



## Article

# Food Insecurity within a Public University and the Role of Food Assistance Programs Amid the Global Pandemic

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**Abstract:** Food insecurity (FI) is a pressing concern among university students in the United States, and the COVID-19 pandemic has exacerbated this issue. Providing food assistance for university students has become more challenging due to pandemic-related consequences and interventions. This study aims to (1) analyze social inequalities in FI among university students in a large public university during the pandemic, (2) investigate the association of their utilization of campus, community, and federal food assistance programs (FAPs) and FI, and (3) understand the barriers students face in accessing FAPs. Survey questionnaires were distributed to students to gather their socio-demographics, FI, and usage of FAPs. Logistic regression was utilized to assess the relationship between students' FI and their use of FAPs. Among the surveyed students ( $n = 282$ ), 33.7% reported experiencing FI. Higher FI rates were observed among socially vulnerable student groups, for example, non-Hispanic Black (62.5%) and Hispanic students (38.7%), compared with non-Hispanic White students (32.1%). FAPs had a limited influence on students' FI due to low utilization. The primary barriers to FAPs were insufficient information, ineligibility, and social stigma. The findings suggest it is crucial to reduce barriers to using FAPs and develop targeted interventions for marginalized students to address inequalities in FI.

**Keywords:** food insecurity; university students; food assistance programs; inequality; global pandemic



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## 1. Introduction

According to the U.S. Department of Agriculture (USDA-ERS 2021), food insecurity (FI) refers to a lack of access to safe and nutritious food that meets one's dietary needs for an active and healthy lifestyle. FI among university students has been found to be an issue of concern across college campuses in the United States (Barrett 2010; Bruening et al. 2016; Payne-Sturges et al. 2018; Adamovic et al. 2022). This issue has been exacerbated by economic hardships and other cascading effects of the COVID-19 global pandemic (Owens et al. 2020; Morales et al. 2021; Mialki et al. 2021). FI can have negative effects on students' physical health, including conditions like obesity, heart disease, and diabetes, ultimately impacting their overall well-being and compromising their academic performance (Ellison et al. 2021). It is imperative to comprehend university students' FI and examine the potential risk factors in the context of a global crisis to identify solutions to improve students' FI.

### 1.1. Review of the Relevant Literature Published in the United States

College presents the first opportunity for many students to experience independent living, which can contribute to FI, especially for low-income students (Fry and Cilluffo 2019; Owens et al. 2020; Davitt et al. 2021). Research indicates that university students face significantly higher rates of FI, with an estimated 37% experiencing this issue, compared with the

national average of 11.8% (Laska et al. 2020; Owens et al. 2020; Ellison et al. 2021). A study conducted in 2015 examined ten University of California campuses and found that 42% of students experienced FI (Martinez et al. 2018; Meza et al. 2019). Similarly, the University of Hawaii at Mānoa found that 21% of students experienced food insecurity, while 24% were at risk of FI (Chaparro et al. 2009). Furthermore, a national survey conducted in 2019 revealed that approximately 41% of students from 68 4-year colleges and universities experienced FI (Goldrick-Rab et al. 2019).

The COVID-19 pandemic resulted in university students facing financial hardship, leading to worsened FI (Owens et al. 2020; Mialki et al. 2021). A state university in the western part of the United States reported that 54% of its students experienced FI (Adamovic et al. 2022). Soldavini et al. (2021) found that 20% of their university student sample experienced higher levels of FI during the pandemic compared with before it. Additionally, Mialki et al. (2021) observed a 59.6% decrease in food security among university students as a direct result of the pandemic. More severely, increased FI among university students was associated with poorer academic performance, worse physical and psychological health, and lower dietary quality during the global crisis (Jehi et al. 2022; Ahmed et al. 2023; OoNorasak et al. 2023).

