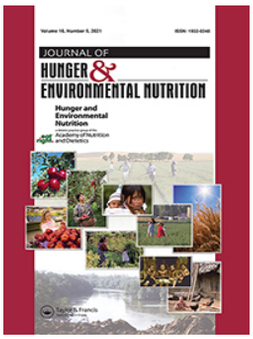

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Cooking Facilities and Food Procurement Skills Reduce Food Insecurity Among College Students: A Pilot Study

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ABSTRACT

Compared to the U.S. population, food insecurity may be more prevalent among university students. Using a cross-sectional survey of 338 undergraduate students, this study assessed how various food preparation abilities are associated with the risk of food insecurity. Food insecurity (FI) (41.4%) and very low food security (VLFS) (21.0%) were prevalent. Loan borrowing predicted VLFS (*OR* = 2.234). Controlling for financial strain indicators, food procurement skills reduced FI (*OR* = 0.466) among male students. Among female students, employment positively predicted FI (*OR* = 1.677) and VLFS (*OR* = 1.966), while cooking facilities access reduced FI (*OR* = 0.436) and VLFS (*OR* = 0.433).

KEYWORDS

Food security; college students; food access

Introduction

The U.S. Department of Agriculture (USDA) defines food insecurity as "limited or uncertain access to nutritious, safe foods necessary to lead a healthy lifestyle"[1] In the United States, food insecurity may be more prevalent among college students than the general population, with observed food insecurity rates ranging between 14% and 59%[2–14] Food insecurity in this population has been associated with low academic performance[13] and physical and mental health risks.[7] The high prevalence of food insecurity in college is often attributed to the changing demographics of the college student population, rising tuition costs, and insufficient financial support for students and parents[5,15] With many students from low-income families enrolling and attending college,[16] loan borrowing[15] and student employment[6,8,14] are commonly reported by students and their families as means for affording the ever-increasing cost of higher education. Researchers have identified the need to evaluate the impact of financial decision-making related to college attainment due to the significant influences of these decisions on the life cycle.[17] University communities' primary responses have been to enhance the availability of campus food banks and financial assistance.[18] Given the close

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relationship between low socioeconomic status and food insecurity,[1] failure to adequately address young adults' food insecurity could widen health inequality in future generations. While resource management skills are critical for combatting food insecurity, research addressing non-financial predictors of food insecurity in a narrow scope is scarce. The prevalence of food insecurity among US college students and our lack of understanding of its predictors may pose significant risks to the health, wellness, and success of this population.

Our knowledge of the aptitudes and abilities relevant to food procurement, storage, and preparation and how these abilities relate to food insecurity among the college student population in the United States is limited. Research analyzing potential behavioral proficiencies associated with food insecurity has been limited, primarily to cooking skills.[19–22] Poor cooking skills have been associated with lower diet quality and reliance on fast food or ready-to-eat meals among young adults.[20] Other factors related to food preparation ability (FPA), such as the skills and access needed to procure groceries within a budget and access to cooking facilities, have scarcely been the focus of research. Researchers have previously described the combination of cooking skills, food acquisition skills, and cooking facilities access as the aptitude and skills needed to prepare healthful meals.[20] Access to grocery stores or cooking equipment, which has been observed to affect food security in adults,[23,24] may comprise an important aspect of food preparation ability among college students.

Differences in food preparation and dietary behaviors among male and female students have been observed,[19,20] indicating that careful evaluation of the different aspects of food preparation ability for male and female college students is needed to develop effective strategies to promote food security. Gender differences in food preferences,[25] food purchasing,[22] and self-reported food preparation efficacy and behaviors[20] have also been observed. Assessing and analyzing food preparation ability more comprehensively may be valuable in the planning, development, and implementation of future interventions. Thus, further research evaluating food preparation ability for its potential role in determining how students maintain food security and healthy lifestyles is warranted.

This study investigated the relationship between food preparation ability and college students' ability to maintain food security while coping with financial strain. It was hypothesized that financial strain instrumented by loan use, student employment, and self-support is associated with an increased likelihood of food insecurity and very low food security. Food preparation ability was assessed in several aspects relevant to the procurement, storage, and preparation of food items for meals, and was hypothesized to have a negative association with the likelihood of food insecurity and very low food security. This study provided separate analyses for male and female college students,

hypothesizing that gender differences exist in the associations between financial strain, aspects of food preparation ability, and the incidence of food insecurity and very low food security.

