Title:
Food insecurity and COVID-19 diagnosis: Findings from a national United States sample

Authors and Affiliations:
Madison Searles, MPH
SUNY Upstate Medical University, Department of Public Health and Preventive Medicine, Syracuse, NY, USA
ORCID: 0000-0003-1969-8886

Roger Wong, PhD, MPH, MSW
SUNY Upstate Medical University, Department of Public Health and Preventive Medicine, Syracuse, NY, USA
ORCID: 0000-0002-2243-1990
Twitter: @RogerWongPhD

Corresponding Author:
Roger Wong
SUNY Upstate Medical University, Department of Public Health and Preventive Medicine, Syracuse, NY, USA, 13210
Telephone Number: 631-533-0163
Fax Number: 315-464-1701
Email Address: WongRo@upstate.edu

This is the Accepted Version of an article published in the *Journal of Hunger & Environmental Nutrition* after peer review. The final authenticated version is available online at: https://doi.org/10.1080/19320248.2022.2128961

ABSTRACT

This study explores the association between experiencing food insecurity and COVID-19 diagnosis in the United States, and what sociodemographic characteristics moderate this relationship. We analyzed a national sample of adults in the United States (n=6,475). Multiple logistic regression results revealed respondents experiencing food insecurity had approximately 3.0 times significantly higher odds of a positive COVID-19 diagnosis (Odds Ratio [OR]=2.95, 95% Confidence Interval [CI]=1.38-6.32, p<.01), which remained significant after adjusting for sociodemographics and COVID-19 mitigation behaviors (OR=2.59, 95% CI=1.09-6.18, p<.05). Age group had a significant moderating effect (OR=42.55, 95% CI=3.13-579.15, p<.01). Results indicate experiencing food insecurity is associated with contracting COVID-19.

Keywords: Coronavirus; COVID; Food Insecurity; Inequalities; Pandemic; Prevention

INTRODUCTION

Food insecurity (FI) is defined by the United States Department of Agriculture (USDA) as a household level social and economic condition in which people have limited or uncertain access to sufficient food, preventing them from living an active, healthy lifestyle [1]. People experiencing severe FI skip meals or experience hunger often due to lacking financial resources to purchase food, or otherwise lacking access to adequate food [2]. Experiencing FI is stressful and has been associated with both short and long term negative mental and physical health outcomes [2, 3].

A 2021 report from the USDA notes that certain United States (U.S.) population subgroups experienced substantial increases in the prevalence of FI from 2019 to 2020, while the overall U.S. prevalence of FI in the country was unchanged from 10.5% in 2019 [4]. Specifically, households with children experienced a jump in FI from 13.6% in 2019 to 14.8% in 2020. Households with non-Hispanic Black residents experienced an increase in the prevalence of FI from 19.1% in 2019 to 21.7% in 2020. Further, married couples with children in the South region also experienced a higher prevalence of FI in 2020. The prevalence of FI declined from 2019 to 2020 for several population subgroups including women living alone, men living alone, households with non-Hispanic White residents, and households in the Midwest region [4].

Early public health responses to the COVID-19 pandemic such as stay at home orders and a switch to remote learning and work substantially affected people's normal daily routines [1, 5–7]. While beneficial in preventing spread of the virus, these restrictions created immediate barriers to food accessibility across the U.S. [1, 8]. Social distancing measures meant school closures for primary and secondary school students and unprecedented levels of unemployment, layoffs, and financial strain for many in the U.S. [8–10]. As a result, children of low-income families, especially those living in urban areas, experienced reduced access to school meals and many working adults faced financial uncertainty related to their employment [8–10].

The COVID-19 pandemic has also had ripple effects that contributed to food shortages and price inflation for food products. In Spring 2020, the U.S. experienced disruptions to the meat and poultry processing industries due to disease outbreaks among workers [11]. It has since been shown that workplace conditions such as increased ambient noise and elevated vocal effort led to higher levels of viral transmission in these work environments [12]. The subsequent impact of facility closures included decreased supply of meat and poultry, resulting in increased prices for consumers. In April 2020, the food price index for meat, poultry, and fish in the U.S. increased by 4.3%, causing Americans to spend more on these food products [11].