Social disparities in FI persist in the United States (Li et al. 2022). Higher rates of FI have been observed among students from underrepresented and marginalized backgrounds, students with disabilities, students with children, and students who identify as pansexual, queer, bisexual, gay or lesbian, transgender, or nonbinary (Adamovic et al. 2022; Soria et al. 2020). Research suggests a strong relationship between university students' FI and various risk factors, including their racial/ethnic background, limited income, increasing tuition and housing costs, housing instability, growing dependence on student loans and other financial sources (i.e., parents), limited access to food assistance programs, and experience of unexpected economic shocks or other hazardous events (Hughes et al. 2011; Coleman-Jensen et al. 2014; Bruening et al. 2016; Morris et al. 2016). As for the onset of the COVID-19 pandemic, studies have indicated higher rates of FI in students who lived alone (Davitt et al. 2021), those who received financial aid (Soria et al. 2020), and those who lost their income due to the pandemic (Owens et al. 2020).

### *1.2. Food Assistance Programs in the United States*

Food assistance programs (FAPs) play a crucial role in addressing the immediate needs of students who are facing FI (Freudenberg et al. 2019). The U.S. government enacted various FAPs to combat FI. Among these programs, the Supplemental Nutrition Assistance Program (SNAP, previously known as food stamps) offers financial support to low-income families to purchase food (Adamovic et al. 2022; USDA-FNS 2021). Since the COVID-19 pandemic began, the total number of SNAP participants increased by 6% from 2019 to 2021 (USDA-FNS 2022). However, it is important to note that university students aged 18 to 49 are eligible for SNAP benefits only by meeting certain criteria, such as working at least 20 h per week and being enrolled in classes at least half-time (USDA-FNS 2019; Mialki et al. 2021).

Community food services have also been instrumental in providing and distributing food to those in need (El Zein et al. 2018). Community FAPs, such as food banks and food pantries, rely on donated food from local communities or private organizations (El Zein et al. 2018). During the COVID-19 pandemic, over 60 million individuals sought support from food banks, food pantries, and other private FAPs (Feeding America 2021). Additionally, college campuses have established food pantries, providing an easily accessible resource for university students. College food pantries are typically located within or near the campus, offering readily available food at no cost (Freudenberg et al. 2019; Feeding America 2021). As of May 2018, there were a total of 640 food pantries on U.S. college campuses (El Zein et al. 2018). A study found that college food pantries were the second most common form of emergency aid for students (Freudenberg et al. 2019).

While FAPs are readily available to university students, potential barriers can prevent them from using these programs and services (Purdam et al. 2016; Bacon and Baker 2017; El Zein et al. 2018; Davitt et al. 2021). A report in 2016 which surveyed 3,765 university students across 34 college campuses in 12 states revealed that 14% of food-insecure students had used a food pantry or food bank within the past month (Dubick et al. 2016; El Zein et al. 2018). Similarly, in the study of El Zein et al. (2018), out of their sample of 899 students, only 15.6% used their college's food pantry. Many students are unaware of FAPs and eligibility requirements (Owens et al. 2020; Perry et al. 2023; Ahmed et al. 2023), and qualifying for SNAP benefits can be challenging (Mialki et al. 2021; Lewis et al. 2021).

### 1.3. Research Gaps and Objectives

As a high-risk population for FI, university students may have been disproportionately affected by the global pandemic (Owens et al. 2020; Mialki et al. 2021), especially those students from marginalized backgrounds. There is still much to learn about social disparities in FI among university students and the potential risk factors in the background of the COVID-19 pandemic (Jehi et al. 2022). Furthermore, during the pandemic, it has become increasingly challenging to provide food assistance for university students due to campus closures, the implementation of physical distancing policies, and various consequences caused by the global pandemic (Blackmon et al. 2021; Esobi et al. 2021; Li et al. 2022; Ahmed et al. 2023). However, little is known about the relationship between students' utilization of FAPs and their FI, particularly among socially vulnerable students.

