



Food Insecurity Among Graduate Students and Postdoctoral Trainees

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Abstract

IMPORTANCE Food insecurity on college campuses has emerged as an urgent public health priority; however, there has been a lack of studies focused on graduate students or postdoctoral trainees, particularly those enrolled at private academic institutions.

OBJECTIVE To estimate the prevalence of and factors associated with food insecurity among graduate students and postdoctoral trainees at a private academic university in Boston, Massachusetts.

DESIGN, SETTING, AND PARTICIPANTS In this cross-sectional survey study, a survey on food insecurity was sent to graduate students and postdoctoral trainees at 3 health-focused graduate schools at Harvard University during the end of the spring 2023 academic term (April to June). Participants were studying medicine, dental medicine, or public health. Data analysis was performed from July to September 2023.

EXPOSURE Sociodemographic characteristics of graduate students and postdoctoral trainees.

MAIN OUTCOMES AND MEASURES The primary outcome was food insecurity as assessed using the US Household Food Security Survey Module. Food insecurity also encompassed low and very low food security. Bidirectional stepwise logistic regression models were conducted to estimate the factors associated with food insecurity for graduate students and postdoctoral trainees.

RESULTS The analytic sample included 1745 participants (response rate, 55%): 1287 were graduate students and 458 were postdoctoral trainees. The median age of respondents was 29.0 (IQR, 7.0) years, and more than half (1073 [61.5%]) identified as female. A total of 694 respondents (39.8%) identified as Asian, 625 (35.8%) as White, and 426 (24.4%) as being of other race or ethnicity. The prevalence of food insecurity was 17.4% (224 of 1287) among graduate students and 12.7% (58 of 458) among postdoctoral trainees. Among graduate students, factors associated with food insecurity included being Asian (OR, 1.06 [95% CI, 1.01-1.11]) or of other race or ethnicity (OR, 1.07 [95% CI, 1.02-1.13]), receiving financial aid (OR, 1.09 [95% CI, 1.05-1.13]), and having housing instability (OR, 1.53 [95% CI, 1.45-1.61]). Among postdoctoral trainees, factors associated with food insecurity included receiving Supplemental Nutrition Assistance Program benefits (OR, 1.59 [95% CI, 1.28-1.97]), having housing instability (OR, 1.33 [95% CI, 1.22-1.45]), and not owning a car (OR, 1.11 [95% CI, 1.04-1.18]).

CONCLUSIONS AND RELEVANCE In this study, a substantial proportion of graduate students and postdoctoral trainees at a private academic institution experienced food insecurity during the academic year. These findings underscore the need for national and institutional interventions to address the complex, structural factors related to food insecurity in these distinct populations.

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Key Points

Question What is the prevalence of food insecurity among graduate students and postdoctoral trainees at 3 schools at Harvard University in Boston, Massachusetts, and what factors are associated with food insecurity?

Findings In this cross-sectional survey study with 1745 participants, 17% of graduate students and 13% of postdoctoral trainees experienced food insecurity during the academic year. Among graduate students, factors associated with food insecurity included belonging to a racial and ethnic minority group, receiving financial aid, and having housing instability; among postdoctoral trainees, these factors included receiving Supplemental Nutrition Assistance Program benefits, having housing instability, and not owning a car.

Meaning These findings suggest that national and institutional interventions are needed to address the complex, structural factors related to food insecurity among graduate student and postdoctoral trainee populations.

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

Introduction

Food insecurity, defined as the lack of access to enough food to attain a healthy, active life, is an important social determinant of future economic mobility and health outcomes for young adults. In 2022, the prevalence of food insecurity was 12.8% in the US and 8.5% in the commonwealth of Massachusetts.¹