Our present study analyzes part of the first wave of the COVID-19 pandemic in the U.S. between late April 2020 and early June 2020. Leading up to this period, U.S. Congress made efforts to alleviate the negative economic effects of the COVID-19 pandemic and to bolster food security across the U.S. [2, 5]. These efforts included the Coronavirus Aid, Relief, and Economic Security (CARES) Act, which allowed families to receive a stimulus payment up to $1200 per adult and an additional $500 per child. Additionally, an extra $600 per week supplemented state unemployment benefits during this time [2, 5]. In October 2020, Supplemental Nutrition Assistance Program (SNAP) also temporarily expanded their caseload by 6.2 million more participants [2, 13]. Even with these relief efforts in 2020, FI persisted across the U.S. [4].

Given the persistence of FI, recent spikes in COVID infections in the U.S., and predictions the virus will become endemic, it is important to understand the relationship between experiencing FI and COVID-19 diagnosis. Moreover, it is crucial we better understand FI during the early stages of this public health crisis so we can better respond in the face of future challenges. Increased global connectivity, the plight of wildlife habitat, and strained health systems cater to similar future pandemics [14]. Our present study therefore aims to investigate the relationship between FI and COVID-19 diagnosis, specifically through two research questions: 1) What is the association between experiencing food insecurity and COVID-19 diagnosis?, and 2) How do sociodemographics (age, race and ethnicity, gender) moderate the relationship between food insecurity and COVID-19 diagnosis?

MATERIALS AND METHODS

Data Source

Data were retrieved from the COVID Impact Survey, administered by the National Opinion Research Center (NORC) at the University of Chicago [15]. The COVID Impact Survey provides regional and national-level statistics to study economic security, social dynamics, physical health, and mental health in the U.S [16]. Data for the national estimates were collected using the AmeriSpeak panel, which is a probability-based panel designed by the NORC to be representative of the U.S. household population. The initial recruitment phase of the AmeriSpeak panel included sampling randomly selected U.S. households with a known zero probability of selection from the NORC National Sample Frame. Households were contacted by email, telephone, mail, and face-to-face. The resulting sample provides coverage of approximately 97% of the U.S. household population. Only those without an address listed in the USPS Delivery Sequence File, those with only a P.O. Box address, and newly constructed dwellings were excluded from the sample. Panel members were randomly selected for interviews, which were completed online or over the telephone. Respondents were 18 years and older, representing all 50 states and the District of Columbia. An iterative ranking process was used to adjust for survey non-response, non-coverage, under sampling, and over sampling resulting from the study's sample design.

Data collection occurred over three one-week waves with the goal of 2,000 interviews each week. Data in Wave 1 was collected from April 20 to April 26, 2020; data in Wave 2 was collected from May 4 to May 10, 2020; and data in Wave 3 was collected from June 1 to June 8, 2020. After combining all three waves, our final sample included 6,475 respondents who had sampling weights representing a national sample. At the beginning of the survey, a consent statement was provided to participants noting survey completion was voluntary, and written or verbal consent was not necessary [16].

COVID-19 Diagnosis Variable

The dependent variable was COVID-19 diagnosis, which was a binary response based on the question: "Has a doctor or other health care provider ever told you that you have COVID-19?" (Yes or No).

Food Insecurity Variable

A two-item screen was used to identify individuals from households at risk for experiencing FI. The first item asked participants how often in the past 30 days they worried their food would run out before getting money to buy more (sometimes or often true, never true). The second item asked participants how often in the past 30 days the food they bought did not last and they did not have money to buy more (sometimes or often true, never true). Respondents who answered "sometimes or often true" for either two items were categorized as being from households experiencing FI. This two-item screen for FI has been tested to have a sensitivity of 97%, specificity of 83%, and high convergent validity, however, using a timescale of 12 months compared to 30 days in the COVID Impact Survey [17].

