Expenditure, Coping, and Academic Behaviors among Food-Insecure College Students at 10 Higher Education Institutes in the Appalachian and Southeastern Regions

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ABSTRACT

Background: A number of studies have measured college student food insecurity prevalence higher than the national average; however, no multicampus regional study among students at 4-y institutions has been undertaken in the Appalachian and Southeast regions of the United States.

Objectives: The aims of this study were to determine the prevalence of food insecurity among college students in the Appalachian and Southeastern regions of the United States, and to determine the association between food-insecurity status and money expenditures, coping strategies, and academic performance among a regional sample of college students.

Methods: This regional, cross-sectional, online survey study included 13,642 college students at 10 public universities. Food-insecurity status was measured through the use of the USDA Adult Food Security Survey. The outcomes were associations between food insecurity and behaviors determined with the use of the money expenditure scale (MES), the coping strategy scale (CSS), and the academic progress scale (APS). A forward-selection logistic regression model was used with all variables significant from individual Pearson chi-square and Wilcoxon analyses. The significance criterion α for all tests was 0.05.

Results: The prevalence of food insecurity at the universities ranged from 22.4% to 51.8% with an average prevalence of 30.5% for the full sample. From the forward-selection logistic regression model, MES (OR: 1.47; 95% CI: 1.40, 1.55), CSS (OR: 1.19; 95% CI: 1.18, 1.21), and APS (OR: 0.95; 95% CI: 0.91, 0.99) scores remained significant predictors of food insecurity. Grade point average, academic year, health, race/ethnicity, financial aid, cooking frequency, and health insurance also remained significant predictors of food security status.

Conclusions: Food insecurity prevalence was higher than the national average. Food-insecure college students were more likely to display high money expenditures and exhibit coping behaviors, and to have poor academic performance. *Curr Dev Nutr* 2019;3:nzz058.

Keywords: college students, food insecurity, money spending, coping strategies, academic performance

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Abbreviations used: AFSS, Adult Food Security Screener; APS, academic progress scale; CSS, coping strategies scale; GPA, grade point average; MES, money expenditure scale; SNAP, Supplemental Nutrition Assistance Program.

Introduction

Food insecurity is defined as the inability to secure consistent access to a sufficient quantity of affordable, nutritious food to sustain a healthy lifestyle. Nationally, 11.8% of US households were food insecure in 2017, equating to 40 million Americans living in food-insecure conditions (1). The prevalence of food insecurity has been associated with a number of factors, including poor socioeconomic status (2), presence of children in the household (1, 3), and minority ethnicity (4). A large body of work has shown the negative impacts food insecurity can have on both young people and adults alike. Food insecurity has been shown to be linked with lower academic performance and increased behavioral issues at school (5–9), higher rates of physical and mental health disorders (10–18), higher rates of stigma experienced by individuals (19, 20), and poor diet quality (8, 17, 21–24).

In recent years it has been determined that college students comprise a population greatly affected by food insecurity (25, 26), with rates of food insecurity on college campuses as high as 59% being identified (25–27). Many studies have examined correlates of college food insecurity and have found a number of the aforementioned health and behavioral effects of food insecurity also present in the college population, including risk of physical and mental illness (6, 17, 26, 28) and poor diet quality (8, 17, 26). These detriments of food insecurity can be especially harmful to college students, who often experience high stress, adjustment issues, and pressure to succeed (29, 30). These circumstances can lead to the development of negative behaviors among food-insecure college students, such as poor spending behaviors, unhealthy ways of coping, and poor academic performance.

To date, these behaviors have only been investigated in a few smaller studies on a single campus (6, 8). Most college food insecurity studies are based on individual universities with few large-scale food insecurity studies completed across multiple states and regions (31–33). Research thus far, however, generally fails to capture students from 4-y institutions, and instead focuses primarily on community colleges (32, 33), with few exceptions (34). However, most students in the United States are enrolled in 4-y institutions (35), and the demographics and lifestyles of these 4-y students often differ from those who are enrolled at community colleges (36, 37), making it important to investigate food insecurity among multiple 4-y institutions as well. For this reason, the relation between food insecurity and expenditure behavioral choices, coping mechanisms, and the academic performance of college students needs to be examined on a larger scale.

Specifically, multicampus studies at US 4-y institutions (38) have not investigated the Appalachian and Southern regions (1), which are disproportionately affected by food insecurity and have higher rates of health disparities (39, 40). Environmental, cultural, social, and economic factors differ from region to region, and significantly influence how and when people eat (41). Geographic variability is lacking in the college food-insecurity literature, especially for regions that are at high risk for food insecurity. It is apparent that food insecurity can have detrimental effects on the physical and mental health of college students (25, 26), but the magnitude of these effects has not been largely studied within the Appalachian and Southeastern regions of the United States (6, 8).

