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Effects of Food Insecurity on College Students' Mental Health During the Coronavirus Pandemic

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**Effects of Food Insecurity on College Students' Mental Health During the Coronavirus
Pandemic**

Kailee Schultz

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Abstract

Over 10 percent of US households were food insecure in 2019. COVID-19 aggravated food insecurity in the US, both by making it worse for already-food insecure households and pushing additional households into food insecurity. College students represent a demographic with unique food security challenges. For this group, food insecurity is often linked to changes in academic performance and mental health. The overall objective of this study is to analyze food insecurity among households with college students during the coronavirus pandemic.

Specifically, this study will (1) characterize food insecurity among households with college students and (2) examine the impact of food security on the mental health of college students during the COVID-19 pandemic. Analyses were conducted using the U.S. Census Bureau's Household Pulse Survey, covering a period from August 2020 to March 2021. Linear regressions were estimated to determine the factors associated with food insecurity among college students as well as food insecurity's association with four mental health indicators. Results reveal a relationship between food security and mental health, with worse mental health linked to lower levels of food security and vice versa. Results also consistently indicate that gender, ethnicity, race, marital status, educational attainment, and income are associated with the food security and mental health of college students. These findings can provide insight needed to identify appropriate food and health policy approaches to alleviate the food security and mental health struggles of college students.

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Effects of Food Insecurity on College Students' Mental Health During the Coronavirus Pandemic

Close to 89.5 percent of US households were identified as food secure throughout 2019, making 10.5 percent of US households food insecure at some point during 2019 (Coleman et al., 2020). Food security is defined as the access by all people at all times to enough food to lead a healthy and active live (Coleman et al., 2020). This is the ideal scenario, but not all households have sufficient access to food. Food insecurity is present when households are at times unable to obtain sufficient food for one or more members of the household due to a lack of money or other resources (Coleman et al., 2020).

Since its start in early 2020, the coronavirus pandemic has exacerbated food insecurity in the US, both by making the issue worse for already food-insecure households as well as pushing additional households into food insecurity. Pandemic-induced risk factors have worsened this issue. Many individuals, particularly lower-paid and self-employed individuals, have experienced a loss of work (Alradhawi et al., 2020). Classroom closures has impacted schools' ability to provide free meals to children in low-income households and has impacted childcare costs for some families (Nicola et al., 2020). One study found that manufacturers in the UK expect a decline in turnover because of the pandemic, which will cause problems for the global supply chain (Nicola et al., 2020). Finally, national lockdowns have disrupted the daily lives of the public and led to economic shrinkage and the closure of many businesses (Alradhawi et al., 2020). This disruption of life has had a significant impact on food-insecure households by limiting access to grocery stores and restaurants and creating challenges for redeeming assistance benefits due to closures and shelter-in-place orders. All these risk factors have put a strain on many households and their access to food resources.

Food insecurity varies across demographic groups as well as throughout different geographic regions such as states. One specific demographic group facing unique food security challenges is college students. Students in higher education not only face different risk factors compared to the general population, but they are also affected by food insecurity in diverse ways. Specific universities have completed studies that analyze the food insecurity levels on their campuses and the way food insecurity impacts students. Results suggest a negative correlation between student food insecurity and academic performance, psychosocial health, and mental health, which will be discussed further throughout this study.

This study will investigate mental health specifically, defined as the emotional, psychological, and social health that affects how people think, act, and feel (What is Mental Health?, 2020). Mental health has become an important part of the discussion in recent years, particularly since the beginning of the coronavirus pandemic. This pandemic has induced things like widespread fear, loneliness, and psychological issues, along with reports of increased feelings of anxiety and depression (Alradhawi et al, 2020). College students may already face mental health struggles and adding food insecurity only exacerbates these issues. Mental health issues in college students are increasing, and studies have found that one in three undergraduates exhibit symptoms of a mental health problem, with depression and anxiety being the two most common issues (Oswalt et al., 2020). The coronavirus pandemic has introduced additional stressors for those in college, which may include postponement of exams, dismissal of accommodations, and canceled graduations (Alradhawi et al., 2020). These issues, on top of the normal struggles that college students face, may account for an increase in mental health struggles for this population.

More research is needed to understand how college students, food insecurity, and mental health are related, especially in the wake of the coronavirus pandemic. Research on this topic is essential because it allows for the establishment of resources to assist these populations. Most college students do not qualify for federal assistance programs like the Supplemental Nutrition Assistance Program (SNAP) due to strict eligibility requirements (Davidson & Morrell, 2020). This forces many students to deal with food insecurity without formal assistance, which can exaggerate issues associated with food insecurity like mental health problems. The results of this research can help students by characterizing the unique challenges they face and provide insight on how programs can better serve this diverse population.

The overall objective of this study is to analyze food insecurity among households with college students during the COVID-19 pandemic. Specifically, this study will (1) characterize food insecurity among households with college students and (2) examine the impact of food security on the mental health of college students during the COVID-19 pandemic.

Literature Review

Prevalence of Food Insecurity on College Campuses

Multiple universities have conducted studies that analyze the prevalence of food insecurity among their student population. These studies not only consider the prevalence of food insecurity, but also student characteristics and risk factors that increase the odds of food insecurity. This section will summarize and compare the prevalence, odds, and risk factors of food insecurity across universities.