To fill these gaps, we conducted a survey in a large public university in the southeastern United States to analyze students' food insecurity during the first two years of the pandemic, from March 2020 to early May 2022. The study period aligns with the period of online teaching during COVID-19 pandemic, as this university fully resumed in-person operations in mid-May 2022. Although the United States economy had gradually recovered by 2022, real gross domestic product (GDP) decreased by 1.6% in the first quarter and 0.9% in the second quarter (U.S. Department of Commerce 2022). Additionally, by 2022, the real personal income in the U.S. was still \$500 lower than the 2019 level (U.S. Census Bureau 2023).

This study aims to (1) analyze social inequalities in FI among university students in a large public university, (2) investigate the association of their utilization of campus, community, and federal food assistance programs (FAPs) and FI, and (3) understand the barriers students faced in accessing FAPs.

Based on the research objectives, two hypotheses were proposed: Hypothesis 1: University students' FI is associated with their sociodemographic factors (e.g., gender, race/ethnicity, and number of children). In other words, students from marginalized groups have a higher risk of experiencing FI during the COVID-19 pandemic. Hypothesis 2: Students' utilization of campus, community, and/or federal FAPs is associated with a significantly lower level of FI.

## 2. Materials and Methods

### 2.1. Study Design and Procedure

The study protocol was approved by the institutional review board at the authors' institution. This cross-sectional study utilized an online survey administered through Qualtrics. The survey questionnaire consisted of 32 questions, including the Adult Food Security Survey Module (AFSSM) developed by the USDA (2012), inquiries about the usage of and barriers to FAPs, and sociodemographic information. Students were eligible to participate in the study if they were 18 years of age or older and enrolled at this university during the study period, from March 2020 to early May 2022. The survey was distributed to all students within the Department of Sociology, Department of Computer Science, College of Community Innovation and Education, and College of Nursing in May and June 2022. The recruitment letter with the survey link was sent to students' emails via their department or college student listserv. Finally, a convenience sample with 289 completed

questionnaires was received. The summary statistics can be found in Table 1. The sample is somewhat skewed, with overrepresentation of female, White, and Asian respondents, as well as graduate students. To address any potential sample bias, the data were weighted based on the proportions of these three variables (gender, race/ethnicity, and classification) among the student population at this university, following established methodologies (Biemer and Christ 2008; Vaske 2011). A weighted sample of 282 respondents was finally obtained for analysis. The summary statistics for all weighted variables are presented in Table 2 and further discussed in the Results section.

**Table 1.** Summary statistics of variables with unweighted survey data ( $n = 289$ ).

Variables	Description	Number	%
Dependent variable			
Food security	Food secure	102	35.70%
	Food insecure	187	64.50%
Independent variables			
Campus food pantry	Never used	265	91.70%
	Used	24	8.30%
Community food banks	Never used	267	92.40%
	Used	22	7.60%
SNAP	Never used	266	92%
	Used	23	8%
Socio-demographics (controls)			
Gender	Woman	207	71.60%
	Man	71	24.60%
	Another identity	11	3.80%
Race/ethnicity	Non-Hispanic White	145	50.20%
	Non-Hispanic Black	45	15.6%
	Hispanic	47	16.3%
	Non-Hispanic Asian	25	8.70%
	Other	27	9.30%
Classification	Undergraduate	184	63.70%
	Graduate student	105	36.30%
Relationship status	Single	215	74.4%
	Divorced or widowed	12	4.20%
	Married	62	21.5%
Received financial support from family	Yes	148	51.2%
	No	141	48.8%
Received scholarship, loans, or debts	Yes	221	76.5%
	No	68	23.5%
		Mean	SD
Age		27.8	10.37
Number of Children		0.45	1.11
Housing expense	USD/month	935.46	693.18

**Table 2.** Summary statistics of variables with weighted survey data ( $n = 282$ ).

Variables	Description	Number	%
Dependent variable			
Food security	Food secure	187	66.31%
	Food insecure	95	33.69%

Table 2. Cont.