The present study has the following aims: *1*) to determine the prevalence of food insecurity among college students in the Appalachian and Southeastern regions of the United States; and *2*) to investigate the relation between food insecurity status and money expenditures, coping strategies, and academic performance among a regional sample of college students. These aims will help to understand if college student food insecurity is high within this geographic region, and investigate if there is any justification for state and federal policies and programs aimed at facilitating an adequate diet for this population.

Methods

Study design

This study used a cross-sectional design to capture food insecurity among young adults attending 10 public universities in the Appalachian and Southeastern regions between Spring 2016 and Spring 2018. For the purposes of this article, participating universities have been deidentified and will be referenced as Universities 1–10 but are located in 1 of 4 states: Mississippi, North Carolina, Tennessee, and West Virginia. At all universities, participants were currently enrolled college students. A convenience sample of undergraduate and graduate students was recruited from each university. Universities 1, 2, 5, and 6 recruited via student listserv with all enrolled students receiving the survey link. Universities 3 and 7 recruited through campus-wide announcements, with university 3 also utilizing flyers around campus. University 4 recruited through professors, with all active professors being emailed and asked to share the survey with students. All universities distributed the survey for student completion via Qualtrics, except 1 university which used CampusLabs—both these platforms are anonymous, online questionnaire programs. Students were required to give informed consent online prior to survey initiation. Students who refused to give consent were thanked for their time and exited from the link. Student incentive value varied at universities, but all included a random chance for incentive after survey completion. Incentive values ranged from $25 to $100 gift cards that could be used universally (i.e., American Express); 2 universities provided incentives that could only be used in campus dining halls; 1 university provided Amazon gift cards. Recruitment and incentive methods are given in **Table 1**. This study was approved by the institutional review board at each university.

Measures

All universities were involved in the development of a 73-item survey to investigate the prevalence and correlates of food insecurity among college students, as well as associated behavioral characteristics. All variables were self-reported, and the survey took ~20–30 min to complete.

Food insecurity.

Student food insecurity status was measured through the use of the validated 10-item USDA Adult Food Security Survey (AFSS) (42). Students responded affirmatively or non-affirmatively to statements regarding their ability to afford and maintain a source of food such as "The food that I bought just didn't last, and I didn't have money to get more," "I couldn't afford to eat balanced meals," and "In the last 12 months, did you ever not eat for a whole day because there wasn't enough money for food?" Food insecurity status was determined by the USDA's protocol (43) where zero affirmative answers reflected high food security,

TABLE 1 Methodologies used for student recruitment at the 10 universities participating in the study[1]

University	Enrollment	Recruitment	Incentive	Response rate, %
1	10,805	Email directly to all students	NA	12.7
2	28,321	Email directly to all students via listerv with reminders	Chance to win 1 of 8 $100 gift cards	12.5
3	13,331	Flyers around campus, announced in campus email	Chance to win 1 of 5 $25 campus dining gift cards	Unknown due to recruitment methods
4	31,514	Email to all professors to pass on to students	Chance to win a $100 gift card	Unknown due to recruitment methods
5	17,932	Email to random students	Chance to win 1 of 2 $100 gift cards	20.3
6	29,469	Email directly to all students via listerv with reminders	Chance to win a $100 gift card	18.8
7	21,127	Announced in campus email and flyers around campus	Chance to win a $50 gift card	Unknown due to recruitment methods
8	7137	Email directly to all students	Chance to win 1 of 4 $25 Amazon gift cards	9.4
9	28,962	Email to random students	Chance to win a $50 gift card	12.3
10	16,886	Email to random students	Chance to win 1 of 5 $25 campus dining gift cards	14.9

[1]NA, not applicable.

1–2 = marginal food security, 3–5 = low food security, and 6–10 = very low food security. Those who scored in the high or marginal food-secure categories were combined and considered food secure, and those who scored in the low and very low food-secure categories were combined and considered food insecure.

Behavioral scales.

Three behavioral measures were used: an 8-item money expenditure scale (MES), a 29-item coping strategies scale (CSS), and a 4-item academic progress scale (APS). The MES measured spending behaviors of students and has been used in previous college food insecurity research (6, 8). This scale assessed how often in the past 12 mo students spent money on other items rather than spending the money on food, specifically assessing the monetary purchases of items including substance purchases (i.e., alcohol, cigarettes, and recreational drugs), transportation (i.e., public transportation fees, car repairs, and gasoline), pet care, and tattoos. Student answer choices were never, sometimes, and often. Responses were scored on a 3-point scale with 1 point representing "never", 2 points = "sometimes," and 3 points = "often.". Total scores for MES could range from 8 to 24 points. Higher MES scores represent students spending more money on other items rather than buying food.