The focus of many academic studies on this topic is to determine if student food insecurity is higher than that of the national population. The national level of food insecurity in 2019 was 10.5 percent. While the numbers vary anywhere from around 25 percent to nearly 50

percent between schools, the general outcome of these studies is that food insecurity rates are higher among college student populations. Table 1 below illustrates the prevalence of food insecurity among college students from six different studies. Each study observed one or a combination of universities within the state listed. Some heterogeneity exists in each study, but all studies can be compared to the food insecurity rate for the US population. The average of the five studies listed in Table 1 suggests that the average food insecurity rate among college students equals 35.08 percent. This number is nearly three times higher than the food insecurity rate for the US population, which is also listed in the table.

Table 1. University Food Insecurity Prevalence (Compared to National Rates)

University Location	Food Insecurity Prevalence
United States	10.5% (Coleman et al., 2020)
North Carolina	46.2% (McArthur et al., 2017, 566)
California	40.0% (Martinez et al., 2018, 6)
Illinois	35.0% (Morris et al., 2016, 379)
Georgia	29.0% (Raskind et al., 2019, 479)
New Hampshire	25.2% (Davidson & Morrell, 2020, 122)

Many studies examining food insecurity prevalence in college students do not consider first-year students. One reason for this is the length of the survey. Some studies look at food insecurity over a 12-month period, and first-year students would not be in college for that entire timeframe (McArthur et al., 2017). Additionally, some studies that use this 12-month model but include first-year students may not be entirely accurate because their food insecurity experience may have occurred before attending college (Martinez et al., 2020). As a result of this exclusion,

some studies specifically observe first-year populations of college students. Bruening et al. (2016) found that of students surveyed, 32 percent of first-year students reported food insecurity over the previous month and 37 percent of first-year students reported food insecurity in the past three months. These numbers are consistent with those found in previous studies, of which some may not include first-year students. This shows that first-year students, while often excluded, experience food insecurity at similar rates to other college students.

Odds. Many factors can lead to food insecurity, with multiple studies finding certain characteristics that put a student at greater odds of experiencing food insecurity. These characteristics include race and ethnicity, as studies have found that higher numbers of Hispanic and African American students experience food insecurity (Martinez et al., 2018 and Morris et al., 2016). Another demographic factor is age, as being an undergraduate and/or young adult can increase the risk of becoming food insecure (Martinez et al., 2018). Multiple studies have also found a connection between financial aid and food security. According to Morris and colleagues (2016), students with financial support that required repayment, such as loans, experienced very low food security more often than those without that type of aid. McArthur et al. (2017) reports an extensive list of factors that increase college student food insecurity odds, including those who do not own a car, have a junior or senior academic classification, live off-campus, have one or more part-time jobs, and/or earn a monthly income of less than five hundred dollars. Another key factor that can heighten food insecurity is GPA. Students with GPAs under 3.0 tend to experience higher rates of food insecurity (Morris et al., 2016).

The educational status of students' parents can also increase the odds of experiencing food insecurity. Students whose parents obtained a bachelor's degree or higher were more food secure than students with parents who obtained associate degrees, some college, a high-school

diploma, or less (Raskind et al., 2019). Additionally, childhood experiences play a role. One study found that odds of food insecurity increased with each adverse childhood experience a student reported (Raskind et al., 2019). A family history with food insecurity also increases the odds of food insecurity among students. A study done by Martinez et al. (2018) determined that one-fifth of their food-insecure participants reported a childhood history of food insecurity.

Studies have also analyzed what behaviors put students at higher risk for food insecurity. Bruening et al. (2016) found that students were more likely to report food insecurity if they participated in the following activities: consuming fast food, reporting unhealthy off-campus eating habits, and irregularly receiving food (sent or purchased) from their parents.

Finally, employment can impact the chances of a student becoming food insecure. College students experience high unemployment rates, and those employed often have lower-paying jobs, despite having large school-related expenses (Morris et al., 2016). This is significant because when low wages are paired with high expenses, students must make choices on what to spend their money on. This can lead to food insecurity if students choose to use these wages to continue paying for school or other non-food items over food resources.

How Food Insecurity Impacts Students in Higher Education

Coping Mechanisms. A popular theme among studies that look at food insecurity's impact on college students is to identify the coping mechanisms food insecure students partake in. Some of these mechanisms include buying food that is cheap and processed, stretching food to make it last longer, and eating meals that are less healthy to eat more (McArthur et al., 2017). These coping strategies can lead to other issues, such as unhealthy lifestyles and poor diets, which can lead to health-related issues. Additionally, other strategies used by students include asking family and friends for money, prioritizing living and educational expenses, and having

trouble studying due to hunger (Martinez et al., 2018). Asking others for financial assistance can often be a hard conversation and can harm relationships if done frequently. Additionally, while students are using their money to pay for their education, if hunger is impacting their studies, they may find it hard to finish their degree due to lack of sufficient food resources.