Variables	Description	Number	%
Independent variables			
Campus food pantry	Never used	258	91.60%
	Used	23	8.10%
Community food banks	Never used	261	92.70%
	Used	20	7.00%
SNAP	Never used	261	92.70%
	Used	21	7.30%
Socio-demographics (controls)			
Gender	Woman	160	56.70%
	Man	114	40.30%
	Another Identity	8	3%
Race/ethnicity	Non-Hispanic White	131	46.50%
	Non-Hispanic Black	24	8.60%
	Hispanic	75	26.5%
	Non-Hispanic Asian	24	8.50%
	Other	18	9.90%
Classification	Undergraduate	239	84.80%
	Graduate student	43	15.20%
Relationship status	Single	222	78.70%
	Divorced or widowed	7	2.50%
	Married	53	18.80%
Received financial support from family	Yes	161	57%
	No	121	43%
Received scholarship, loans, or debts	Yes	217	77%
	No	65	23%
		Mean	SD
Age		25.67	8.9
Number of Children		0.3	0.89
Housing expense	USD/month	867.79	653

## 2.2. Survey Measures

FI was assessed using the 10-item U.S. Adult Food Security Survey Module (AFSSM) (USDA 2012). Most previous studies have applied the AFSSM to examine the prevalence of FI among university students (e.g., El Zein et al. 2018; Adamovic et al. 2022; Ahmed et al. 2023). The AFSSM is widely recognized in the FI literature as a valid and reliable measure of FI (Chaparro et al. 2009; Patton-López et al. 2014; Maroto et al. 2015; Bruening et al. 2016; Payne-Sturges et al. 2018; Nikolaus et al. 2019; Adamovic et al. 2022). Students were identified as food-insecure or secure using the USDA coding schemes (Bickel et al. 2000; USDA 2012). For each survey question, affirmative responses were coded as 1, and negative responses were coded as 0. For example, a participant was coded as 1 if they answered “often true” or “sometimes true” to the statement “Worried food would run out” and coded as 0 if they answered “never true”. A total score was obtained for each student by summing up the coded scores of the ten questions. The USDA methodology (USDA 2012) groups respondents into four categories based on the total scores: high food security (score of zero), marginal food security (score of 1–2), low food security (score of 3–5), or very low food security (score of 6–10). Respondents are then further divided into two categories for analysis: food secure (high/marginal food security) or food insecure (low/very low food security). Food-secure respondents were coded with 0, while food-insecure respondents were coded with 1. To assess the use of campus food pantries,

community FAPs, and SNAP, three survey questions were included (El Zein et al. 2018). For example, one question was, “Since the outbreak of COVID-19 in the U.S., how often did you use the campus food pantry?” Questions about the barriers to using FAPs were also analyzed. Additionally, the questionnaire included 11 questions to collect information on students’ socio-demographic factors, such as age, gender, race/ethnicity, classification (undergraduate or graduate students), relationship status, and number of children, as well as other potential risk factors such as housing expenses and financial support.

### 2.3. Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistic 27. Descriptive statistics were used to present weighted respondents’ demographic characteristics (Table 2), the prevalence of FI among students (Table 3), the socio-demographic factors among food-insecure students (Table 4), and students’ usage of and barriers to FAPs (Table 5). Lastly, a binary logistic regression analysis was conducted to examine the statistical association between FI, socio-demographic factors, and the utilization of FAPs (Table 6). The dependent variable was the student’s FI, and the independent variables included students’ usage of campus, community resources, and SNAP. Control variables consisted of socio-demographic factors and other potential risk factors such as age, gender, race/ethnicity, number of children, housing cost, receiving financial aid, scholarships, loans, and student debt. Following the equation proposed by Hsieh et al. (1998), we conducted a power analysis for the logistic regression. The resulting minimum sample size was 206, with a statistical power of 0.8 at a significance level of 0.05. Therefore, the sample size ( $n = 282$ ) is sufficient to run the logistic regression model and test the hypothesis.