In the past decade, food insecurity on college campuses has emerged as an urgent public health priority. Prior studies have shown that college food insecurity is associated with lower academic performance, adverse health behaviors, and poor mental health.^{2,3} Exposure to food insecurity during college has also been associated with lower college graduation rates and higher risk of food insecurity in later adulthood.^{4,5} Despite this robust existing literature, most studies have been conducted among undergraduate students enrolled at 2- or 4-year public institutions; few studies have been conducted among students enrolled at private institutions, and even fewer studies have assessed food insecurity among graduate students.⁶ Additionally, to our knowledge, no study has examined food insecurity among postdoctoral trainees (eg, those with a doctoral degree enrolled in a full-time training position to facilitate the transition to an independent investigator).⁷ Exploring food insecurity among graduate students and postdoctoral trainees is important because of the complexities of their experiences, which could exacerbate food insecurity. Examples include difficulties in achieving work-life balance, financial hardships, and demanding and stressful workloads.^{8,9} For postdoctoral trainees specifically, salaries are often based on the US National Institutes of Health model, which may be insufficient to meet the true costs of living in some geographic areas or the needs of other family members.¹⁰

Given that food insecurity is an urgent public health problem with long-term implications, studying food insecurity among future health professionals and health-focused academic researchers becomes even more important. Therefore, the primary aim of this study was to assess the prevalence of food insecurity and the factors associated with it among students and postdoctoral trainees at 3 health-focused graduate schools within Harvard University.

Methods

The protocol for this cross-sectional survey study was considered exempt by the Harvard T.H. Chan School of Public Health Office of Regulatory Affairs and Research Compliance. Written consent was obtained electronically at the beginning of the survey. The study followed the American Association for Public Opinion Research (AAPOR) reporting guideline for survey studies.

Using registration information obtained from registrar offices of the 3 respective schools, we invited all master's and PhD-level graduate students and postdoctoral trainees (n = 3621) at the Harvard T.H. Chan School of Public Health, Harvard Medical School, and Harvard School of Dental Medicine to complete a brief online (Qualtrics) survey via an email with a personalized survey link. Over a 3-week period, students and trainees received up to 3 reminder emails to complete the survey. Respondents received a \$10 gift card upon survey completion. The survey was sent during the end of the spring 2023 academic term (April to June). We received 1443 responses from graduate students and 525 responses from postdoctoral trainees, reflecting a 55% total response rate. After excluding 218 respondents with missing data, 11 who did not provide consent, and 26 who were enrolled in fully remote programs, the final analytic sample included 1287 graduate students and 458 postdoctoral trainees.

We assessed food insecurity using the validated 18-item US Household Food Security Survey Module (HFSSM).¹¹ The HFSSM was not developed specifically for college students; however, this measure has been used extensively to assess food insecurity in college populations because there is no current measure of food insecurity specific to college students.^{12,13} Indicators were modified to assess experiences over the past academic year (ie, since the beginning of the fall 2022 semester). Food security was categorized as follows: (1) high food security (0 affirmative responses to the

survey items), defined as having no problems or anxiety about access to sufficient food; (2) marginal food security (1-2 affirmative responses to the survey items), defined as having some problems or anxiety about access to sufficient food, but the quality and quantity of food intake were not considerably reduced; (3) low food security (3-5 affirmative responses for households without children or 3-7 affirmative responses for households with children), defined as the reduction in the quality but without a considerable reduction in the quantity of food consumed; and (4) very low food security (6-10 affirmative responses for households without children or 8-18 affirmative responses for households with children), defined as a disruption of eating patterns and a reduction in the quantity of food consumed due to the lack of money and other resources for food.^{11,14} Food security encompassed both high and marginal food security, and food insecurity encompassed both low and very low food security.