Academic Performance. One way to evaluate academic performance is by analyzing GPA. While studies done using GPA as an academic performance indicator use slightly different measures, they all reach the same conclusion: food insecurity hurts student GPA. Two studies by Martinez and colleagues came to this conclusion. The first, from 2018, found that more food insecure students reported suspending their studies at some point due to financial hardship and had a lower cumulative GPA than food-secure students. The second study, published in 2020, found that 51 percent of food-secure students had a cumulative A average, whereas only 30 percent of food-insecure students achieved the same GPA. Both these studies show that food insecurity negatively impacts academic performance. Another study found that the decline in academic performance has been so severe in some cases that students have contemplated major changes or simply dropping out altogether (Meza et al., 2018).

Other studies have analyzed the impact on other academic indicators. Results found that food-insecure students were less likely to rate class attendance, attention span in class, and understanding of concepts taught in class as excellent or good (McArthur et al., 2017). These factors likely lead to lower GPAs and class performance among food-insecure students. Additionally, food insecurity tends to affect study habits. One study found that 30 percent more students who were food insecure reported having difficulty with studying because they had no money for food (Martinez et al., 2020).

While GPA and class attendance can be measured to show the impact of food insecurity, some studies have also considered why students have trouble performing well in school. A study done by Meza and colleagues analyzed physical manifestations of food insecurity and how these can have academic consequences. Many students reported feelings of tiredness and stated this affected their ability to perform well in school (Meza et al., 2018). Additionally, money is a significant factor in being able to afford food. Students sometimes must work more hours to make the money they need for food, which means fewer hours are available for studying (Meza et al., 2018). Other physical manifestations include sleeping long hours as a result or coping mechanism of hunger as well as sleep deprivation because of preoccupation with food thoughts (Meza et al., 2018). All these things can have detrimental effects on academics, both also on health—physically, psychosocially, and mentally.

Health and Dietary Outcomes. Multiple studies have established a relationship between food insecurity and student health. Some of the coping mechanisms discussed above involve buying and eating unhealthy meals. Additionally, one study reports that students who rated their health as poor or fair were three times more likely to be food insecure, and a higher proportion of food insecure students have a BMI rating of overweight or obese (McArthur et al., 2017). Knol et al. (2018), however, determined that food security status has no association with college student obesity, but it may coexist with food insecurity in populations with both as risk factors. The study did find that fair and poor self-rated health are associated with food insecurity among off-campus students, which can help predict poor future health outcomes and is related to health behaviors that might contribute to poor health (Knol et al., 2017). As discussed above, coping mechanisms in people with low food security can include the purchase of cheap and processed food. This can result in poor health as well as the reporting of poor health. In this way, food

security can affect physical health, leading to things like obesity and other health problems in the long term, and can also lead to health issues on a less physical scale.

Psychosocial and Mental Health. Mental health includes our emotional, psychological, and social health and affects how people think, act, and feel (What is Mental Health?, 2020). Psychosocial health, on the other hand, encompasses many distinct aspects of health and relates very closely to mental health. For this reason, they will be discussed as one concept. Food insecurity has been found to affect mental health, but mental health issues associated with food insecurity can also impact some of the other factors discussed above. Martinez et al. (2020) found that students who were food insecure has considerably higher proportions of mental health indicators. One mental health factor affected by food insecurity is stress. Meza et al. (2018) analyzed seven themes related to the psychosocial effects of food insecurity, and one of these themes was the stress of food insecurity affecting daily life. Additionally, Bruening et al. (2018) found that concurrent food insecurity was related to two times higher odds of students experiencing stress and depressed mood in elevated levels.

Other factors affected by food insecurity are depression and anxiety. According to Raskind et al. (2017), food insecurity has been associated with three markers of psychosocial health: depression, anxiety, and hope. These researchers have made two conclusions with relation to these markers and food insecurity. First, food insecurity has been associated with higher levels of depression, anxiety, and stress. Second, food insecurity has been theorized to be a toxic stressor, which means that food insecurity can disrupt physiological function and impair mental health (Raskind et al., 2017). Additionally, Bruening et al. (2016) found that students who reported food insecurity in the last 3 months had a higher chance of reporting depression and anxiety. According to this study, the odds of anxiety and depression were three times higher

when compared to peers for these food insecure students, which has implications for learning and student success (Bruening et al., 2016).

One success factor that is impacted by the poor mental health caused by food insecurity is GPA. According to Martinez and colleagues (2020), “food insecurity among students was related to lower GPA both directly and indirectly through poor mental health” (1935). Put another way, food insecurity was directly related to lower GPA and poor mental health, but poor mental health was also associated with lower GPA (Martinez et al., 2020). These findings are reiterated in research analyzing psychosocial health as well. Raskind et al. (2017) found that food insecurity is related to poor psychosocial health and poor psychosocial health can lead to lower GPA. These researchers also posit two factors of psychosocial health—*anxiety and depression*—may hinder academic performance (Raskind et al., 2017).

The profound impact that psychosocial and mental health can have on students who experience food insecurity is a prominent issue to continue exploring. This study will continue to analyze food insecurity’s impact on college students’ mental health, especially related to the COVID-19 pandemic.

Relationship Between Coronavirus and Food Insecurity within Higher Education

The COVID-19 pandemic has changed almost every aspect of life in some way. Much research has been done on the impact of COVID-19 for different groups, with some studies focusing on food insecurity and some studies focusing on other issues worsened by the pandemic. There is, however, a gap in research that looks at universities during COVID-19 and how university students have been impacted by the pandemic.