The CSS has also been used in previous college food-insecurity research (6, 8) and was developed with guidance from the food-insecurity literature (44–46). The CSS measured how often students used coping strategies and included strategies that addressed food intake/access, saving, support, and selling. Food intake/access questions asked if students ate in excess when food was plentiful, took food home from on-campus dining, ate less healthy options and purchased processed food, obtained food from a dumpster or trash, or bartered services/items for food. The saving topic included questions regarding if students took fewer classes, used less utilities, shared responsibilities such as housing or meals with others, stretched meals, used coupons and planned meals, or spent less on medications and medical appointments. Support questions included if students participated in a research study/clinical trial for extra money for food, borrowed money or visited family for food, attended functions with free food or where you "pay when you can," obtained food from a food bank, food pantry, or assistance program [Supplemental Nutrition Assistance Program (SNAP), Women, Infants and Children, etc.], or held ≥1 part-time/full-time jobs or used a credit card to buy food. Lastly, the selling topic included questions to investigate if students ever sold items, including textbooks, personal possessions, blood/plasma, or sperm/eggs, to obtain food. Similar to the MES, the CSS answer choices were never, sometimes, and often. Responses were scored on a 3-point scale with 1 point representing "never", 2 points = "sometimes," and 3 points = "often." CSS scores could range from 29 to 87 points with higher scores indicating use of more coping strategies and more frequent use of these behaviors.

The APS measured students' perceived academic behaviors regarding class attendance and attention span, comprehension of class concepts, and progression towards graduating on time (6, 8). APS answer choices were excellent, good, fair, and poor, and were scored on a 4-point scale with 4 points assigned for the "excellent," 3 = "good," 2 = "fair," and 1 = "poor" responses. Therefore, scores on the APS could range from 4 to 16 points, with higher scores representing students who displayed better academic performance behaviors. Grade point average (GPA) was also captured for an additional measure of academic performance.

Sociodemographic and health characteristics.

The remaining variables captured student demographics, economic and health status, and culinary skills. Demographics included gender (male/female), age, marital status (married/not married), race (white/minority), dependents (has dependents/does not have dependents), student status (part time/full time), academic year (freshman, sophomore, junior, senior, graduate), housing (on campus/off campus), international student (yes/no), car ownership (has car/does

not have car), and utilization of public transportation (uses public transportation/does not use public transportation). Economic variables included financial aid receipt (receives financial aid/does not receive financial aid), employment status (employed/unemployed), and meal plan (has a meal plan/does not have a meal plan). Income was also assessed but was excluded from the analysis due to the high variability in student response. Health variables included self-reported health status (excellent or good/fair or poor), health insurance (has health insurance/does not have health insurance), and BMI. BMI was calculated from self-reported height and weight as kilograms per meter squared. Two remaining questions with a culinary focus asked students how often they cooked for themselves (sometimes/often/never) and how they would rate their cooking skills (excellent or good/fair or poor).

Statistical analyses

Descriptive statistics were computed for all demographic, economic, health, support, and dietary variables as appropriate. As aforementioned, food insecurity status was determined in accordance with the Guide to Measuring Household Food Security scoring system (43). Pearson chi-square frequency analyses were used to determine associations between each variable and university. Pearson chi-square frequency analyses were also used to determine bivariate associations between food-secure and food-insecure students with all variables to assess which variables to include in the full model. MES, CSS, APS, age, GPA, and BMI were assessed as continuous variables, and Wilcoxon analyses were used due to lack of normality. All variables that showed significant association between food security status were used in the full regional model. A forward-selection multivariate logistic regression was used in a full model to predict food insecurity. Forward selection was used to identify the most important variables predictive of food insecurity. Further, subgroup analysis was completed to investigate differences between low and very low food-security classifications following the same analysis plan as the full regional model. Data were analyzed with JMP Pro version 12.2 (SAS Institute Inc.) and SAS version 9.4 software (SAS Institute Inc.). The significance criterion α for all tests was 0.05.

Results

Student demographics

The survey was completed by 14,293 students across all 10 universities. Data from all schools were combined and cleaned by 2 researchers at 1 university for consistency. Due to food insecurity being the primary outcome, all responses that did not have a complete response on the USDA AFSS ($n = 651$) were excluded from the analysis. A final sample of 13,642 was used for data analysis of aim 1. Sample characteristics by university are presented in **Table 2**.

Food-insecurity prevalence at the universities ranged from 22.4% to 51.8% with an average of 30.5% for the full sample. Individual university food-insecurity rates are as follows: University 1, 38.6%; University 2, 29.7%; University 3, 51.8%; University 4, 36.6%; University 5, 46.2%; University 6, 22.3%; University 7, 36.7%; University 8, 47.3%; University 9, 35.0%; University 10, 46.6%. More specific food-insecurity status details are provided in **Table 3**.

Regional analysis

University 2 ($n = 4463$) omitted the CSS questions from its survey and was consequently excluded from the full model. Additionally, responses from each of the universities that were missing data from 1 of the behavioral scales ($n = 853$) were excluded. Therefore, a sample of 9179 was used for aim 2, i.e., the investigation of the relation between food insecurity and money expenditures, coping strategies, and academic performance. The relation between all variables and food security status is presented in **Table 4**. Significant associations were shown for ethnicity, student status, marital status, academic year, employment, financial aid, health status, health insurance, BMI, cooking frequency, age, MES, CSS, APS, and GPA. Therefore, these variables were included in the full, forward-selection logistic regression model. When the forward-selection logistic regression was used, observations that had a missing value for any variable were automatically excluded from the analysis, resulting in a final sample of 5578. University was included in the model to control for differences across universities that could potentially be a confounder or mediator of outcomes. The results are shown in **Table 5**.