We collected information on the sociodemographic characteristics of students and trainees, including age, gender identity, race and ethnicity, marital status, parental status, employment status, first-generation status, residency status, degree type, receipt of financial aid, receipt of Supplemental Nutrition Assistance Program (SNAP) benefits, car ownership, and housing stability. Students and trainees reported their age in years; age was analyzed as both a continuous variable (for descriptive purposes) and as a categorical variable (≤ 30 , 31-40, 41-50, or >50 years) in regression analyses. Gender identity was assessed using the categories female, male, transgender woman, transgender man, or neither exclusively male nor female; due to sparse sample sizes, these categories were collapsed into female, male, and other (including transgender man, transgender woman, neither exclusively male nor female [gender-queer or gender nonconforming], agender, and 2-spirit) to protect the identities of those respondents. Race and ethnicity were self-reported by respondents using categories based on the US Office of Management and Budget¹⁵ revisions to the standards for the classification of federal data on race and ethnicity. Due to sparse sample sizes, race and ethnicity categories were collapsed into Asian, White, and other race or ethnicity (including American Indian or Alaska Native, Black or African American, Hispanic, Middle Eastern or North African, Native Hawaiian or Other Pacific Islander, and multiple races or ethnicities) to protect the identities of those respondents. In this study, race and ethnicity was assessed because of its association with food insecurity, as indicated in previous literature.¹⁶ Marital status (married, single, divorced, separated, or living with a partner), parental status (having children or not having children), and employment status (currently working for pay or currently not working for pay) were self-reported. Information about employment status was only collected among graduate students. First-generation status was defined as both of the respondent's parents having less than a college degree. Residency status was assessed as whether the respondent had domestic, international, or other residential status. Degree type (master's degree; PhD, DMD, or equivalent degree; or postdoctoral trainee) was assessed as the respondent's current program type. Receipt of financial aid (yes or no) was defined as whether the respondent had received any financial aid, need-based grants or scholarships, or need-based loans to pay for college, living expenses, or both since the beginning of the fall 2022 semester. Only graduate students were asked about their receipt of financial aid. Participation in SNAP (yes or no) was defined as whether the respondent reported receipt of SNAP benefits since the beginning of the fall 2022 semester. Car ownership (yes or no) was defined as whether the respondent owned a vehicle. Finally, housing instability (yes or no) was defined as an affirmative response to either of the following: (1) any inability to pay the mortgage or rent on time or in full or (2) worry about losing housing since the beginning of the fall 2022 semester. The questions pertaining to the sociodemographic characteristics are available in the eTable in [Supplement 1](#).

Sociodemographic characteristics of students and trainees by food security categories were compared using χ^2 tests for categorical variables (or the Fisher exact test when appropriate; ie, for variables with sample sizes <10 per cell) and 2-sample *t* tests for continuous variables. Factors associated with food insecurity were estimated using bidirectional stepwise logistic regression with food insecurity as the outcome and sociodemographic characteristics as covariates, with separate

Table 1. Sociodemographic Characteristics of Graduate Students and Postdoctoral Trainees by Food Security Status at Harvard University^a