As of August 2020, only one study has been published that looks specifically at food insecurity among college students during the pandemic. Owens and colleagues administered

surveys at a Texas university in 2020 to assess food insecurity. This study conducted a multi-step assessment and determined 34.5 percent of students faced food insecurity (Owens et al, 2020). This number falls in the range of estimates for other universities pre-pandemic (see Table 1). This study, however, states that research done in 2019 using the same methodology reported a food insecurity rate that was nearly 15 percent lower (Owens et al., 2020). This suggests that the rates have increased over time, potentially due to the pandemic. Additionally, the survey included a two-question food sufficiency screener, and this found that 65.5 percent of students were considered at risk for food insecurity. Within this group, low and very low food security was widespread (Owens et al., 2020).

This study further identified factors that put college students at higher risk of food insecurity during the pandemic. Four features were put forth that explain why college students are at higher risk during this time. First, many students work in the service industry, which was highly impacted by the pandemic. Second, many students do not qualify for federal food assistance. Third, college students are often considered dependents and thus are not eligible for stimulus payments. Finally, many students in college possess low food literacy, meaning they are not well equipped with the ability to plan, shop for, and prepare balanced meals (Owens et al., 2020). Taken together, these factors may explain why college students are facing food insecurity risk at a higher rate than prior to the pandemic. Owens further identified that the two biggest predictors of food insecurity were connected to these four unique features. Around 25 percent of students shared that their current living arrangements changed or were impacted directly by COVID-19, which put them at higher risk for food insecurity (Owens, et al., 2020). Additionally, over 50 percent of students shared that their employment status was directly impacted by

COVID-19, and this negative effect on income increased their risk of becoming food insecure (Owens et al., 2020).

Owens and colleagues provided initial insight on how COVID-19 is impacting college students' food insecurity in Texas. The following research looks to continue those efforts to fill the gap of information that surrounds COVID-19, college students, and food insecurity, and seeks to build on Owens' research by looking at how food insecurity during this pandemic has affected college students and their mental health nationwide.

Data

The Household Pulse Survey was administered by the US Census Bureau and other federal agencies to produce data related to the experiences of different households during the coronavirus pandemic (U.S. Census Bureau, 2021). The data included in this survey is broken up into a few broad categories including education, employment, food sufficiency, health, and housing. The survey has taken place in multiple phases since 2020 and is still ongoing. Phase 1 began on April 23, 2020, and measured data on a weekly basis. All later phases have taken place on a two-week collection approach. The survey is currently in Phase 3.2 and the most recent data set covers Week 39, which ended on October 11, 2021 (U.S. Census Bureau, 2021).

For this study, data analysis will start with Week 13, which ran from August 19 to August 31, 2020, and end with Week 27, which ran from March 17 to March 29, 2021 (U.S. Census Bureau, 2021). This subset of data is being used because it includes the education information required to identify the sample relevant to this study's objective. The Household Pulse Survey public use data files will be used to gather the data necessary to identify our sample and conduct statistical analyses.

This study will utilize the food sufficiency, education, and health variables from the public use files. The education variables will allow us to identify our sample, which is households with a college student(s). The variable used, QPS1, asked survey participants how many members of the household (including themselves) were planning to take classes from some form of post-secondary program prior to the coronavirus pandemic. We will use this variable to identify which households have members that were planning to take classes from a university program.

We will also consider a variable to help analyze food sufficiency among the households in our sample. Food sufficiency was measured in this survey as food sufficiency in the last seven days. The survey asked participants, through Q#24, to select one of the options that best described the food eaten in their household in the last week. The choices were (1) enough of the kinds of food (I/we) wanted to eat, (2) enough, but not always the kinds of food (I/we) wanted to eat, (3) sometimes not enough to eat, and (4) often not enough to eat. Data from this question will allow us to measure each household's food sufficiency.

Finally, we will be using mental health variables to analyze mental health status among our sample. Multiple areas will factor into this analysis. Variables Q#32 through Q#35 asked survey participants to rate their frequency of feeling four different emotions—*anxiety, worry, having little interest, and depression*. Participants were asked to select how frequently they felt each of these over the last 7 days, ranging from not at all to nearly every day. Other mental health questions were asked by this survey, but this research is focusing on the indicators that are commonly included in research on this topic. As a result, only these four emotion-related questions will be analyzed. Identifying these different emotions will help us gauge individual

struggles with mental health. We can compare these variables with food sufficiency numbers to determine the correlation that exists between the two.

This study will also analyze basic demographic data in relation to food insufficiency. The demographics that will be analyzed include gender (Q#2), ethnicity (Q#3), race (Q#4), education level (Q#5), marital status (Q#6), and income (Q#50). Analyzing these variables will allow us to determine which demographic characteristics may put households at higher likelihood of food insufficiency. All the specific variables we will be monitoring are listed in Table 2, including the name of each variable and the description provided.

Table 2. Description of Variables (U.S. Census Bureau, 2021).