For the forward-selection logistic regression model, the reference was a white graduate student with excellent/good health who receives financial aid and cooks often. University 2 was used as a reference because it reported the lowest levels of food insecurity prevalence and had the largest sample size. Results showed MES (OR: 1.53; 95% CI 1.44, 1.62), CSS (OR: 1.19; 95% CI 1.17, 1.20), and APS (OR: 0.93; 95% CI 0.89, 0.97) behaviors remained significant predictors of food insecurity, as well as GPA (OR: 0.73; 95% CI 0.60, 0.87). Academic year, health status, ethnicity, financial aid, and cooking frequency also remained significant predictors of food security status. Specifically, sophomore (OR: 1.57; 95% CI 1.21, 2.02) and junior (OR: 1.29; 95% CI 1.01, 1.65) academic years showed heightened risk for food insecurity. Further, ethnic minority (OR: 1.55; 95% CI 1.29, 1.86) students who reported fair/poor health (OR: 1.33; 95% CI: 1.08, 1.64), received financial aid (OR: 1.34; 95% CI: 1.14, 1.57), and cooked sometimes (OR: 1.24; 95% CI: 1.04, 1.48) or never (OR: 1.67; 95% CI: 1.27, 2.20) had increased risk for food insecurity. Additionally, the university in which a student was enrolled influenced odds of being food insecure, with students at universities 1, 3, 5, 7, and 10 having increased risk compared with university 2. Inversely, university 4 showed decreased odds compared with university 2. BMI, student status, employment, age, health insurance, and marital status were removed from the model because they were not significant predictors. MES and CSS were the best predictors of food insecurity based on Wald chi-square P values (data not shown) (43).

Low and very low food-security subgroup analysis

Of the sample (9179) used for regional analysis, 15.5% were classified as having low food-security status and 15.1% were classified as having very low food-security status, resulting in a sample of 2800 for subgroup analysis. Significant associations were found for gender ($P = 0.0077$), academic year ($P < 0.0001$), ethnicity ($P < 0.0001$), health status ($P < 0.0001$), health insurance ($P = 0.0238$), BMI ($P = 0.0317$), MES ($P < 0.0001$), CSS ($P < 0.0001$), APS ($P < 0.0001$), and GPA ($P < 0.0001$). Therefore, these variables were entered into a forward-selection logistic regression model along with university to control for differences across universities. The results are shown in **Table 6**.

TABLE 2 Characteristics of respondents at the 10 universities participating in the study[1]