Characteristic	Graduate students (n = 1287)			Postdoctoral trainees (n = 458)		
	Food secure (n = 1063)	Food insecure (n = 224) ^b	P value	Food secure (n = 400)	Food insecure (n = 58) ^b	P value
Age, median (IQR), y	27.0 (6.0)	27.0 (6.0)	.08	32.0 (4.3)	32.0 (4.0)	.56
Gender identity						
Female	689 (83.0)	141 (17.0)	.07	221 (90.9)	22 (9.1)	.03
Male	354 (82.9)	73 (17.1)		175 (83.3)	35 (16.7)	
Other ^c	20 (66.7)	10 (33.3)		4 (80.0)	1 (20.0)	
Race and ethnicity						
Asian	420 (82.8)	87 (17.2)	<.001	162 (86.6)	25 (13.4)	.80
White	392 (88.9)	49 (11.1)		163 (88.6)	21 (11.4)	
Other ^d	251 (74.0)	88 (26.0)		75 (86.2)	12 (13.8)	
Student or trainee status ^e						
Domestic	722 (84.1)	136 (15.9)	.09	161 (89.0)	20 (11.0)	.09
International	334 (79.5)	86 (20.5)		205 (84.7)	37 (15.3)	
Other ^f	7 (77.8)	2 (22.2)		33 (97.1)	1 (2.9)	
Degree type						
Master's degree	479 (82.3)	103 (17.7)	.96	NA	NA	NA
PhD, DMD, or other graduate professional degree	569 (82.8)	118 (17.2)		NA	NA	
Other ^g	15 (83.3)	3 (16.7)		NA	NA	
Employed ^e						
Yes	675 (82.6)	142 (17.4)	>.99	NA	NA	NA
No	386 (82.5)	82 (17.5)		NA	NA	
Marital status						
Married	249 (87.4)	36 (12.6)	.02	198 (89.2)	24 (10.8)	.31
Not married	814 (81.2)	188 (18.8)		202 (85.6)	34 (14.4)	
Children						
Yes	138 (86.2)	22 (13.8)	.23	85 (89.5)	10 (10.5)	.60
No	925 (82.1)	202 (17.9)		315 (86.8)	48 (13.2)	
First-generation status ^h						
Yes	177 (76.3)	55 (23.7)	.007	122 (88.4)	16 (11.6)	.77
No	886 (84.0)	169 (16.0)		278 (86.9)	42 (13.1)	
Received financial aid ^e						
Yes	308 (74.0)	108 (26.0)	<.001	NA	NA	NA
No	755 (86.8)	115 (13.2)		NA	NA	
Received SNAP						
Yes	49 (68.1)	23 (31.9)	.001	3 (37.5)	5 (62.5)	.001
No	1014 (83.5)	201 (16.5)		397 (88.2)	53 (11.8)	
Housing instability						
Yes	82 (44.1)	104 (55.9)	<.001	34 (60.7)	22 (39.3)	<.001
No	981 (89.1)	120 (10.9)		366 (91.0)	36 (9.0)	
Car ownership						
Yes	284 (89.0)	35 (11.0)	<.001	139 (95.2)	7 (4.8)	<.001
No	779 (80.5)	189 (19.5)		261 (83.7)	51 (16.3)	

Abbreviations: NA, not applicable; SNAP, Supplemental Nutrition Assistance Program.

^a Unless indicated otherwise, values are presented as No. (%) of respondents.

^b Includes students and trainees with low and very low food security status (ie, ≥3 affirmative responses on the US Household Food Security Survey Module).

^c Includes transgender man, transgender woman, neither exclusively male nor female (gender-queer or gender nonconforming), agender, and 2-spirit.

^d Includes American Indian or Alaska Native, Black or African American, Hispanic, Middle Eastern or North African, Native Hawaiian or Other Pacific Islander, and multiple races or ethnicities.

^e Includes missing data of less than 0.5% for the following variables: residency status (missing n = 1), employment status (missing n = 2), or receipt of financial aid (missing n = 1).

^f Includes Green Card holders, J-1 visa holders, individuals with dual citizenship, and international but tax residents.

^g Includes residency programs, dental residents, nondegree students or trainees, and multiple degrees.

^h Defined as both of the respondent's parents having education of less than a college degree.

models fit for graduate students and postdoctoral trainees. Covariates included respondent self-reported age, gender identity, race and ethnicity, marital status, parental status, first-generation student status, receipt of financial aid (not included in the postdoctoral trainee model), receipt of SNAP benefits, car ownership, and housing instability. We examined the presence of multicollinearity between the covariates in the regression models using the variance inflation factor.

Statistical analysis was performed in R, version 4.2.2 (R Project for Statistical Computing). All tests were 2 sided, and $P < .05$ was considered statistically significant. Data analysis was performed from July to September 2023.

Results

This study included 1745 participants: 1287 were graduate students and 458 were postdoctoral trainees. Their sociodemographic characteristics are presented in **Table 1**. The median age of all respondents was 29.0 (IQR, 7.0) years. More than half of the respondents (1073 [61.5%]) identified as female, and 637 (36.5%) identified as male. A total of 694 respondents (39.8%) identified as Asian, 625 (35.8%) as White, and 426 (24.4%) as being of other race or ethnicity. Among all respondents, 280 (16.0%) experienced marginal food security, 177 (10.1%) experienced low food security, and 105 (6.0%) experienced very low food security.