Education
Instrument QPS1: TNUM_PS Description: Number planning to take post-secondary classes 0-40
Food Sufficiency
Instrument Q#24: CURFOODSUF Description: Household food sufficiency for last 7 days
Mental Health
Instrument Q#32: ANXIOUS Description: Frequency of anxiety over previous 7 days
Instrument Q#33: WORRY Description: Frequency of worry over previous 7 days
Instrument Q#34: INTEREST Description: Frequency of having little interest in things over previous 7 days
Instrument Q#35: DOWN Description: Frequency of feeling depressed over previous 7 days
Demographics
Instrument Q#2: EGENDER Description: gender (male or female)
Instrument Q#3: RHISPANIC Description: Hispanic origin (yes/no)
Instrument Q#4: RRACE Description: Race (White, Black, Asian, other/combo)
Instrument Q#5: EEDUC Description: Education attainment
Instrument Q#6: MS Description: Marital status
Instrument Q#50: INCOME Description: Total household income (before taxes)

Methodology

Descriptive statistics and regression analysis will be used to analyze the correlation between food sufficiency and multiple other variables. Descriptive statistics will be completed for demographics (Q#2—Q#6, Q#50), mental health indicators (Q#32—Q#35), and current food sufficiency levels (Q#24), as well as on the number of college students per household (QPS1).

Multiple regressions will be estimated in this study. The first regression will be a linear regression that compares food sufficiency levels across demographics and mental health indicators. A linear regression is an appropriate model for these variables because the food sufficiency variable (Q#24) is an ordinal variable. Estimating this regression will allow for an analysis of which demographic characteristics may indicate higher levels of food insufficiency among students. This regression will also help to determine if mental health affects food sufficiency. The equation for a linear regression is:

$$y_i = \alpha + \beta x_i + \delta z_i + \varepsilon$$

Where y_i is the food sufficiency level for household i , α is a constant term, x_i are demographic characteristics, z_i are mental health measures for household i , β and δ are coefficients to be estimated, and ε is an error term.

Four linear regressions will be estimated to compare each mental health variable (anxiety, worry, interest, and depression, as shown by Q#32—Q#35) to food sufficiency levels as well as demographics (Q#2—Q#6, Q#5). A linear regression is appropriate because the mental health indicators are ordinal variables. Regression results will allow for identification of which mental health indicators may be affected by food insufficiency and/or demographic characteristics. Each linear regression is defined as follows:

$$z_i = \gamma + \eta x_i + \theta y_i + \varepsilon$$

Where z_i is the mental health indicator for household i , γ is a constant term, x_i are demographic characteristics, y_i are food sufficiency measures for household i , η and θ are coefficients to be estimated, and ε is an error term.

Results

Sample Size

1,235,023 households responded to the Household Pulse Survey between Week 13 and Week 27 of data collection. The target sample of this study is households with college students. This is determined through the variable examining the number of household members taking post-secondary classes (QPS1). Of these 1,235,023 responses, 243,746 respondents stated one or more members of the household were enrolled in post-secondary classes, or 25 percent of the entire respondent population. After adjusting these results to ensure that the current food sufficiency variable as well as all four mental health variables were completed, the sample size comes to a total of 242,261 observations.

Demographic Characteristics

Stata was used to complete all statistical analyses. Table 3 displays the descriptive statistics mentioned above. Descriptive statistics indicate the frequency and proportion of several demographic characteristics, including gender, ethnicity, race (including Black, Asian, and other or combination), educational attainment, marital status (married vs. not married), and income.

Frequency and proportion are also provided for food sufficiency. Food sufficiency is measured on a scale of one to four, with one being very food sufficient (always having enough to eat) and four being very food insufficient (often not having enough to eat). 57.68 percent of households reported being very food sufficient. 31.05 percent reported they had enough food to eat, but it was not always the foods they wanted. 8.74 percent of households answered that they

sometimes did not have enough to eat, and 2.53 percent of households answered that they often did not have enough to eat. The final two responses would fall into the food insufficient and very food insufficient categories. When combined, these two responses indicate that 11.27 percent of the sample reported being food insufficient.

Mental health variables are measured in the same way, where the respondent never experienced the feeling if they answered with a one or felt the feeling nearly every day if they answered with a four. These statistics show the severity of the mental health issue, as most responses in all mental health categories show some form of struggle with mental health. People reported a four 24.49 percent of the time for anxiety, 17.27 percent of the time for worry, 13.44 percent of the time for interest, and 13.76 percent for depression (down).

Table 3. Proportions and Frequencies for Variables Q#2—Q#6, Q#32—Q#35, Q#50

Variable name	Frequency	Proportion
Q#2 (EGENDER): Gender		
(1) Male	92,202	38.06%
(0) Female	150,069	61.94%
Q#3 (RHISPANIC): Hispanic, Latino, or Spanish Origin		
(1) Yes	32,464	13.40%
(0) No	209,797	86.60%
Q#4 (RRACE)—modified: Black, alone (rblack)		
(1) Yes	26,755	11.04%
(0) No	215,506	88.96%
Q#4 (RRACE)—modified: Asian, alone (rasian)		
(1) Yes	14,920	6.16%
(0) No	227,341	93.84%
Q#4 (RRACE)—modified: Other/Combination (rcombo)		
(1) Yes	16,851	6.96%
(0) No	225,410	93.04%
Q#5 (EEDUC): Educational Attainment		
(1) Less than high school	1,322	0.55%
(2) Some high school	2,969	1.23%
(3) High school graduate or equivalent	19,169	7.91%
(4) Some College but not degree	61,693	25.47%
(5) Associate's Degree	29,308	12.10%
(6) Bachelor's Degree	70,407	29.06%
(7) Graduate Degree	57,383	23.69%