**Table 3.** Summary of food insecurity among students ( $n = 282$ ).

Items/Questions	Participants’ Responses		
	Often true	Sometimes true	Never true
Q1: Worried food would run out	32 (11.2%)	85 (30.1%)	165 (58.7%)
Q2: Couldn’t afford to eat balanced meals	50 (17.8%)	74 (26.2%)	157 (55.7%)
Q3: Food bought just didn’t last	23 (8.0%)	61 (21.7%)	198 (70.3%)
Q4: Cut or skipped meals	Yes	No	
	76 (27.1%)	198 (70.2%)	
(Q4a:) How often did this happen?	Almost every month	Some months	1 or 2 months
	24 (8.5%)	41 (14.4%)	8 (2.9%)
Q5: You ate less than felt you should	Yes	No	
	79 (28.1%)	185 (65.8%)	
Q6: You were hungry but didn’t eat	68 (24.1%)	201 (71.3%)	
Q7: You lost weight because not enough food	30 (10.6%)	228 (81.1%)	
Q8: Did not eat for a whole day	17 (5.9%)	256 (90.7)	
(Q8a:) How often did this happen?	Almost every month	Some months	1 or 2 months
	11 (3.8%)	4 (1.5%)	2 (0.6%)

**Table 4.** Numbers and percentages of food-insecure students among socio-demographic groups ( $n = 95$ ).

Socio-Demographics	Description (Total Number of Each Group)	Number of Food-Insecure Students (%)
Gender	Woman (160)	66 (41.3%)
	Man (114)	26 (22.8%)
	Another identity (8)	4 (50%)

**Table 4.** *Cont.*

Socio-Demographics	Description (Total Number of Each Group)	Number of Food-Insecure Students (%)
Race/Ethnicity	Non-Hispanic White (131)	42 (32.1%)
	Non-Hispanic Black (24)	15 (62.5%)
	Hispanic (75)	29 (38.7%)
	Asian (24)	5 (20.8%)
	Other (18)	4 (22.2%)
Classification	Undergraduate students (239)	84 (35.1%)
	Graduate students (43)	11 (25.6%)
Relationship status	Single (222)	78 (81.6%)
	Divorced or widowed (7)	1 (1.4%)
	Married (53)	16 (17%)
Children	With children (38)	14 (36.8%)
	Without children (244)	82 (33.6%)

**Table 5.** Summary of usage and barriers of food assistance programs (*n* = 282).

Usage	Never	Only Once	Once or Twice/Semester	Once or Twice/Month	Once or More than Once/Week
Campus FAP	259 (91.8%)	6 (2.1%)	5 (1.7%)	6 (2.1%)	6 (2.1%)
Community FAP	262 (92.9%)	3 (1.1%)	8 (2.8%)	6 (2.1%)	3 (1.1%)
SNAP	261 (92.6)	0 (0%)	1 (0.4%)	7 (2.5%)	13 (4.6%)
Barriers	Stigma	Insufficient Information	Hours Unaccommodating	Taking from Those in Need	Ineligibility
Campus FAP	36 (12.9%)	100 (35.4%)	16 (5.8%)	203 (72.1%)	N/A
Community FAPs	26 (9.3%)	92 (32.5%)	14 (5%)	199 (70.5%)	N/A
SNAP	N/A	81 (28.7%)	N/A	N/A	172 (61%)

**Table 6.** Result of logistic regression models (*n* = 282).

Variables	Odd Ratio	95% CI
Independent Variables		
Campus food pantry (reference: no—0)	1.336	0.911, 1.959
Community food pantry/food bank (reference: no—0)	2.025 **	1.264, 3.245
SNAP (reference: no—0)	2.237 ***	1.424, 3.515
Control Variables		
Age	1.003	0.953, 1.056
Gender (Reference: Male—1)		
Female	2.28 *	1.174, 4.438
Another identity	3.551	0.73, 17.27
Race (Reference: Non-Hispanic White—1)		
Non-Hispanic Black	2.36	0.842, 6.613
Hispanic	1.09	0.554, 2.14
Asian	0.217	0.055, 0.857
Other	0.278	0.071, 1.09

Table 6. Cont.