	University										
Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	***P*** value
Food security status											<0.0001
Food secure	212 (61.5)	3138 (70.3)	27 (48.2)	439 (63.4)	588 (53.8)	4086 (77.3)	360 (63.3)	127 (52.7)	269 (65.0)	271 (53.4)	
Food insecure	133 (38.6)	1325 (29.7)	29 (51.8)	253 (36.6)	505 (46.2)	1176 (22.4)	209 (36.7)	114 (47.3)	145 (35.0)	236 (46.6)	
Gender											<0.0001
Male	78 (23.4)	1475 (33.5)	7 (13.7)	190 (28.7)	304 (29.2)	1385 (27.4)	173 (30.7)	45 (20.4)	90 (22.2)	113 (24.9)	
Female	255 (76.6)	2925 (66.5)	44 (86.3)	472 (86.3)	739 (70.8)	3675 (72.6)	391 (69.3)	175 (79.6)	315 (77.8)	340 (75.1)	
Race											<0.0001
White	276 (84.2)	3551 (81.7)	39 (76.5)	552 (87.3)	925 (88.4)	3459 (68.8)	421 (74.9)	93 (42.3)	268 (66.3)	357 (80.4)	
Minority	52 (15.9)	798 (18.3)	12 (23.5)	80 (12.7)	121 (11.6)	1570 (31.2)	141 (25.1)	127 (57.7)	136 (33.7)	87 (19.6)	
Marital status											<0.0001
Married	75 (22.5)	469 (10.6)	8 (15.7)	38 (5.7)	51 (4.8)	610 (12.0)	57 (10.0)	28 (12.8)	35 (8.6)	38 (8.4)	
Not married	258 (77.5)	3964 (89.4)	43 (84.3)	627 (94.3)	1002 (95.2)	4488 (88.0)	511 (90.0)	191 (87.2)	372 (91.4)	413 (91.6)	
Dependents											<0.0001
Yes	40 (12.0)	201 (4.5)	7 (13.7)	15 (2.3)	20 (1.9)	220 (4.3)	26 (4.6)	23 (10.4)	23 (5.7)	17 (3.7)	
No	293 (88)	4232 (95.5)	44 (86.3)	650 (97.7)	1035 (98.1)	4881 (95.7)	540 (95.4)	197 (89.6)	384 (94.3)	437 (96.3)	
Academic year											<0.0001
Freshman	8 (2.4)	1089 (24.9)	9 (17.7)	154 (23.5)	18 (1.7)	841 (16.6)	117 (20.7)	42 (19.2)	86 (21.5)	140 (21.3)	
Sophomore	74 (22.7)	689 (15.7)	8 (15.7)	87 (13.3)	297 (28.3)	650 (12.9)	113 (20.1)	38 (17.3)	82 (20.5)	70 (15.6)	
Junior	80 (24.5)	743 (17.0)	10 (19.6)	121 (18.5)	270 (25.7)	757 (15.0)	121 (21.5)	55 (25.1)	88 (22.0)	91 (20.3)	
Senior	82 (25.2)	684 (15.7)	6 (11.7)	155 (23.7)	313 (29.8)	753 (14.9)	96 (17.0)	65 (29.7)	127 (31.8)	97 (21.6)	
Graduate student	82 (25.2)	1162 (26.6)	18 (35.3)	138 (21.1)	151 (14.4)	2069 (40.7)	117 (20.7)	19 (8.7)	17 (4.2)	50 (11.2)	
International student											<0.0001
Yes	1 (0.3)	246 (5.6)	2 (3.9)	35 (5.3)	8 (0.8)	302 (5.9)	23 (4.1)	1 (0.4)	5 (1.2)	13 (2.9)	
No	329 (99.7)	4151 (94.4)	49 (94.7)	621 (94.7)	1045 (99.2)	4785 (94.1)	540 (95.9)	219 (99.6)	402 (98.8)	435 (97.1)	
Student status											<0.0001
Part time	47 (14.4)	311 (7.1)	5 (9.8)	16 (2.5)	46 (4.4)	266 (5.2)	38 (6.7)	18 (8.3)	23 (5.7)	36 (8.0)	
Full time	280 (85.6)	4055 (92.9)	46 (90.2)	615 (97.5)	1005 (95.6)	4819 (94.8)	527 (93.3)	200 (91.7)	383 (94.3)	412 (92.0)	
Employment											<0.0001
Unemployed	97 (29.6)	1770 (40.6)	13 (25.5)	277 (43.8)	386 (36.9)	2005 (39.6)	264 (46.5)	88 (40.0)	168 (41.5)	175 (39.2)	
Employed	231 (70.4)	2585 (59.4)	38 (74.5)	355 (56.2)	660 (63.1)	3055 (60.4)	304 (53.5)	132 (60.0)	237 (58.5)	271 (60.8)	
Housing											<0.0001
On campus	109 (33.2)	1482 (34.0)	19 (37.2)	203 (32.1)	253 (24.2)	1837 (36.2)	179 (31.5)	102 (47.2)	121 (29.7)	213 (47.8)	
Off campus	219 (66.8)	2876 (66.0)	32 (62.8)	429 (67.9)	794 (75.8)	3232 (63.8)	389 (68.5)	114 (52.8)	286 (70.3)	233 (52.2)	
Car ownership											<0.0001
Yes	297 (90.6)	3645 (83.7)	48 (94.1)	452 (71.5)	877 (83.8)	3293 (65.0)	501 (88.5)	163 (75.5)	323 (79.6)	358 (80.8)	
No	31 (9.4)	710 (16.3)	3 (5.9)	180 (28.5)	170 (16.2)	1772 (35.0)	65 (11.5)	53 (24.5)	83 (20.4)	85 (19.2)	
Use of public transportation											<0.0001
Yes	34 (10.4)	1287 (29.6)	0 (0.0)	401 (63.4)	664 (63.5)	3695 (73.0)	136 (24.1)	6 (2.8)	205 (50.5)	89 (20.1)	
No	294 (89.6)	3068 (70.4)	51 (100.0)	231 (36.6)	383 (36.5)	1367 (27.0)	429 (75.9)	208 (97.2)	201 (49.5)	354 (79.9)	
Financial aid											<0.0001
Yes	223 (68.0)	3128 (73.2)	47 (92.2)	508 (80.4)	674 (64.5)	3266 (64.5)	422 (64.4)	164 (76.6)	280 (69.1)	295 (67.3)	
No	105 (32.0)	1144 (26.8)	4 (7.8)	124 (19.6)	371 (35.5)	1797 (35.5)	145 (25.6)	50 (23.4)	125 (30.9)	143 (32.7)	

[1] All values are n (%) unless otherwise indicated.