Covariates

Our regression models adjusted for sociodemographics and COVID-19 mitigation behaviors recommended to reduce the risk of contracting COVID-19. Sociodemographic variables included: age (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, or 75+), race and ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, or non-Hispanic Other race), gender (male or female), education (less than high school, high school graduate or equivalent, some college, Bachelors or above), employment in the past 7 days (no or yes, worked for someone else or self-employed), number of household minors younger than age 18 years (0, 1, 2, or 3+), number of household adults age 18 years or older (1, 2, or 3+), household income (under $10,000; $10,000 to under $20,000; $20,000 to under $30,000; $30,000 to under $40,000; $40,000 to under $50,000; $50,000 to under $75,000; $75,000 to under $100,000; $100,000 to under $150,000; $150,000 or more), urbanicity (urban, suburban, or rural), geographic region (Northeast, Midwest, South, or West), and self-rated general health (below average, average, or above average).

Three variables on COVID-19 mitigation behaviors were included. First, respondents were asked if they wear a face mask as a preventative measure against COVID-19 (yes or no). Second, respondents were asked if they socially distance by keeping six feet distance from those outside their household as a preventative measure against COVID-19 (yes or no). Third, respondents were asked if they wash or sanitize their hands as a preventative measure against COVID-19 (yes or no).

Data Analysis

Bivariate analysis was conducted using a chi-square test to examine the relationship between experiencing FI and COVID-19. Three hierarchical multiple logistic regression models explored how experiencing FI is associated with COVID-19 diagnosis, after sequentially adjusting for sociodemographics and COVID-19 mitigation behaviors. Model A was an unadjusted crude model with only the FI variable. Model B added all sociodemographic covariates: age, race and ethnicity, gender, education, employment, number of minors in house, number of adults in house, household income, urbanicity, geographic region, and general health. Model C added the three major COVID-19 mitigation behaviors: mask wearing, social distancing, and handwashing. The average variance inflation factor (VIF) was 1.22, which indicates there is no harmful multicollinearity.

Interaction effects were also created to analyze whether three key sociodemographic variables (age, race and ethnicity, and gender) moderated the relationship between FI and COVID-19 diagnosis. These three sociodemographic variables were analyzed for their potential moderating effects given extensive literature noting COVID-19 disparities by age, race and ethnicity, and gender [18–20].

Regression models were weighted using the national sampling weights recommended by the COVID Impact Survey when combining all three waves. Missing data were removed with listwise deletion, and our final model retained 97.6% of the full sample. All analyses were conducted in Stata statistical software package version 16.1 (StataCorp LLC, College Station, TX, USA) with two-tailed tests at a 0.05 significance level.

RESULTS

Sample Characteristics

Among the 6,475 individuals in the sample, 26.7% (n=1,728) were identified as experiencing FI based on the 2-item FI screener. Approximately 0.8% (n=49) of the respondents reported a COVID-19 diagnosis from a health care provider. As shown in Table 1, of the seven age categories, the most commonly reported age was 25-34 years old (22.2%). Most were non-Hispanic White (65.5%), and female (51.3%). For COVID-19 mitigation behaviors, most wore a mask (83.9%), social distanced (85.3%), and practiced handwashing as a precaution against COVID-19 (91.2%). People from households who were experiencing FI were generally in the 25-34 year age range (27.5%), female (57.1%), unemployed (59.7%), and had 3+ adults in the household (36.8%). Those who were from households experiencing FI also tended to have a household income between $20,000 and $30,000 (20.4%).

Bivariate Results

There was a statistically significant relationship between experiencing FI and COVID-19 diagnosis [$X^2(1)=12.53$, $p<.05$]. Among those with a positive COVID-19 diagnosis, 51.0% (n=25) were not experiencing FI and 49.0% (n=24) were experiencing FI. When looking at the association between adherence to the three COVID-19 mitigation behaviors and food security status, results revealed a significant relationship between practicing social distancing and food security status [$X^2(1)=17.59$, $p<.05$]. Among those who practiced social distancing, 25.8% (n=1,422) were experiencing FI and 74.2% (n=4,081) were not experiencing FI. There was also a significant relationship between practicing handwashing and food security status [$X^2(1)=17.70$, $p<.05$]. Among those who practiced handwashing, 26.1% (n=1,537) were experiencing FI and 73.9% (n=4,355) were not experiencing FI. There was no significant relationship between mask wearing and food security status [$X^2(1)=3.60$, $p=.06$].