Variables	Odds Ratio	95% CI
Classification (Reference: Undergraduate—1)	0.569	0.220, 1.47
Number of Children	0.762	0.468, 1.24
Relationship status (Reference: Single—1)	0.337	0.032, 3.58
Spending on housing	1.00	1.00, 1.00
Receiving financial support from family or other individuals (Reference: yes—1)	1.95 *	1.06, 3.60
Receiving scholarship/student loans/debt (Reference: yes—1)	0.474	0.219, 1.03
Omnibus tests (model significance)	<0.001	
–2Loglikelihood	287,810	
Cox and Snell R <sup>2</sup>	0.227	
Nagelkerke R <sup>2</sup>	0.315	

Note: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .

### 3. Results

#### 3.1. Summary of Respondents' Socio-Demographic Information

The summary statistics of weighted survey data are presented in Table 2. Overall, 66.3% of the students were found to be food secure and 33.7% were food insecure. The average age of the participants was 25 years, with 46.5% identified as Non-Hispanic White, 8.6% as Non-Hispanic Black, 26.5% as Hispanic, 8.5% as Asian, and 9.9% as other. Regarding gender composition, 56.7% identified as women, 40.3% as men, and 3% as another gender identity. The survey included 84.8% undergraduate students and 15.2% graduate students. Most students were single (78.7%), some were married (18.8%), while a few were divorced or widowed (2.5%). A small percentage of students reported having children (13.5%) while the majority reported not having children (86.5%). In terms of living expenses, the average housing cost for most students was USD 868. About 57% of students reported having received financial support from family or other individuals, while the remaining 43% did not. Additionally, 77% of students reported having received scholarships, student loans, and/or other debts, while the other 23% did not.

#### 3.2. Food Insecurity among Students

The prevalence of FI among students at the focal university was estimated using the AFSSM questionnaire. The results of analyzing the 10-item AFSSM are presented in Table 3, which reveals a significant proportion of students experiencing FI during the pandemic. Approximately 41.3% (117) of surveyed students worried that their food would run out, with 32 stating that it was often true and 85 stating that it was sometimes true. Moreover, 44% of surveyed students responded with “often true” (50) or “sometimes true” (74) to the question “couldn’t afford to eat balanced meals”. Additionally, 29.7% of students reported that it was often true (23) or sometimes true (61) in response to the statement “food bought didn’t last”. Roughly 27.1% of students acknowledged cutting or skipping meals, 28.1% ate less than felt they should, and 24.1% felt hungry but did not eat. Around 5.9% of students experienced going a whole day without food, for almost every month to some months. As a result of insufficient food, 10.6% of students reported weight loss.

#### 3.3. Socio-Demographics of Food-Insecure Students

Table 4 presents the numbers and percentages of food-insecure students among different socio-demographic groups. The analysis reveals the disparities in FI across gender groups, with 41.3% of female students experiencing FI compared with 22.8% of male students. Students identifying with other gender identities exhibited an extremely high FI rate of 50%. Among racial and ethnic groups, non-Hispanic Black (62.5%) and Hispanic students (38.7%) displayed the highest levels of FI, followed by non-Hispanic White students (32.1%), other race/ethnic groups (22.2%), and Asian students (20.8%). Moreover, single students (35.1%) experienced higher FI compared with married students (30.2%) and those

who were divorced or widowed (14.3%). FI was more prevalent among undergraduate students (35.1%) compared with graduate students (25.6%). Finally, students with children (36.8%) experienced higher FI compared with students without children (33.6%).