TABLE 3 Food security status for the 10 universities participating in the study

University (*n*)	High food security, *n* (%)	Marginal food security, *n* (%)	Low food security, *n* (%)	Very low food security, *n* (%)
1 (345)	145 (42.0)	67 (19.4)	62 (18.0)	71 (20.6)
2 (4463)	2132 (47.8)	1006 (22.5)	626 (12.0)	699 (15.7)
3 (56)	16 (28.6)	11 (19.6)	16 (28.6)	13 (23.2)
4 (692)	236 (34.1)	209 (29.3)	115 (16.6)	138 (19.9)
5 (1093)	337 (30.8)	251 (30.0)	240 (22.0)	265 (24.2)
6 (5262)	2939 (55.9)	1147 (21.8)	663 (12.6)	513 (9.7)
7 (569)	202 (35.5)	158 (27.8)	107 (18.8)	102 (17.9)
8 (241)	72 (29.9)	55 (22.8)	76 (15.8)	76 (31.5)
9 (414)	153 (37.0)	116 (28.0)	66 (15.9)	79 (19.1)
10 (507)	176 (34.7)	95 (18.7)	111 (21.9)	125 (24.7)

For the subgroup analysis, the reference categories were white, female students with excellent/good health. The results showed that MES (OR: 1.17; 95% CI 1.11, 1.24), CSS (OR: 1.08; 95% CI 1.06, 1.10), and GPA (OR: 0.77; 95% CI 0.63, 0.93) remained significant indicators of increased severity of food-insecurity status. Gender, ethnicity, and health status also remained significant predictors of increased food-insecurity status. Specifically, ethnic minority (OR: 1.26; 95% CI 1.03, 1.54), male (OR: 1.30; 95% CI 1.05, 1.62) students who reported fair/poor health (OR: 1.45; 95% CI 1.15–1.83) had increased risk for very low food-security status. Academic year, health insurance, BMI, APS, and university fell out of the model due to lack of significance.

Discussion

This study represents the largest investigation, to date, of food insecurity among college students attending 4-y institutions, specifically among college students within the Appalachian and Southeastern regions of the United States. The study average of 30.5% students identifying as food insecure, which is above that of the national food insecurity average (1), is consistent with what has been demonstrated in the college food-insecurity literature (25–27). This continues to suggest that college students are an at-risk population for food insecurity, therefore justifying calls for policies and programs to prevent the detrimental effects of food insecurity among this population. Additionally, the prevalence of food insecurity among the 10 universities within the Appalachian and Southeastern regions is similar to findings for other universities across the nation, suggesting that geographic differences in household food insecurity might not be present among college students, but rather indicating that the disparity is among the college student population as a whole.

Certain determinants of food insecurity identified among this sample population are similar to previous studies. Specifically, ethnic minority students (28, 34, 47–53), those who receive financial aid (8, 17, 28, 34, 49, 53–57), those who report their health as fair or poor (8, 58), and those who report cooking less frequently (8) have been previously identified as at a higher risk for food insecurity. This calls attention to the type of students who might need additional resources to maintain food-secure status while attending college and can identify a target population for intervention. Further, within this study, ethnic minorities and men were at risk for the highest level of food insecurity, very low food security, thus indicating those students who may be faced with hunger.

Additionally, within this study, student food-insecurity risk was greatest during the undergraduate years, specifically the sophomore and junior years. Predicted food insecurity peaked for sophomore students, suggesting that students may require additional resources as they end their freshman year to prevent the increased occurrence of food insecurity. This finding agrees with previous research showing that undergraduate students are at increased risk (48), although various authors have identified different academic years (sophomore, junior, or senior) as the highest predictors of student food insecurity with little consistency in terms of specific academic year (8, 54). It is further suggested that food-insecurity prevalence increases following the freshman year (8, 59, 60), making it important that students transitioning out of their freshman year are equipped with the knowledge and skills to maintain a food-secure lifestyle wherever possible. However, in a more recent study of only freshman, scholars found that food insecurity was almost 3 times higher when the students lived on campus than when they lived with their families (61). Therefore, it could be suggested that it is warranted to equip all students transitioning into college and independence, including all academic years, with the skills to ward off food insecurity.

Some factors that have been previously identified as being associated with food insecurity among college students, such as off-campus housing (6, 8, 47, 49), were not identified as significant in this large-scale student assessment despite being found previously to be important predictors within the Appalachian region (6, 8). Overall, campuses should seek to understand their campus-specific food-insecurity correlates, such as the ones identified here, to help universities pinpoint students who may be at increased risk for food insecurity and to develop appropriate programs to assist them.

The behavioral impact of food insecurity among college students in this study is also consistent with previous literature (6, 8, 62–65). First, in this study, food-secure students exhibited better academic performance as represented by APS scores and higher GPAs, suggesting that having a secure source of food can be beneficial to overall college success. This is consistent with previous literature, as food-insecure college students are less likely to show positive academic performance, including attending class and maintaining a high GPA (6, 8, 33, 66). Specifically, this finding is in line with previous multicampus food-insecurity work, in which food insecurity is reported as directly related to lower student GPA (38). As acquiring a college degree is dependent

TABLE 4 Characteristic of respondents for regional analysis and correlations with food security status[1]

