnerability bearers." These vulnerability bearers are the segment of the population that have significant physical and mental health complications as a direct result of unequal exposure to social and health consequences that are partly related to who they are, as well as where they live.[51] These health complications create a complex intersection of suffering that further impacts levels of food security.

Learning lessons is noteworthy and valuable, but if we do not heed the warnings and start changing how we prepare for these types of events (like the current pandemic), the disenfranchised and disadvantaged will continue to be over-burdened and under-resourced. In turn, this will translate into higher morbidity rates, higher mortality rates, higher childhood, and adolescent health risks, and poorer health outcomes for a large segment of the American population where the spotlight of racial/ethnic disparities, economic segregation, and social inequality continues to shine.

What precisely needs to be changed to address the complexity of food insecurity in the midst of a pandemic is certainly up for debate. However, if we look carefully at the data and the work that we present here and that other studies provide, several key factors emerge as important practical and even policy-related features for future direction. While SNAP benefits have been shown to be effective at reducing food insecurity, the evidence suggests that they are not sufficient for many recipients. The price of food plays an important role in determining food insecurity generally, but also the effectiveness of SNAP benefits. Extant research has demonstrated the need to index SNAP benefits according to food prices across place within the United States.[52,53] The present study suggests that SNAP benefits must also consider price variability during times of economic and health crises. This also compliments earlier studies showing that negative income shocks, moves, and changes in household size – all factors that intersect with an event such as the COVID-19 pandemic – are associated with increases in food insecurity.[54] In short, policy must consider the variability of food price across both time and place, as well as acknowledge the spillover impacts from non-economic factors related to disasters.

Additionally, we need to continue to examine alternative strategies for providing food for those persons and communities at greatest risk. Local farming collectives, neighborhood gardens, increasing access through free delivery and drop-off points are alternative strategies that should be developed.[55] Implementing these alternative approaches to addressing food insecurity will require considerable funding, expanded infrastructure, and a shift in attitudes regarding how best to address the long-standing crisis of food insecurity that is exacerbated during public health crises like the current pandemic. The key to developing and implementing successful programs to help stem the tide of food insecurity during a crisis like the current pandemic is to begin that work now. Advanced planning, forward thinking, and innovation are just some of the critical components of a comprehensive preparedness strategy required to address the food needs of high-risk individuals and communities when the next public health or natural disaster strikes the US.

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