Materials and Methods

Research Design

A cross-sectional survey was developed and conducted using Qualtrics (Qualtrics, Provo, UT)[26]. The sampling frame was defined as undergraduate students enrolled full-time in Fall 2016 and Spring 2017 at the main campus the University of Mississippi. The Survey Panel Group of the Office of Institutional Research, Effectiveness, and Planning generated a random, representative sample within the sampling frame, following the institution's campus survey and panel policy. The survey was distributed via e-mail. Before advancing to the main questionnaire, survey participants were prompted with informed consent and provided the e-mail contact of the primary investigator. The questionnaire included screening questions to ensure participants were at least 18 years of age and enrolled as full-time undergraduate students.; items to assess food security and food preparation ability; and questions regarding employment and descriptive information such as sex, race, meal plan use, college classification, and living location.

Institutional Review Board

The questionnaire and survey protocol were reviewed and approved as exempt by the University's Institutional Review Board under 45 CFR 46.101(b)(#2) prior to distribution.

Participants and Recruitment

E-Mail invitations with a web link to the online survey were distributed to a representative sample of 6,000 undergraduate students. Students were contacted via e-mail on two occasions, at four days and at one week after the original invitation, to remind and encourage their participation in the research. Completed survey data were anonymous and unidentifiable. A total of 490 respondents met the screening requirement, with an initial response rate of 8.16%. Of those, 152 were excluded from analysis due to incomplete responses, yielding a final sample of 338 respondents for analysis, a 5.63% response rate.

Food Security

Food security status was assessed using the USDA's U.S. Adult Food Security Survey Module (AFSSM), a 10-item survey with questions designed to assess food security status in households with adults and no children. According to AFSSM guidelines, the reference period of the academic semester was used to ensure that the assessment of food security status would apply to the student's time in college.[27] Following the USDA's AFSSM scoring procedures (US Department of Agriculture, Economic Research Service) affirmative responses were counted. Responses of "3 or more" to questions 5a and 9a were considered affirmative. This study used a dichotomous variable for Food Insecurity (scored as 1 if AFSSM score ≥ 3 and 0 otherwise). The dichotomous variable Very Low Food Security (scored as 1 if AFSSM score ≥ 6 and 0 otherwise) was created to represent the more severe level of food insecurity.

Financial Strain Indicators

Participants were asked 2 questions regarding potential risk factors for financial strain, focusing on how they, or their parents, acquired the financial means needed to afford post-secondary education. Respondents were asked to indicate their sources of financial resources including student loans, parent loans, student income and savings, parent income and savings, scholarships and grants, as well as other relative/friend support. Financial strain was indicated according to responses to this question, creating 2 dichotomous variables: Loan Borrowing and Self-Supporting. Loan Borrowing was scored as 1 for an affirmative response to student loans, parent loans, or both, and 0 otherwise. Self-Supporting was scored as 1 if the respondent did not indicate using financial resources from their parents or other relatives/friends as a means for paying for college, and 0 otherwise. The second question addressing financial strain assessed employment categorically. Prior to analyses, responses to this item were coded into a dichotomous independent variable, Employment, scored as 1 if the respondent was employed and 0 otherwise.

Food Preparation Ability

Food preparation ability was assessed using 11 questions that were drawn from previously validated instruments designed to assess food preparation abilities among young adults[20,28] and adapted for this study. Respondents were asked to rate each of these items on a 5-point Likert scale ranging from 1 (very poor) to 5 (very good). The factorability of the 11 items was tested. First, it was observed that each component possessed a Pearson's correlation coefficient of at least 0.356 with at least one other item. Second, the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.653, and the Bartlett's test of sphericity