Among the 1287 graduate students, 224 (17.4%) were food insecure. Food insecurity was higher among students identifying as other race or ethnicity (88 [26.0%]), first-generation students (55 [23.7%]), students who received SNAP benefits (23 [31.9%]) or financial aid (108 [26.0%]), students with housing instability (104 [55.9%]), and students who did not own a car (189 [19.5%]). Among the 458 postdoctoral trainees, 58 (12.7%) were food insecure. Food insecurity was higher among male students (35 [16.7%]), students who received SNAP benefits (5 [62.5%]), students with housing instability (22 [39.3%]), and students who did not own a car (51 [16.3%]).

The results of the bidirectional stepwise regression models are shown in **Tables 2 and 3**. Among graduate students, factors associated with food insecurity included being Asian (odds ratio [OR], 1.06 [95% CI, 1.01-1.11]) or of other race or ethnicity (OR, 1.07 [95% CI, 1.02-1.13]), receiving financial aid (OR, 1.09 [95% CI, 1.05-1.13]), and having housing instability (OR, 1.53 [95% CI, 1.45-1.61]) (Table 2). Among postdoctoral trainees, factors associated with food insecurity included receiving SNAP benefits (OR, 1.59 [95% CI, 1.28-1.97]), having housing instability (OR, 1.33 [95% CI, 1.22-1.45]), and not owning a car (OR, 1.11 [95% CI, 1.04-1.18]) (Table 3). No evidence of multicollinearity, as assessed using the variance inflation factor, was detected in these models.

Discussion

To our knowledge, this study is the first to assess food insecurity among graduate students and postdoctoral trainees at a private academic university in Boston, Massachusetts. The findings demonstrate a high prevalence of food insecurity, higher than both national and state averages.¹ Furthermore, 1 in 3 respondents responded affirmatively to at least 1 indicator of food insecurity; this is concerning given that even marginal levels of food security have been associated with poorer health.¹⁷

The implications of food insecurity in this population of future health professionals are substantial. Food insecurity has adverse consequences on student health, well-being, and success. Students experiencing food insecurity have a higher risk of mental health issues, including stress, anxiety, and depression.¹⁸ They are also more likely to have lower diet quality compared with their food-secure counterparts.¹⁹ Food insecurity has consequences on student academic performance and could hinder their academic achievement and success.^{4,18,19} Nevertheless, the existing body of food insecurity research predominantly focuses on the undergraduate student population or a combination of undergraduate and graduate student populations. This presents a major limitation in

Table 2. Factors Associated With Food Insecurity Among Graduate Students

Factor	Odds ratio (95% CI) (n = 1287) ^a
Race and ethnicity	
Asian	1.06 (1.01-1.11)
White	1 [Reference]
Other ^b	1.07 (1.02-1.13)
Receipt of financial aid	
Yes	1.09 (1.05-1.13)
No	1 [Reference]
Housing instability	
Yes	1.53 (1.45-1.61)
No	1 [Reference]

^a Obtained from a bidirectional stepwise logistic regression with food insecurity as the outcome and other sociodemographic characteristics as covariates, with separate models for graduate students and postdoctoral trainees. Sociodemographic characteristics included were age in categories, gender identity, race and ethnicity, marital status, parental status, first-generation student status, receipt of financial aid (only in the graduate student model), receipt of Supplemental Nutrition Assistance Program benefits, car ownership, and housing instability.

^b Includes American Indian or Alaska Native, Black or African American, Hispanic, Middle Eastern or North African, Native Hawaiian or Other Pacific Islander, and multiple races or ethnicities.

the food insecurity literature given that previous studies have shown varying characteristics associated with food insecurity for the distinct undergraduate and graduate student populations.^{20,21} Future studies are needed to examine the long-term health and academic trajectories of food insecurity, with a focus on graduate students as a distinct and unique population.

Although the consequences of food insecurity among college students have been established, there is a notable gap in the literature on adverse outcomes associated with food insecurity among postdoctoral trainees. This gap is concerning given that the postdoctoral period is often a stepping stone to future academic and research-intensive careers. Postdoctoral trainees' social identity, gender identity, race and ethnicity, and the intersectionality of these factors all affect their career self-efficacy, which later affects their transition to academia.²² These disparities in transition to academia could be exacerbated by food insecurity and its aforementioned associated factors, as food insecurity is also associated with social stigma and belonging to a racial and ethnic minority group.²³ This underscores the need for future studies aimed at examining the consequences of food insecurity among the postdoctoral trainee population.