Regression Results

In Model A (Table 2), our unadjusted crude model indicated that experiencing FI was significantly associated with COVID-19 diagnosis. Compared to respondents who were food secure, experiencing FI was significantly associated with a 2.95 times higher odds of a positive COVID-19 diagnosis (OR=2.95, 95% CI 1.38-6.32, $p<.01$). After adjusting for sociodemographics in Model B (Table

2), experiencing FI was again significantly associated with COVID-19 diagnosis, with those experiencing FI having a 2.83 times higher odds of a positive COVID-19 diagnosis (OR=2.83, 95% CI 1.15-6.97, $p<.05$). After further adjusting for COVID-19 mitigation behaviors in Model C (Table 2), experiencing FI remained significantly associated with COVID-19 diagnosis. Specifically, experiencing FI was significantly associated with a 2.59 times higher odds of a positive COVID-19 diagnosis (OR=2.59, 95% CI 1.09-6.18, $p<.05$).

In Model C, we also found being employed and handwashing were significantly associated with COVID-19 diagnosis. Those who were employed had a 2.88 times higher odds of a positive COVID-19 diagnosis compared to those who were not employed (OR=2.88, 95% CI 1.19-6.95, $p<.05$). Those who reported handwashing had a 0.24 times lower odds of a positive COVID-19 diagnosis compared to those who did not practice handwashing (OR=0.24, 95% CI 0.09-0.63, $p<.01$). Across all three multiple logistic regression models, each model was statistically significant ($p<.05$).

When examining interactions between experiencing FI and key sociodemographics (age, race and ethnicity, and gender), we found no statistically significant interactions for race and ethnicity ($p=.69$) or gender ($p=.41$) after adjusting for all other sociodemographics and COVID-19 mitigation behaviors. Age was a significant moderator between experiencing FI and COVID-19 diagnosis ($p=.01$), when using the age categories of young adult (18-34 years), middle-age adult (35-54 years), and older adult (55+ years). Specifically, young adults who were experiencing FI had a marginally higher odds of COVID-19, though not statistically significant (OR=1.42, 95% CI 0.14-14.74, $p=.77$). In contrast, middle-aged adults who were experiencing FI had a significantly higher odds of COVID-19 after adjusting for sociodemographics and COVID-19 mitigation behaviors (OR=14.87, 95% CI 1.42-155.48, $p=.02$). Results for older adults could not be generated due to low statistical power.

DISCUSSION

For our first research question, we found those who were experiencing FI had a significantly higher odds of a positive COVID-19 diagnosis. There could be several elements contributing to this association, including socioeconomic and biological factors. Previous research has noted under-resourced communities in the U.S., most of which are communities of color, have been most affected by the pandemic and that socially vulnerable people have a higher odds of experiencing FI [21, 22]. More specifically, increased vulnerability to FI has been seen for those among low-income households, parents, and Black and/or Hispanic individuals [21]. This increased vulnerability is a result of economic disruptions caused by the pandemic, including lost employment and substantial disruptions to the food supply chain, among others [23].

Previous research indicates FI could influence COVID-19 risk because individuals experiencing food shortages may have lower quality diets or undernutrition and that some risk factors of infection and death from COVID-19 are associated with nutritional status [24–27]. Specifically, essential nutrients have been identified as contributing to healthy immune function, impacting resistance to infection and ability to fight infection [25, 26]. A lower quality diet or undernutrition could potentially lead to suboptimal immune response and increased susceptibility to viral infections, which has been shown for influenza [24]. Malnutrition can also induce poor immunological and virological responses which may be associated with increased risk of infectious disease transmission [28]. A prospective cohort study looking at diet quality and risk and severity of COVID-19 found that high diet quality was associated with lower risk of contracting COVID-19 and experiencing severe COVID-19 when contracted [29]. With this association being particularly evident among individuals with lower socioeconomic status and those consuming lower quality diets generally experiencing food insecurity and low socioeconomic status, nutrition is an important social determinant of health in the context of COVID-19 [29, 30].

While research on FI during the pandemic is limited, this should not prevent us from considering policy efforts to lessen the gravity of FI amidst the present-day pandemic. Pre-pandemic research revealed SNAP benefits is not enough to alleviate FI as much as they could if they were to account for variation in food costs across the U.S. [3, 13, 21, 31]. Moreover, federal efforts should further expand

SNAP benefits beyond the current 20.3% increase, in response to the unique challenges presented by the pandemic [3, 13, 21, 31]. It is also important to consider alternative strategies that may promote food security for those at risk, especially in times of widespread food shortages. Comprehensive efforts could develop community and urban gardens, local farming collectives, and affordable food delivery programs to promote equitable food access and availability across demographics [21, 32-35].