Q#6 (MS)—modified: Marital Status		
(1) Now married	135,879	56.34%
(0) Not married	105,302	43.66%
Q#32 (ANXIOUS): Frequency of anxiety over the previous 7 days		
(1) Not at all	63,510	26.22%
(2) Several days	81,494	33.64%
(3) More than half the days	37,937	15.66%
(4) Nearly every day	59,320	24.49%
Q#33 (WORRY): Frequency of worry over the previous 7 days		
(1) Not at all	87,243	36.01%
(2) Several days	80,193	33.10%
(3) More than half the days	32,979	13.61%
(4) Nearly every day	41,846	17.27%
Q#34 (INTEREST): Frequency of having little interest in things over the previous 7 days		
(1) Not at all	94,887	39.17%
(2) Several days	80,659	33.29%
(3) More than half the days	34,150	14.10%
(4) Nearly every day	32,565	13.44%
Q#35 (DOWN): Frequency of feeling depressed over the previous 7 days		
(1) Not at all	98,135	40.54%
(2) Several days	81,734	33.76%
(3) More than half the days	28,888	11.93%
(4) Nearly every day	33,321	13.76%
Q#50 (INCOME): Total household income (before taxes)		
(1) Less than \$25,000	27,415	11.89%
(2) \$25,000 - \$34,999	21,134	9.16%
(3) \$35,000 - \$49,999	26,214	11.37%
(4) \$50,000 - \$74,999	39,690	17.21%
(5) \$75,000 - \$99,999	32,685	14.17%
(6) \$100,000 - \$149,999	41,151	17.84%
(7) \$150,000 - \$199,999	20,025	8.68%
(8) \$200,000 and above	22,304	9.67%
Q#24 (CURFOODSUF): Household food sufficiency for the last 7 days		
(1) Enough of the kinds of foods (I/we) wanted to eat	139,725	57.68%
(2) Enough, but not always the kinds of foods (I/we) wanted to eat	75,231	31.05%
(3) Sometimes not enough to eat	21,174	8.74%
(4) Often not enough to eat	6,131	2.53%
QPS1 (TNUM_PS): Number planning to take post-secondary classes		
(1) One household member	178,158	73.54%
(2) Two household members	50,688	20.92%
(3) Three household members	13,415	5.54%

Regression Analysis

Food Sufficiency Indicators

Table 6 provides the results for the linear regression analyzing food sufficiency determinants. The null hypothesis for this regression is that demographic and mental health characteristics have no impact on a household's food sufficiency levels. As shown by the table below, all results are significant at the 99 percent level, showing that every variable has a significant impact on food sufficiency levels. For this regression, the r-squared equals 26.97, indicating nearly 27 percent of the variation in food sufficiency levels can be explained by these variables.

Some demographic characteristics make food sufficiency worse, while others make it better. The results indicate that male food sufficiency levels are 0.03 points higher than female food sufficiency levels, meaning males are more food insecure. Marriage also increases food sufficiency levels by 0.01 points, suggesting that being married raises your chances of experiencing food insufficiency. Additionally, food insufficiency is 0.08 points higher among Hispanics than non-Hispanics. Race has a similar affect. All race categories, when compared to whites, are more likely to experience food insufficiency. Food sufficiency levels increased, or got worse, by 0.20 points for African Americans, 0.06 points for Asians, and 0.16 points for those of other/combo races.

Two demographic characteristics lead to improvements in food sufficiency—educational attainment and income levels. When the level of educational attainment increases one level, food sufficiency levels decrease by 0.06 points, suggesting that the higher the level of education a person has, the more food sufficient they are. Additionally, when income levels increase by one income bracket, food sufficiency levels decrease by 0.10 points, suggesting that higher levels of income lead to more food sufficiency.

Four mental health indicators were also evaluated—anxiety, worry, lack of interest, and depression (down). When each of these measures increases by 1 point, food sufficiency levels also increase, suggesting that food sufficiency levels get worse as mental health gets worse. The highest impact comes from higher levels of worry with a 0.11 point increase, followed by interest with a 0.07 point increase, and depression with a 0.06 point increase. Anxiety impacts food sufficiency the least, increasing (or worsening) food sufficiency levels by 0.01 points.

Table 6. Linear Regression Estimates for Food Sufficiency by Demographic Characteristics and Mental Health Indicators (n=229,523)

<i>Variable</i>	<i>Coefficient</i>	<i>SE</i>	<i>t</i>	<i>P</i>
<i>Egender</i>	0.029	0.003	10.35	0.000
<i>Rhispanic</i>	0.08	0.004	19.63	0.000
<i>Eeduc</i>	-0.06	0.001	-54.70	0.000
<i>Ms</i>	0.01	0.003	4.62	0.000
<i>Income</i>	-0.09	0.001	-120.58	0.000
<i>Rblack</i>	0.20	0.004	43.94	0.000
<i>Rasian</i>	0.05	0.006	9.57	0.000
<i>Rcombo</i>	0.16	0.005	28.83	0.000
<i>Anxious</i>	0.01	0.002	5.83	0.000
<i>Worry</i>	0.11	0.002	45.41	0.000
<i>Interest</i>	0.07	0.002	30.74	0.000
<i>Down</i>	0.06	0.002	25.58	0.000
<i>R-Squared</i>	0.27			

Food Sufficiency and Mental Health

Linear regression results for mental health variables anxiety (Q#32), worry (Q#33), lack of interest (Q#34), and down (Q#35) are present in Tables 7, 8, 9, and 10, respectively. The null hypothesis for each regression is that the mental health indicator is not impacted by food sufficiency and demographic characteristics. Almost all variables are significant at least at the 90 percent confidence level, except for combination race (rcombo) in the interest and depression regressions.