There are existing strategies to improve food access at the 3 Harvard University graduate schools that were the focus of the present study. For example, graduate students and postdoctoral trainees are offered 20% discounts on foods and beverages purchased at some school cafeterias.^{24,25} The main cafeteria at the Harvard T.H. Chan School of Public Health also offers Daily Dollar Deals for breakfast and lunch, which were implemented due to anecdotal evidence of rising student food insecurity.²⁶ In addition, many on-campus meetings offer free meals to their attendees, which may be an important food resource for individuals at risk of food insecurity. The aforementioned strategies need to be formally evaluated and assessed for effectiveness, limitations and barriers, and sustainability in addressing food insecurity.

Given the lifelong consequences of food insecurity, our findings may urge other private academic institutions to assess food insecurity among their graduate students and postdoctoral trainees—both understudied populations—and identify and implement institutional interventions. Previous studies have shown the effectiveness of short-term interventions such as campus food pantries in addressing food insecurity and improving participant diet-related outcomes.^{27,28} However, food pantries are meant to provide short-term support for individuals needing immediate access to food. Acknowledging the limitations of short-term interventions, the establishment of comprehensive, more sustainable initiatives becomes paramount. An illustrative example is the establishment of a basic needs initiative at the University of California that aims to create "a long-term strategy to eliminate basic needs insecurity."²⁹ Although this is not a permanent solution, it acknowledges and recognizes that food insecurity and other basic needs insecurities are prominent among students and should be addressed holistically. Future long-term, sustainable interventions and policies—such as increasing the living wage of graduate students and postdoctoral trainees to accurately reflect the cost of living across diverse geographic areas—are still needed.^{30,31}

Limitations

The primary limitation of this study is its cross-sectional design, which limits causal interpretations of food insecurity and the factors associated with it. Additionally, due to the limited sample size, some gender and racial and ethnic categories were collapsed to protect the identities of those individuals, limiting our ability to make inferences about food insecurity in specific structurally marginalized groups. Our findings cannot be generalized to medical students, as their responses are being captured in another multi-institutional study of food insecurity. Furthermore, this study was conducted at only 1 academic private institution in an urban setting, which limits its generalizability to other academic and geographic settings. The survey was also administered near the end of the spring 2023 academic term, which may have contributed to a lower response rate due to students' other preoccupying obligations. Finally, social desirability bias may have led to the underreporting of food insecurity in this study.

Table 3. Factors Associated With Food Insecurity Among Postdoctoral Trainees

Factor	Odds ratio (95% CI) (n = 458) ^a
Receipt of SNAP benefits	
Yes	1.59 (1.28-1.97)
No	1 [Reference]
Housing instability	
Yes	1.33 (1.22-1.45)
No	1 [Reference]
Car ownership	
No	1.11 (1.04-1.18)
Yes	1 [Reference]

Abbreviation: SNAP, Supplemental Nutrition Assistance Program.

^a Obtained from a bidirectional stepwise logistic regression with food insecurity as the outcome and other sociodemographic characteristics as covariates, with separate models for graduate students and postdoctoral trainees. Sociodemographic characteristics included were age in categories, gender identity, race and ethnicity, marital status, parental status, first-generation student status, receipt of financial aid (only in the graduate student model), receipt of SNAP benefits, car ownership, and housing instability.

Conclusions

The findings of this cross-sectional survey study suggest that there is a concerning level of food insecurity among future health professionals and health-focused academic researchers. These findings underscore the need for interventions and systematic policy changes to address this crucial problem, and they urge other private institutions to recognize and assess food insecurity among their graduate students and postdoctoral trainees.

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SUPPLEMENT 1.

eTable. Sociodemographic Characteristics Assessed and Their Corresponding Question(s) on the Survey

SUPPLEMENT 2.

Data Sharing Statement