### 3.4. Usage and Barriers of Food Assistance Programs

Table 5 provides a summary of the usage of and barriers to FAPs among students. About 91.8% of students and 85.3% of food-insecure students reported that they had never used the campus food pantry, while only 2.1% of students and 4.4% of food-insecure students indicated that they had used the campus food pantry once or more than once a week. The main barriers reported by students in accessing the campus food pantry include the stigma associated with welfare/assistance programs (12.9%), insufficient information about how the program works (35.4%), and concerns about taking resources from those in greater need (72.1%). Regarding community FAPs, about 92.9% of students and 85.1% of food-insecure students reported that they have never used community FAPs, while less than 1.1% of students and 6.7% of food-insecure students reported having used community FAPs once or twice a week. Similar to the campus food pantry, students reported experiencing barriers such as stigma (9.3%), insufficient information (32.5%), and concerns about taking from those in need (70.5%) as reasons for not accessing community FAPs. Moreover, when asked about their eligibility for SNAP, 61% of students reported being ineligible, 10.2% reported being eligible, and 28.7% stated they did not know about this program. About 21.8% of food-insecure students reported being ineligible and 22.8% indicated they did not know about this program. Among all eligible students, 8 (27.7%) never used SNAP, 1 (4.5%) used it once or twice per semester, 7 (23.7%) used it once or twice per month, and 13 (44.8%) students used it once or more than once a week when combined. The primary reasons reported by students for not using SNAP were ineligibility (61%) and insufficient information (28.7%). The data reveal that only a very small percentage of students frequently utilized FAPs.

### 3.5. Results of Logistic Regression Models

Table 6 summarizes the results of the binary logistic regression model. The analysis demonstrates that the usage of SNAP or community FAPs was significantly associated with students' FI status. Students who used SNAP ( $p < 0.001$ ; odds ratio, 2.24; 95% CI, 1.42, 3.52) and/or community FAPs ( $p < 0.01$ ; odds ratio, 2.03; 95% CI, 1.26, 3.25) exhibited higher odds of experiencing FI compared with those who did not use these programs. However, usage of the campus food pantry did not show a significant association with students' FI. Among the socio-demographic factors, only gender and financial support emerged as significant predictors of FI. Male students had a lower risk of experiencing FI compared with female students ( $p < 0.05$ ; odds ratio, 2.28; 95% CI, 1.26, 3.25). Students who received financial support from family or other individuals had lower odds of facing FI compared with those who did not receive such support ( $p < 0.05$ ; Odds Ratio, 1.95; 95% CI, 1.06, 3.6). The remaining control variables, including age, race/ethnicity, and so on, were not found to be significant to FI.

## 4. Discussion

This study investigated FI among students at a public university during the global pandemic. While FI is prevalent across campuses throughout the United States, the findings of this study emphasize the vulnerability of university students, in particular those from underrepresented groups, to experiencing FI during a global crisis.

The findings generally support the first hypothesis, which suggests that socio-demographic factors are associated with FI among university students. The analysis shows disparities in FI rates across different socio-demographic groups (Table 4). Female students (41.3%) and students with another identity (50%) experienced higher rates of FI compared with their male counterparts (22.8%). Moreover, Hispanic students (38.7%) and Black students (62.5%) had much higher rates of FI compared with non-Hispanic White (32.1%) and Asian

students (20.8%). These findings align with previous research highlighting the presence of racial and gender inequalities in food insecurity (El Zein et al. 2018; Adamovic et al. 2022; Davitt et al. 2021; Mialki et al. 2021). The disproportionate impact of the COVID-19 pandemic on racial and ethnic minority students is evident in the disparity among food-insecure students (Wolfson and Leung 2020). Additionally, students who received financial aid or support from family tended to have greater FI, demonstrating the social capital theory that emphasizes the role of family and peer support in reducing FI levels (Willis and Fitzpatrick 2019).