was significant (χ^2 (3) = 137.247, $p < .001$). Factor analysis with principal component and Varimax rotation was applied, which consolidated the 11 questions into 3 underlying dimensions of the food preparation ability. The first factor, *cooking skills* (Cronbach's Alpha = 0.839), consisted of 5 items such as 1) self-rated quality of prepared meals, 2) ability to prepare healthful meals, 3) ability to follow a recipe, 4) ability to prepare fresh vegetables, and 5) ability to properly cook meat. The second factor, *procurement ability* (Cronbach's Alpha = 0.618), consisted of 3 items such as 6) ability to shop with a list, 7) ability to shop on a budget, and 8) access to convenient grocery shopping. The third factor, *access to cooking facilities* (Cronbach's Alpha = 0.934), consisted of 3 items such as 9) access to food preparation appliances, 10) access to food preparation tools (e.g., cookware/utensils), and 11) access to food storage equipment (e.g., refrigerator/freezer). Cooking skills, procurement ability, and access to cooking facilities explained 41.0%, 18.3%, and 40.7% of the total variance, respectively.

Descriptive Information & Demographics

Participants were asked demographic and other general questions at the end of the questionnaire. These items assessed descriptive information, including sex, student classification, marital status, race, living location, physical activity level, height, weight, transportation, meal plan participation, as well as the educational attainment of both parents. Due to low sampling from minority students, race was transformed into a dichotomous variable and scored as 0 if the respondent was white and 1 if the respondent was nonwhite. Living location was scored as 0 if the respondent lived on-campus and 1 if the respondent lived off-campus. These data were analyzed for correlations with the independent variables (Financial Strain and Food Preparation Ability) and dependent variables (Food Insecurity and Very Low Food Security).

Data and Statistical Methods

The sample for analysis consisted of 338 participants who provided complete responses. All statistical analysis used a two-tailed 95% confidence interval or a significance level of $\alpha = .05$. Statistical analysis was conducted using IBM SPSS 24. Frequencies were reported for demographic information to provide a description of the sample characteristics. Descriptive statistics were reported for food security variables, food preparation variables, and financial strain indicators. Two-tailed independent samples t-tests were performed to assess differences for these variables between male and female students. Regression models were utilized to observe the independent associations between both financial strain indicators and aspects of food preparation ability in predicting food insecurity and very low food security. The probability equations of food

insecurity and very low food security were assessed using logistic regression models. Each regression model was conducted using a stepwise method with three steps. The initial step assessed the role of covariates, which included race, living location, and meal plan use, in determining the outcome measure. The second step included the financial strain indicators, such as employment, loan borrowing, and self-supporting. The final step assessed the role of the aspects of food preparation ability. Reported statistics from regression analyses include β, SE, and odds ratio (OR). Cox & Snell R square changes associated with financial strain and food preparation ability were also reported.

Results

Sample Characteristics

A description of the sample characteristics is on Table 1. Of the respondents, 116 were male (34.3%), and 222 were female (65.7%). A large majority of the sample identified their race as white (n = 297, 87.9%).

Descriptive Statistics: Food Insecurity, Financial Strain, and Food Preparation Ability

Descriptive statistics are reported for food insecurity variables, food preparation ability aspects, and indicators of financial strain on Table 2. Almost half of the sample (n = 140, 41.4%) experienced food insecurity during the reference period, and most of these students experienced very low food security (n = 71,

Table 1. Sample Characteristics of US College Students at a 4-year University (N = 338).

Variable & Characteristics	Frequency (%)
Sex	
Male	116 (34.3)
Female	222 (65.7)
Race/Ethnicity	
White	297 (87.9)
Nonwhite	41 (12.1)
Classification	
Freshman	45 (13.3)
Sophomore	38 (11.2)
Junior	123 (36.4)
Senior	132 (39.1)
Financial Support	
Parental	80 (23.7)
Scholarships and/or Grants	107 (31.7)
Other Relatives or Friends	1 (0.3)
Living Location	
On campus	87 (25.7)
Off campus	251 (74.3)
Meal Plan Use	
Yes	119 (35.2)
No	219 (64.8)

Table 2. Descriptive Statistics of Food Insecurity, Financial Strain, and FPA.