Another noteworthy finding of our study was that those who are employed had a significantly higher odds of a positive COVID-19 diagnosis. Several studies have found employees in certain fields may be at an increased risk of exposure to COVID-19 [36–38]. Healthcare workers specifically, experience increased risk from closely working with patients infected with COVID-19 [39]. The COVID-19 recession has also substantially increased the number of gig workers, many of which work for high risk ride hailing and delivery apps [40, 41]. With the fifth wave of COVID-19 now upon us, and the current Omicron variant spreading more easily than past variants, workplace spread is an ever present concern [42].

The importance of handwashing has been consistently reinforced throughout the pandemic with public health messaging by multiple organizations. For example, the World Health Organization and the Centers for Disease Control and Prevention focused on promoting handwashing as a fundamental disease mitigation behavior, important even as COVID-19 vaccinations have become readily available in the U.S. [43–46]. Not surprisingly, we found those who reported handwashing as a preventive measure against COVID-19 was significantly associated with a decreased odds of having a positive COVID-19 diagnosis.

For our second research question, our results indicated that age is a significant moderator between experiencing FI and COVID-19 diagnosis. This is seen in our interaction model in which middle-aged adults who are experiencing FI have a significantly increased odds of a positive COVID-19 diagnosis after adjusting for sociodemographics and COVID-19 mitigation behaviors. Past research has found higher FI rates among those in early and late mid-life compared to those who are in younger age groups [47, 48]. In addition, past research has found higher incidence of COVID-19 and increased COVID-19 risk and severity in older age groups [49–52]. An increased risk for FI in mid-life coupled with the increased risk for COVID-19 in older ages could therefore magnify odds of COVID-19 diagnosis for this demographic compared to young adults and those who are food secure. Ultimately, more research is needed to better understand the interrelationships between experiencing FI, age, and COVID-19 diagnosis.

We recognize our study has several limitations. First, our data combines survey results from three separate periods between April and June 2020. Therefore, our findings are representative of only the first wave of COVID-19 infections in the U.S., which occurred approximately between March and June 2020. Considering the lack of data on this topic, though, we believe this also sets our study apart, as our research provides insight into the association between FI and COVID-19 diagnosis at the onset of this public health crisis. Second, this study presents the results of a cross-sectional survey administered to unique respondents across the three survey sampling periods. Because of this, we cannot establish causality between experiencing FI and COVID-19 diagnosis. Third, COVID-19 diagnosis was self-reported early in the pandemic. With a lack of data supporting the validity of our main outcome and the survey being administered at a time when COVID-19 testing was still lagging, it is possible the true prevalence of COVID-19 diagnosis is underestimated in our sample. Fourth, a short 2-item screening method was used to assess food security and while this screener has been tested to have high sensitivity, specificity, and convergent validity, it is a modification of the more commonly used USDA 18-item U.S. Household Food Security Survey Module [17]. Our study does, however, have several notable strengths such as a validated measure of FI and a nationally representative U.S. sample with sampling weights applied. Our research also adds to a small but growing body of research centered around FI during the COVID-19 pandemic and provides valuable insight into an ever-present concern.

CONCLUSIONS

To the best of our knowledge, this is the first study to examine the relationship between experiencing FI and COVID-19 diagnosis. Our results suggest FI is associated with higher odds of COVID-19 diagnosis, and we should consider how FI may be related to age disparities in COVID-19 risk. These findings provide a unique view on food security during the first few months of the pandemic and add to an important conversation on FI during a time of food supply shortages and food price inflation during the COVID-19 pandemic. Moving forward, further exploration, advanced planning, and innovative strategies will be critical in developing comprehensive solutions to FI that can be quickly supplemented in times of a public health crisis.

Acknowledgements
Not applicable.

Disclosure Statement
The authors report there are no competing interests to declare.

Funding
No funds, grants, or other support was received.

Ethics Approval
This study was deemed exempt by the SUNY Upstate Institutional Review Board for the Protection of Human Subjects.