Variable	Food secure, *n* (%)	Food insecure, *n* (%)	*P* value
Total population	6379 (69.5)	2800 (30.5)	
Gender			
Male	1641 (18.7)	744 (8.4)	0.2434
Female	4490 (51.1)	1916 (21.8)	
Ethnicity			
White	4573 (52.5)	1817 (20.8)	<0.0001
Minority	1496 (17.2)	830 (9.5)	
Student status			
Part time	370 (4.2)	125 (1.5)	0.0118
Full time	5748 (65.4)	2540 (28.9)	
Marital status			
Not married	5393 (61.0)	2512 (28.4)	<0.0001
Married	764 (8.6)	176 (2.0)	
Dependents			
Has dependents	266 (3.0)	125 (1.4)	0.5000
No dependents	5895 (66.6)	2566 (29.0)	
School year			
Freshman	1072 (12.2)	343 (3.9)	<0.0001
Sophomore	891 (10.2)	528 (6.0)	
Junior	977 (11.2)	616 (7.0)	
Senior	1054 (12.0)	640 (7.3)	
Graduate student	2107 (24.0)	544 (6.2)	
International student			
Yes	282 (3.2)	108 (1.2)	0.2600
No	5855 (66.4)	2570 (29.2)	
Car ownership			
Yes	4415 (50.4)	1897 (21.7)	0.2611
No	1678 (19.2)	764 (8.7)	
Use public transportation			
Yes	3638 (41.6)	1592 (18.2)	0.8523
No	2453 (28.1)	1064 (40.1)	
Housing			
On campus	2114 (24.1)	3987 (45.5)	0.9802
Off campus	922 (10.5)	1741 (19.9)	
Employment status			
Unemployed	2535 (29.0)	938 (10.7)	<0.0001
Employed	3559 (40.6)	1724 (19.7)	
Financial aid			
Yes	3883 (44.4)	1996 (22.8)	<0.0001
No	2205 (25.2)	659 (7.6)	
Meal plan			
Yes	1985 (22.7)	887 (10.1)	0.4518
No	4111 (47.0)	1770 (20.2)	
Health status			
Excellent/good	5551 (63.4)	2028 (23.2)	<0.0001
Fair/poor	546 (6.2)	629 (7.2)	
Health insurance			
Yes	6018 (68.8)	78 (0.9)	<0.0001
No	2554 (29.2)	101 (1.1)	
Cooking frequency			
Often	2883 (33.1)	1164 (13.4)	0.0009
Sometimes	2393 (27.4)	1156 (13.3)	
Never	792 (9.1)	324 (3.7)	
Cooking skills			
Excellent/good	4217 (48.6)	1860 (21.4)	0.4473
Fair/poor	1829 (21.1)	776 (8.9)	
BMI, kg/m^2	23.89 ± 0.06	24.69 ± 0.10	<0.0001
Age, y	22.9 ± 0.07	22.0 ± 0.11	<0.0001
MES score	8.55 ± 0.02	10.10 ± 0.03	<0.0001
CSS score	37.69 ± 0.09	47.57 ± 0.13	<0.0001
APS score	13.39 ± 0.02	12.41 ± 0.03	<0.0001
GPA	3.49 ± 0.42	3.29 ± 0.53	<0.0001

[1]Demographic data are presented as frequencies and percentages; other data as means ± SDs. Pearson chi-square frequency and Wilcoxon analyses were performed. APS, academic progress scale; CSS, coping strategies scale; GPA, grade point average; MES, money expenditure scale.

upon academic progress, barriers to high academic performance should be limited. Thus, ensuring college students have a secure source of food is essential for universities to help prevent poor student outcomes in the classroom, and may potentially promote student retention rates (5, 66).

Further, this study found that food-insecure college students were more likely to display an increased number of coping strategies and to spend their money on other items rather than buying food. This may indicate that many college students lack the financial skills necessary to utilize their limited means in a manner that protects against food insecurity (67). An important time to ensure that students have the skills needed could be as they progress from their freshman year because it was found that they are at greater risk at this point. Specifically, food-insecure freshman have reported consuming lower-quality diets (68) and having poorer financial confidence (69); hence incorporating budgeting, cooking, and other life skills into freshman orientation courses could assist students in gaining the skills to manage more their lives more efficiently and improve their nutrition. The need for these skills has also been acknowledged by students themselves, and thus, from a community-based approach, could enhance current campus curricula (8, 70).

Due to the unfavorable effects of food insecurity, it is essential that universities institute programs that can aid students in need, and also advocate for policy change that can improve social justice for college students (27). Many colleges and universities are beginning to implement initiatives on campus that can provide emergency relief to students (31), including food pantries (57, 71), campus gardens and farmers' markets (72), and food recovery programs (73) that can provide food for hungry students. These programs can help to alleviate some of the short-term symptoms of hunger and ensure that students can avoid going without a meal, thereby possibly improving the academic performance of affected students. However, even with available programs, students often do not utilize such resources (31, 57). University personnel should aim to alleviate the stigma of receiving benefits and promote the use of resources for all students (57).