	All (N = 338)	Male (n = 116)	Female (n = 222)	T-test
Food Insecurity, No. (%)				
Food Insecurity	140 (41.4)	49 (42.2)	91 (41.0)	0.221
Very Low Food Security	71 (21.0)	26 (22.4)	45 (20.3)	0.458
Indications of Financial Strain, No. (%)				
Loan Borrowing	135 (39.9)	48 (41.4)	87 (39.2)	0.389
Self-Supporting	257 (76.3)	88 (76.7)	169 (76.1)	0.122
Employment	163 (48.2)	60 (51.7)	103 (46.4)	1.451
FPA, Mean (*SD*)				
Cooking Skills	3.8 (0.82)	3.7 (0.84)	3.9 (0.80)	1.80
Procurement	4.0 (0.69)	3.9 (0.71)	4.1 (0.68)	2.04*
Cooking Facilities Access	4.0 (1.11)	3.9 (1.08)	4.1 (1.13)	1.38

*$P < .05$
Two-tailed independent samples t-tests

21.0%). There were no statistically significant differences in the prevalence of food insecurity (t = 0.221) and very low food security (t = 0.458) between male and female students. Male and female students did not report statistically significant differences in financial strain indicators. Male (3.83, ± 0.71) and female (4.00, ± 0.64) students expressed statistically significant differences across the three-component measure of food preparation ability (t = 2.197, $p < .05$).

Logistic Regression Analyses

Pearson correlation coefficients were calculated for all variables to determine potential associations. Correlational analysis revealed potential associations between race, living location, and meal plan use and dependent and independent variables. It was determined that regression analyses should include an initial step accounting for these covariates.

The results from the logistic regression analysis of the determinants of food insecurity can be found on Table 3. Among all students, employment had a statistically significant positive association with food insecurity (β = 0.343, OR = 1.410, p = .016). Food procurement ability among male students had a statistically significant negative association with food insecurity (β = −0.764, OR = 0.466, p = .043). Among female students, employment had a statistically significant positive association with food insecurity (β = 0.517, OR = 1.677, p = .006) while access to cooking facilities was negatively associated with food insecurity (β = −0.829, OR = 0.436, p = .000).

The results from the logistic regression analyses of very low food security and its potential determinants are found in Table 4. Among the entire sample, loan borrowing (β = 0.804, OR = 2.234, p = .017) was positively associated with very low food security. Among female students, significant predictors of very low food security were employment (β = 0.676, OR = 1.966, p = .002) and nonwhite race (β = 1.030, OR = 2.800, p = .042) There were no statistically

Table 3. Logistic Regression Results for Predictors of Food Insecurity.

Variables	β	*SE*	*OR*
		All (*n* = 338)	
Nonwhite	0.701	0.382	2.015
Living Off Campus	0.460	0.393	1.584
Meal Plan Use	−0.303	0.291	0.739
Financial Strain			
Employment	0.343	0.143	1.410*
Loan Borrowing	0.261	0.269	1.298
Self-Supporting	0.379	0.318	1.461
FPA			
Cooking Skills	0.022	0.165	1.023
Procurement	−0.318	0.194	0.728
Cooking Facilities Access	−0.444	0.151	0.642**
		Male (*n* = 116)	
Nonwhite	0.943	0.809	2.568
Living Off-Campus	−0.214	0.745	0.808
Meal Plan Use	−0.141	0.551	0.868
Financial Strain			
Employment	0.156	0.256	1.169
Loan Borrowing	0.101	0.497	1.107
Self-Supporting	0.920	0.578	2.508
FPA			
Cooking Skills	0.079	0.319	1.082
Procurement	−0.764	0.377	0.466*
Cooking Facilities Access	0.059	0.261	1.060
		Female (*n* = 222)	
Nonwhite	0.628	0.464	1.874
Living Off-Campus	1.139	0.528	3.124*
Meal Plan Use	− 0.432	0.366	0.649
Financial Strain			
Employment	0.517	0.187	1.677**
Loan Borrowing	0.427	0.346	1.533
Self-Supporting	−0.064	0.404	0.938
FPA			
Cooking Skills	0.129	0.206	1.138
Procurement	−0.125	0.240	0.882
Cooking Facilities Access	−0.829	0.212	0.436***

*$P < .05$
**$P < .01$
***$P < .001$
Step-wise logistic regression analysis

significant predictors of very low food security among male students. Better access to cooking facilities was negatively associated with very low food security (β = −0.838, *OR* = 0.433, $p = .001$) among female students.