The analysis does not support the second hypothesis, which states students' utilization of campus, community, and/or federal FAPs is associated with their significantly lower FI. The findings reflect significant baseline differences between FAP participants and non-participants (Guo et al. 2019; Li et al. 2023). Students who participated in FAPs had a higher risk of experiencing FI, as most of them were already facing financial hardships and experiencing FI, while non-participants of FAPs generally experienced fewer social and economic challenges (Bruening et al. 2016; Davitt et al. 2021). Factors such as campus closures, changes in housing situation, and employment status fluctuations during the pandemic may have further enlarged these baseline differences (Mialki et al. 2021). Also, the low utilization of FAPs among students may have limited their effectiveness in alleviating FI. For example, only 8.1% (23) of students in our study had the campus food pantry, which is much lower than the reported 23.4% in three public colleges in New York State (Ahmed et al. 2023). About 7.3% of students (21) had utilized SNAP while 60.3% (147) were not eligible and 26.6% (65) did not know this program at all.

Previous studies have obtained inconsistent findings in the relationship between food insecurity and FAP participation. Some research suggests that students participating in food assistance programs tend to have a higher risk of FI (Patton-López et al. 2014; Esaryk et al. 2021), while other studies found that students' usage of FAPs is not significantly related to their FI (Payne-Sturges et al. 2018) or is associated with enhanced food security (Nazmi et al. 2023) and health outcomes (Martinez et al. 2022). Furthermore, surveys conducted at several universities in the USA reveal that on-campus and/off-campus FAPs were among students' preferred solutions to combat food insecurity (Adamovic et al. 2022; Esaryk et al. 2021). However, investigations into the role of FAPs among university students remain limited in the context of the COVID-19 pandemic. Our paper is one of the first studies to shed light on the usage of and barriers to various FAPs available on campus, in the community, and provided by the federal government in the wake of the global pandemic.

The major barriers to students' of FAPs included social stigma, insufficient information on FAPs, concerns about taking from those in greater need, and ineligibility for SNAP, consistent with previous studies (El Zein et al. 2018; Davitt et al. 2021). However, we found different patterns among socio-demographic groups. For example, when compared with non-Hispanic White students (8%), higher percentages of non-Hispanic Black (24.2%) and Hispanic (16.7%) students reported social stigma as a barrier to using the campus food pantry. Over 70% of students had concerns about taking resources from those in greater need, with over 80% of Hispanic students expressing this concern, the highest among all racial-ethnic groups.

This research is not without limitations. For one, the cross-sectional nature of this study and its small sample size prevent drawing definitive conclusions regarding the causal relationship between FI and utilization of FAPs. Another limitation to consider is the small sample size. The questionnaire was distributed to several departments and colleges at a public university, which may limit the study's generalizability due to the small and unrepresentative sample.

## 5. Conclusions

In summary, this research contributes to a better understanding of how unexpected shocks or hazardous events, such as the global pandemic, influence FI among university students. We provide new evidence that many students at the focal university experienced

FI during the first two years of the pandemic, particularly those from underrepresented socio-demographic groups. Moreover, despite the high prevalence of FI at this university, this research reveals the limited utilization of FAPs by food-insecure students and the barriers preventing their use. By highlighting these findings, this study can increase public awareness of social inequalities in FI among university students and encourage campus and community engagement for initiatives addressing the issues and barriers related to FAPs. It is with this understanding that policy development and societal action can focus on combating FI and improving FAPs within universities and off campus.

This study has practical and policy implications. First, there is an urgent need to address social inequalities in FI across different socio-demographic groups. One suggested approach is implementing an outreach program that specifically targets socially vulnerable students, such as female students and Black and Hispanic students, especially those who hesitate to use FAPs due to social stigma (Adamovic et al. 2022). Secondly, to lower the barriers of FAPs and increase students' utilization, students at the focal university suggested several measures. These include providing handouts with information of both on-campus and off-campus FAPs, disseminating this information to students via emails, accommodating food pantry opening hours, and offering free and healthy meals to both on-campus and off-campus students. In addition, considering the profound negative impact of FI on university students, it is imperative to strengthen the partnership between federal and community FAPs and campus food pantries. The collaborative effort would make food assistance more accessible and available for all students in need. By enhancing coordination and cooperation among these entities, universities can better address FI faced by their students.

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