Table 7. Linear Regression for Anxiety by Current Food Sufficiency and Demographic Characteristics (n=229,681)

<i>Variable</i>	<i>Coefficient</i>	<i>SE</i>	<i>t</i>	<i>P</i>
<i>Curfoodsuf</i>	0.43	0.003	136.99	0.000
<i>Egender</i>	-0.23	0.004	-50.38	0.000
<i>Rhispanic</i>	-0.06	0.007	-9.51	0.000
<i>Eeduc</i>	0.02	0.002	11.98	0.000
<i>Ms</i>	-0.16	0.005	-32.33	0.000
<i>Income</i>	-0.03	0.001	-22.33	0.000
<i>Rblack</i>	-0.30	0.007	-42.38	0.000
<i>Rasian</i>	-0.25	0.008	-27.63	0.000
<i>Rcombo</i>	-0.02	0.009	-2.68	0.007
<i>R-Squared</i>	0.13			

Table 8. Linear Regression for Worry by Current Food Sufficiency and Demographic Characteristics (n=229,681)

<i>Variable</i>	<i>Coefficient</i>	<i>SE</i>	<i>t</i>	<i>P</i>
<i>Curfoodsuf</i>	0.47	0.003	155.97	0.000
<i>Egender</i>	-0.21	0.004	-49.40	0.000
<i>Rhispanic</i>	-0.03	0.006	-3.99	0.000
<i>Eeduc</i>	-0.00	0.002	-2.37	0.018
<i>Ms</i>	-0.12	0.005	-26.23	0.000
<i>Income</i>	-0.03	0.001	-25.94	0.000
<i>Rblack</i>	-0.16	0.007	-22.90	0.000
<i>Rasian</i>	-0.07	0.009	-8.24	0.000
<i>Rcombo</i>	0.01	0.012	1.66	0.097
<i>R-Squared</i>	0.16			

Table 9. Linear Regression for Interest by Current Food Sufficiency and Demographic Characteristics (n=229,681)

<i>Variable</i>	<i>Coefficient</i>	<i>SE</i>	<i>t</i>	<i>P</i>
<i>Curfoodsuf</i>	0.42	0.003	145.69	0.000
<i>Egender</i>	-0.05	0.004	-11.02	0.000
<i>Rhispanic</i>	-0.04	0.006	-6.82	0.000
<i>Eeduc</i>	-0.02	0.002	-14.57	0.000
<i>Ms</i>	-0.19	0.004	-41.52	0.000
<i>Income</i>	-0.03	0.001	-27.06	0.000
<i>Rblack</i>	-0.14	0.007	-20.93	0.000
<i>Rasian</i>	-0.06	0.008	-7.22	0.000
<i>Rcombo</i>	0.01	0.008	0.91	0.363
<i>R-Squared</i>	0.15			

Table 10. Linear Regression for Depression (Down) by Current Food Sufficiency and Demographic Characteristics (n=229,523)

<i>Variable</i>	<i>Coefficient</i>	<i>SE</i>	<i>t</i>	<i>P</i>
<i>Curfoodsuf</i>	0.43	0.003	148.4	0.000
<i>Egender</i>	-0.07	0.004	-15.99	0.000
<i>Rhispanic</i>	-0.05	0.006	-8.90	0.000
<i>Eeduc</i>	-0.02	0.002	-10.34	0.000
<i>Ms</i>	-0.19	0.004	-41.89	0.000
<i>Income</i>	-0.03	0.001	-29.13	0.000
<i>Rblack</i>	-0.21	0.007	-32.50	0.000
<i>Rasian</i>	-0.08	0.008	-9.85	0.000
<i>Rcombo</i>	-0.01	0.008	-0.96	0.335
<i>R-Squared</i>	0.15			

Each regression has a similar r-squared value. The regression with anxious as a dependent variable has the lowest r-squared at 12.86 percent, showing that these variables account for about thirteen percent of the changes in anxiousness. The other three variables have an r-squared value between fourteen and sixteen percent—15.50 percent for worry, 14.57 percent for interest, and 14.99 percent for down—meaning that the variables account for around fifteen percent of the variation in these three variables on average.

Similar trends are present across all four of these regressions. First, as food sufficiency levels increase, all mental health indicators are negatively impacted by a large amount. When food sufficiency levels increase by one point, anxiety increases by 0.43 points, worry increases by 0.47 points, interest increases by 0.42 points, and down increases by 0.43 points. These results clearly show that an increase in food insufficiency for a household greatly increases the frequency of feelings of anxiety, worry, lack of interest, and depression.