The multivariate coefficients (R^2) changes are reported in Table 5 to show the additional variation in the dependent variables explained by the addition of financial strain indicators and food preparation ability to the regression models.

Discussion

In this study of students from a large public university in the Southern United States, the prevalence of food insecurity (41.4%) and very low food security (21.0%) are higher than the rates for national (11.8% and 4.5%, respectively) and

Table 4. Logistic Regression Results for Predictors of Very Low Food Security.

Variables	β	SE	OR
All (n = 338)			
Nonwhite	0.695	0.418	2.004
Living Off-Campus	0.215	0.477	1.240
Meal Plan Use	−0.083	0.365	0.921
Financial Strain			
Employment	0.588	0.170	1.801**
Loan Borrowing	0.804	0.337	2.234*
Self-Supporting	0.158	0.456	1.172
FPA			
Cooking Skills	0.045	0.204	1.046
Procurement	−0.270	0.230	0.763
Cooking Facilities Access	−0.618	0.182	0.539
Male (n = 116)			
Nonwhite	0.031	0.871	1.031
Living Off-Campus	0.278	0.869	1.321
Meal Plan Use	0.069	0.636	1.072
Financial Strain			
Employment	0.452	0.299	1.572
Loan Borrowing	0.901	0.611	2.463
Self-Supporting	0.276	0.788	1.318
FPA			
Cooking Skills	0.018	0.375	1.018
Procurement	−0.631	0.446	0.532
Cooking Facilities Access	−0.218	0.326	0.804
Female (n = 222)			
Nonwhite	1.030	0.505	2.800*
Living Off-Campus	0.267	0.611	1.306
Meal Plan Use	−0.292	0.460	0.747
Financial Strain			
Employment	0.676	0.221	1.966**
Loan Borrowing	0.721	0.429	2.057
Self-Supporting	0.069	0.580	1.072
FPA			
Cooking Skills	−0.111	0.261	0.859
Procurement	−0.152	0.289	0.859
Cooking Facilities Access	−0.838	0.243	0.433**

*$P < .05$
**$P < .01$
***$P < .001$
Step-wise logistic regression analysis

Table 5. Additional Percentage of Variation Explained by Financial Strain and FPA.

Independent Variables	All (N = 338)	Male (n = 116)	Female (n = 222)
Food Insecurity			
Financial Strain [a]	3.5%	4.9%	4.1%
FPA [b]	5.0%	4.3%	8.5%
Very Low Food Security			
Financial Strain [a]	6.7%	8.3%	5.5%
FPA [b]	5.1%	3.9%	6.4%

Note: Values were calculated using Cox & Snell R Square estimations.
[a]Financial Strain indicators include the variables Employment, Loan Borrowing, and Self-Supporting.
[b]FPA includes the variables Cooking Skills, Procurement, and Cooking Facilities Access.

state populations (17.2% and 6.6%, respectively).[1] These findings are consistent with previous studies which found food insecurity rates at college campuses ranging from 14% to 59% [2–14] The covariates (race, living situation, and meal plan use) were not statistically significant predictors of food insecurity and very

low food security among the sample of male students. Among the sample of female students, off-campus living was associated with an increase in the odds of the likelihood of food insecurity (*OR* = 3.124), and nonwhite race was associated with the likelihood of very low food security (*OR* = 2.800).

This study sought to identify possible risk factors for financial strain that are associated with the incidence of food insecurity and very low food security among US college students. Only loan borrowing predicted very low food security (*OR* = 2.234) among the entire sample. For the sample of female students, employment was associated with an increase in the odds of the likelihood of food insecurity (*OR* = 1.667) and very low food security (*OR* = 1.966). No financial strain indicator was a statistically significant predictor of food insecurity and very low food security among the sample of male students. However, multivariate coefficient changes indicate that the inclusion of financial strain variables explains 8.3% of the variation in the likelihood of very low food security among male students, suggesting that the summative effect of these factors may have a moderate impact on the likelihood of very low food security among male students. Male students have been observed to have more positive outlooks on their well-being and financial situation when compared to females who are more likely to report financial insecurity.[29] This previous observation offers a possible explanation for the sex differences observed in the present study and may help explain how male students effectively cope with financial strain, potentially by adjusting their food purchasing priorities.[25]