Data Availability
The data that support the findings of this study are publicly available through the COVID Impact Survey website: https://www.covid-impact.org/results.

Author Contributions
All authors contributed to study conception and design, analysis and interpretation of data, drafting of manuscript, and critical revisions of the manuscript. All authors read and approved the final manuscript.

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Table 1. Sample characteristics of 6,475 participants from the COVID Impact Survey

	Whole Sample		Food Secure		Food Insecure	
	%	N	%	N	%	N
Sociodemographics						
Age Group						
18-24	5.6%	362	4.4%	209	8.8%	152
25-34	22.2%	1,437	20.3%	956	27.5%	475
35-44	16.5%	1,066	15.2%	717	20.1%	348
45-54	14.8%	951	14.2%	671	16%	276
55-64	19.2%	1,245	20.4%	965	15.8%	273
65-74	14.6%	948	16.7%	788	9%	155
75+	7.2%	466	8.8%	414	2.8%	49
Race/Ethnicity						
White, non-Hispanic	65.5%	4,091	70.5%	3,306	44.9%	773
Black, non-Hispanic	11.9%	768	9.8%	460	17.5%	302
Hispanic	16.5%	1,062	28.2%	486	28.2%	486
Other	8%	518	9.6%	161	9.4%	161
Gender						
Male	48.7%	3,154	50.8%	2,397	42.9%	741
Female	51.3%	3,321	49.2%	2,323	57.1%	987
Education						
Less than high school	5.1%	332	2.9%	139	11%	190
High school	18.8%	1,219	16.4%	776	25.1%	434
Some college	41.5%	2,686	40.2%	1,897	45%	777
Bachelors or above	34.6%	2,238	40.4%	1,908	18.9%	327
Employed						
Yes	50.2%	3,225	53.9%	2,527	40.3%	692
No	49.9%	3,206	46.1%	2,162	59.7%	1,026
Number of Minors in House						
No Minors	73.8%	4,778	77.2%	3,645	64.4%	1,112
1 Minor	8.7%	564	7.8%	367	11.3%	196
2 Minors	8.5%	549	7.7%	363	10.7%	184
3+ Minors	9%	584	7.3%	345	13.7%	236
Number of Adults in House						
1 Adult	32%	2,074	32.9%	1,554	29.3%	507
2 Adults	40%	2,588	42.3%	1,995	33.9%	586
3+ Adults	28%	1,813	24.8%	1,171	36.8%	635
Household Income						
Under $10,000	5.1%	332	2.8%	131	11.6%	200
$10,000 to under $20,000	8.8%	571	6.3%	297	15.8%	273
$20,000 to under $30,000	12.3%	796	9.3%	437	20.4%	353
$30,000 to under $40,000	10.7%	691	9.4%	445	14%	241
$40,000 to under $50,000	8.9%	576	8.9%	422	8.9%	153
$50,000 to under $75,000	19.6%	1,267	21%	990	15.7%	271
$75,000 to under $100,000	13.9%	902	16.6%	781	6.9%	119

$100,000 to under $150,000	13.7%	887	16.9%	796	14%	86
$150,000 or more	7%	453	8.9%	421	1.9%	32
Urbanicity						
Urban	73.2%	4,736	72.9%	3,436	74.2%	1,282
Suburban	18.8%	1,214	19.5%	920	16.7%	289
Rural	8%	520	7.6%	360	9%	156
Geographic Region						
Northeast	14.3%	927	14.4%	679	14%	242
Midwest	24.7%	1,601	25.9%	1,223	21.8%	376
South	35%	2,266	33.2%	1,566	39.7%	686
West	26%	1,681	26.5%	1,252	24.5%	424
General Health						
Below average	15.8%	1,025	12.2%	577	25.5%	440
Average	33.1%	2,141	31.5%	1,484	37.6%	649
Above average	51.1%	3,304	56.3%	2,657	36.9%	637
COVID-19 Mitigation Behaviors						
Mask Wearing						
No	16.9%	1,092	17.3%	818	15.3%	265
Yes	83.9%	5,383	82.7%	3,902	84.7%	1,463
Social Distancing						
No	14.8%	955	13.5%	639	17.7%	306
Yes	85.3%	5,520	86.5%	4,081	82.3%	1,422
Handwashing						
No	8.8%	567	7.7%	365	11.1%	191
Yes	91.2%	5,908	92.3%	4,355	89%	1,537