Many demographics also show similar trends. One interesting finding is that, save for a few variables, all demographic factors have a negative impact on mental health indicators, or make them less frequent. When the gender is male, anxiety frequency decreases by 0.23 points, worry frequency decreases by 0.21 points, lack of interest frequency decreases by 0.05 points,

and depression frequency decreases by 0.07 points. This means that being male lowers the frequency of experiencing mental health issues, particularly anxiety and worry, relative to being female. For ethnicity, identifying as Hispanic lowers your chances of experiencing mental health by 0.06 points for anxiety, 0.03 points for worry, 0.04 points for lack of interest, and 0.05 points for depression. Those who are married also experience less mental health issues than those with other marital statuses, as being married decreases anxiety levels by 0.16 points, worry by 0.12 points, lack of interest by 0.19 points, and depression by 0.19 points.

Education shows an interesting trend, as educational attainment has a positive effect on anxiety, meaning that when education is increased by one point, anxiety goes up by 0.02 points. The opposite is found in all other categories, however, as worry decreases by 0.00 points, lack of interest decreases by 0.02 points, and depression decreases by 0.02 points when educational attainment increases by one level. Higher levels of income also have a negative impact on mental health. As income increases by one income bracket, all four indicators—*anxiety, worry, lack of interest, and depression*—decrease by 0.03 points.

The race demographic factors show some interesting trends. Being African American has the highest impact in most categories, decreasing anxiety by 0.30 points, worry by 0.16 points, and lack of interest by 0.14 points compared to whites. Those who identify as Asian also experience an improvement in mental health issues in these categories compared to African Americans, with anxiety decreasing by 0.03 points, worry decreasing by 0.07 points, and lack of interest decreasing by 0.06 points. Depression is much better for Asians than African Americans, however, with depression compared to whites decreasing by 0.83 points and 0.21 points, respectively. Those of other or a combination of races only had a significant impact on anxiety and worry. This demographic also had an interesting trend, as being other or combination race

raises worry by 0.01 points compared to whites. Anxiety improves, however, decreasing by 0.02 points when a respondent identifies as an other or combination race, compared to whites.

Discussion

This study focused on two main objectives—characterizing food insecurity among households with college students and examining the impact of food security on the mental health of college students in relation to COVID-19. Results show that food insecurity is significantly impacted (at the 99 percent level) by four mental health variables (anxiety, worry, lack of interest, and depression). Results also indicate that food insecurity has a significant impact (at the 99 percent level) on all four mental health variables.

11.27 percent of households responded that they sometimes or often experience food insufficiency. This number is well below estimates gathered by universities across the US but is almost a percent higher than the prevalence in the United States overall. One reason this number is lower than prior estimates for college students is because the data was not collected at college campuses, but rather in US households with college students. This would explain the proximity to the US number and indicates that the prevalence of food insecurity has increased during the pandemic for certain US households. The Owens study conducted on a Texas campus during the pandemic also shows much higher levels of food insecurity than found in this study. This finding suggests that a correlation does not always exist between a college student's food sufficiency level and the level of food sufficiency they experienced in their household prior to going to college. This could suggest that resources from the household are not reaching the student at college, whether in the form of income or government food assistance.

These findings provide critical insight to policymakers and other groups tasked with alleviating food security and mental health challenges in the US. The results show a correlation

between food sufficiency and mental health in both ways—food sufficiency affects mental health and vice versa. These findings show the importance of implementing multi-faceted policies that can fix both these problems at the same time. One way this can be done is through a collaboration with mental health organizations and food security organizations, specifically on college campuses to help this problem for college students. Colleges often provide both these services, but they should consider expanding and/or changing these programs to be more effective for students.

Additionally, as previously mentioned, researchers Davidson and Morrell share that many college students do not qualify for formal food assistance through the Supplemental Nutrition Assistance Program (SNAP). These results provide evidence supporting the college student participation in the SNAP program. The findings above support this, as governmental food assistance given to households in the US may not be reaching students at college, and thus students are not receiving any formal food assistance and falling into higher levels of food insufficiency. Formal federal assistance programs can help students improve their food sufficiency, specifically if they are part of a demographic that experience food insufficiency at higher rates than the average student. In turn, improvements in food sufficiency will also improve the mental health issues that many food-insecure students face.

Limitations

A primary limitation of this study relates to the data sample utilized. Students in the sample are not identified the same as those in other studies of this nature. Many other studies surveyed students on actual college campuses, as opposed to households with students. As a result, this study may not be entirely representative of the current college population.

Another limitation surrounding this dataset involves the number of incomplete responses. In the survey weeks studied, over 1.2 million participants responded to the Household Pulse Survey. Many participants did not fully complete the survey, however, largely reducing the number of usable responses in multiple categories. While the incomplete responses affected some categories more than others, this study was impacted in some way by the incompleteness of certain survey questions. As a result, not everyone who took the survey and met the inclusion criteria was able to be included in this study.

Conclusions

This study examined the prevalence of food insufficiency among households with college students and examined how food sufficiency impacted the mental health of students during the coronavirus pandemic. This study showed that food insufficiency levels have risen in households with students since the start of the pandemic. Additionally, it was found that food sufficiency levels and the mental health of college students have significant impacts on each other. These findings highlight the importance of implementing multi-faceted policies on college campuses that simultaneously address food assistance and mental health services among students.

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