Despite self-reporting similar cooking skills and access to cooking facilities, male and female college students expressed differences in the specific aptitudes that reduce the odds of the likelihood of food insecurity. Male students reported lower skills and access needed for grocery shopping within a budget. Yet, these skills were associated with less than half the odds of the likelihood of food insecurity (*OR* = 0.466) among male students in the sample. Among the sample of female students, better access to cooking facilities was associated with decreased odds of the likelihood of food insecurity (*OR* = 0.436) and very low food security (*OR* = 0.433). Together, the aptitudes and access assessed by the three-component food preparation ability measure explained more variation in the occurrence of food insecurity and very low food security among female students (8.5% and 6.4%, respectively) than male students (4.3% and 3.9%, respectively).

Conclusions

The findings of this study have implications for food insecurity literature as well as curriculum design seeking to address the threat of food insecurity among US college students. Employment was positively associated with the food insecurity and very low food security. Loan borrowing, a common practice among individuals and families seeking to afford the cost of higher

education,[15] displayed a positive association with very low food security. Sex differences existed in how food preparation abilities mitigated the effects of financial strain on the incidence of food insecurity and very low food security among this small sample of US college students. Food procurement ability, the skills and access needed to shop for groceries, was a mitigating factor to the effects of financial strain on the likelihood of food insecurity among male students. For female students, better access to cooking facilities was a mitigating factor to the effects of financial strain on the likelihood of food insecurity and very low food security. For female students, this study found that the aspects of food preparation ability explained more variation in the occurrence of food insecurity and very low food security than the financial strain indicators.

The literature indicated needs to develop a greater understanding of the determinants of food insecurity and very low food security among the college student population and to develop effective intervention strategies accordingly. This study contributes to the development of potential solutions for these issues by identifying food preparation ability, and the subset of skills and aptitudes encompassed by it, as a determinant of food insecurity and very low food security that can be targeted through future interventions. However, the development of more reliable and valid assessments of the behavioral factors related to coping with food insecurity and very low food security is warranted. Comprehensive analyses of the behaviors employed by college students should be conducted to identify threats to college students' health, diet, and food security. These findings suggest that attempts at reducing food insecurity at university campuses may need to utilize a variety of methods to address differences between male and female students. In doing so, interventions should aim to equip US college students with the aptitudes and self-efficacy needed to maintain food security while coping with the financial commitment associated with pursuing post-secondary education. Opportunities exist to address these determinants of food security through programmatic instruction which can be offered through a variety of settings such as university orientation programming, financial literacy courses, and class offerings delivered through university food banks. The successful development and implementation of these interventions could provide a significant improvement to the quality of life of US college students, particularly those from low-income families.

Limitations

The present study did not have information on the degree of loan borrowing or the level of self-support among college students. Additionally, this study did not assess participation in food assistance programs. Employment was analyzed as a dichotomous variable, preventing the analysis of how different types

of employment or levels of earnings may have been associated with the risks for food insecurity and very low food security. Therefore, this study did not account for differences that may exist between students who experienced moderate financial strain and those who experienced severe financial strain.

The assessment of food preparation ability depended on self-ratings and may have reflected self-efficacy rather than true ability. Though, this limitation is shared with other studies which observed aspects of food preparation ability.[19–22] Additionally, Procurement (Cronbach's Alpha = 0.632) and Cooking Facilities Access (Cronbach's Alpha = 0.935) items did not have good internal reliability. Further development of food preparation ability, as a metric of the skills and aptitudes related to procuring and preparing healthy foods, is warranted. Rather than food preparation ability, food preparation behaviors may possess more meaningful associations with food insecurity and very low food security among college students.

This study relied on a relatively small convenience sample from one university in the southeastern United States. While this limitation may impact the generalizability of the observations made, similar studies which assessed food insecurity among US college students share this concern.[2–14,28,] Future studies should aim to assess food insecurity and its determinants across multiple campuses of multiple universities to recruit samples that are more representative of the college student population in the region and the United States. Finally, observational measures of financial strain and food preparation behaviors may ultimately produce less subjectivity bias in subsequent studies.

Disclosure Statement

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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