Table 2. Multiple Logistic Regression Examining the Relationship Between Food Insecurity and COVID-19 Diagnosis

		Model A			Model B			Model C	
	OR	95% CI	p	aOR	95% CI	p	aOR	95% CI	p
Food Insecurity									
Food Secure		reference			reference			reference	
Food Insecure	2.95	1.38-6.32	<.01	2.83	1.15-6.97	0.02	2.59	1.09-6.18	.03
Sociodemographics									
Age Group									
18-24					reference			reference	
25-34				1.86	0.32-10.77	.49	1.73	0.29-10.45	.55
35-44				3.31	0.54-20.23	.20	3.30	0.52-20.88	.21
45-54				3.37	0.41-27.98	.26	3.53	0.42-29.89	.25
55-64				2.16	0.30-15.43	.44	2.27	0.30-17.35	.43
65-74				0.37	0.04-3.55	.39	0.40	0.04-4.11	.44
75+				6.34	0.54-74.84	.14	6.50	0.52-81.64	.15
Race/Ethnicity									
White, non-Hispanic					reference			reference	
Black, non-Hispanic				2.36	0.74-7.47	.15	2.27	0.70-7.39	.17
Hispanic				3.18	0.94-10.75	.06	3.14	0.92-10.74	.07
Other, non-Hispanic				3.01	0.96-9.40	.06	2.69	0.87-8.29	.09
Gender									
Male					reference			reference	
Female				1.32	0.58-3.00	.51	1.56	0.66-3.65	.31
Education									
Less than high school					reference			reference	
High school				1.70	0.32-9.08	.54	1.63	0.29-9.05	.58
Some college				0.96	0.20-4.60	.96	0.98	0.19-4.90	.98
Bachelors or above				1.88	0.40-8.91	.43	1.85	0.37-9.15	.45
Employed									
No					reference			reference	
Yes				2.90	1.23-6.88	.02	2.88	1.19-6.95	.02
Number of Minors in House									

None		reference			reference	
1 minor	0.75	0.23-2.47	.64	0.77	0.22-2.66	.68
2 minors	0.30	0.06-1.45	.13	0.33	0.07-1.59	.17
3+ minors	0.40	0.10-1.54	.18	0.42	0.11-1.60	.21
Number of Adults in House						
1 adult		reference			reference	
2 adults	1.37	0.49-3.83	.54	1.29	0.47-3.53	.62
3+ adults	2.71	1.04-7.06	.04	2.66	1.00-7.11	.05
Household Income (1-9; <$10,000-$150,000+)	0.91	0.76-1.08	.28	0.92	0.78-1.08	.31
Urbanicity						
Urban		reference			reference	
Suburban	1.39	0.47-4.09	.55	1.36	0.47-3.94	.57
Rural	0.53	0.07-4.10	.55	0.52	0.07-4.14	.54
Geographic Region						
Northeast		reference			reference	
Midwest	0.96	0.32-2.92	.95	1.01	0.34-3.00	.99
South	0.36	0.11-1.20	.10	0.37	0.11-1.22	.10
West	0.94	0.33- 2.71	.91	0.94	0.32-2.74	.91
General Health						
Below average		reference			reference	
Average	1.64	0.56-4.83	.37	1.60	0.55-4.70	.39
Above average	0.89	0.27-2.92	.84	0.80	0.24-2.63	.71
COVID-19 Mitigation Behaviors						
Mask Wearing						
No					reference	
Yes				1.09	0.47-2.50	.85
Social Distancing						
No					reference	
Yes				1.66	0.62-4.47	.31
Handwashing						
No					reference	
Yes				0.24	0.09-0.63	<.01

	Model A		Model B		Model C	
Number of Observations	6,406		6,322		6,322	
Weighted Population Size	248,552,457		245,217,878		245,217,878	
Model Significance	F(1,6405)=7.79	p<.05	F(28,6294)=5.75	p<.001	F(31,6291)=6.60	p<.001

Note. Model A is an unadjusted crude model, Model B is adjusted for sociodemographics, and Model C is adjusted for sociodemographics and COVID-19 mitigation behaviors.