Lastly, there is a need to delve deeper into the issue and promote policy changes that prevent college students from becoming food insecure or relieve the burden of those currently in that situation (54). Targeting campus, state, and national policy change to address longer-term student needs is essential. Suggested advocacy includes expanding college students' SNAP eligibility (27, 31, 32), making college more affordable (27), and reform of campus dining programs for low-income students (27). The states included in this study (North Carolina, Mississippi, Tennessee, and West Virginia) have similar requirements

TABLE 5 Logistic regression model predicting food insecurity in students[1]

Variable	OR (95% CI)
MES score	1.53 (1.44, 1.62)
CSS score	1.19 (1.17, 1.20)
APS score	0.93 (0.89, 0.97)
GPA	0.73 (0.60, 0.87)
University	
1	1.89 (1.28, 2.79)
3	3.38 (1.53, 7.49)
4	0.63 (0.45, 0.88)
5	2.00 (1.61, 2.48)
6	1 (Ref.)
7	1.67 (1.28, 2.19)
8	1.13 (0.74, 1.74)
9	1.02 (0.73, 1.42)
10	2.39 (1.70, 3.36)
Academic year	
Freshman	1.29 (0.94, 1.76)
Sophomore	1.57 (1.21, 2.02)
Junior	1.29 (1.01, 1.65)
Senior	1.16 (0.91, 1.47)
Graduate	1 (Ref.)
Health	
Fair/poor	1.33 (1.08, 1.64)
Excellent/good	1 (Ref.)
Race	
Minority	1.55 (1.29, 1.86)
White	1 (Ref.)
Financial aid	
Yes	1.34 (1.14, 1.57)
No	1 (Ref.)
Cooking frequency	
Often	1 (Ref.)
Sometimes	1.24 (1.04, 1.48)
Never	1.67 (1.27, 2.20)

[1] Selection criterion for the model entry was $P < 0.05$. Variables from simple analyses were entered into a forward-selection multiple logistic regression model. University was added due to potential confounding. APS, academic progress scale; CSS, coping strategies scale; GPA, grade point average; MES, money expenditure scale.

TABLE 6 Logistic regression model predicting very low food security status in food-insecure students[1]

Variable	OR (95% CI)
MES score	1.17 (1.11, 1.24)
CSS score	1.08 (1.06, 1.10)
GPA	0.77 (0.63, 0.93)
Health	
Fair/poor	1.45 (1.15, 1.83)
Excellent/good	1 (Ref.)
Race	
Minority	1.26 (1.03, 1.54)
White	1 (Ref.)
Gender	
Male	1.30 (1.05, 1.62)
Female	1 (Ref.)

[1] Selection criterion for the model entry was $P < 0.05$. Variables from simple analyses were entered into a forward-selection multiple logistic regression model. CSS, coping strategies scale; GPA, grade point average; MES, money expenditure scale.

for SNAP eligibility with most eligible students working an average of 20 hours per week or more, enrolled in work-study, caring for young dependents, or already participating in the state Temporary Assistance for Needy Families program (74).

State policy, specifically, can lend a hand to students and increase enrollment for college students. For example, California has been a trailblazer for advocating for college student access to food assistance programs with the recent passing of the state-level Hunger Free Campus Bill (75). This bill allocates funding to campuses to address food insecurity and promote enrollment in CalFresh, California's SNAP program (75). Of states participating in this study, none has taken this level of action to promote student well-being and reach students in need. Further, 35 states are improving enrollment and recertification processes by utilizing mobile applications (75). However, the states in this study do not have mobile platforms to allow students to apply and maintain SNAP benefit certification, which may increase the participation of eligible students in this program. States within this study and beyond can aim to direct efforts to policy change to shift the college environment towards one that is just for students from all backgrounds and create a food-secure campus that fosters students' academic success and well-being.

Limitations

This study was limited by its cross-sectional design which used a nonprobability sample of college students and therefore causation cannot be determined. Additionally, the results only represent students at 10 public universities in the Appalachian and Southeastern regions and may not be generalizable to other regions or private institutions. Further, there was large variability in the response rate from each university and thus university representation is disproportionate. Next, the survey measures were all self-reports and some self-response bias may have occurred. The survey measures, such as the USDA AFFS, have also not been validated within a college population. Therefore, it is unclear if college students respond to this questionnaire in the same manner as previous populations, and this highlights the need for validated tools to use among college students. Additionally, income was excluded from analysis due to the high variability in student response, thereby limiting our understanding of these students' socioeconomic status. It is recommended that in future researchers ensure studies capture the food-insecurity risk factors identified by the Government Accountability Office in their 2018 report to Congress (76).

Conclusions

Food insecurity prevalence among college students in the Appalachian and Southeastern regions is found to be higher than the US national household food-insecurity average. These food-insecure students are at risk for poor spending behaviors and resort to a variety of coping behaviors, and exhibit diminished academic performance. Administrators of higher education institutes should evaluate the impact of food insecurity on students to help provide resources to ensure student success.

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