Rates of and characteristics associated with food insecurity differ among undergraduate and graduate students at a large public university in the Southeast United States

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ABSTRACT

The objective of this study was to estimate the prevalence of food insecurity and identify characteristics associated with food security status separately for undergraduate and graduate students. We conducted a cross-sectional analysis of 4819 students from a public flagship university in the Southeastern US. Students completed an online questionnaire assessing food security status over the past 12 months using the 10-item US Adult Food Security Survey Module and self-reported demographics and student characteristics. Data were collected in October and November of 2016. Analyses were stratified by student status (undergraduate or graduate). We calculated frequencies of food security status categories and used multinomial logistic regression to assess the association between food security status and student characteristics. Food insecurity rates were 25.2% for undergraduates and 17.8% for graduate students. Characteristics associated with food security status (p < .05) for undergraduates only were gender, year in school, receipt of financial aid, cooking frequency, perceived cooking skills, and having a meal plan. For graduate students only, characteristics included age, marital status, having dependent children, enrollment status, and body mass index. Characteristics associated with food security status across both groups included race/ethnicity, perceived health, international student, and employment status. While most prior studies of college food insecurity look only at undergraduate students or combine undergraduate and graduate students into one group, we found differences between undergraduate and graduate students. It is important to consider undergraduate and graduate students as two separate groups as strategies that would be most effective for addressing food insecurity may differ between them.

1. Introduction

Food insecurity refers to not having enough money for consistent and dependable access to enough food to support an active and healthy life. It is a serious public health problem in the US, with 41.2 million individuals, nearly 13% of the noninstitutionalized US civilian population, living in food-insecure households in 2016 (Coleman-Jensen et al., 2017). Food insecure individuals have been shown to have poorer dietary intake, higher rates of a variety of chronic health conditions and mental health problems, and lower self-rated health (Bruening et al., 2016, 2018; Casey et al., 2004; Dixon et al., 2001; Gallegos et al., 2014; Hagedorn and Olfert, 2018; Heflin et al., 2005; Hughes et al., 2011; Leung et al., 2014; Leung and Tester, 2018; Martínez et al., 2018; Laura Helena McArthur et al., 2018; Laura H McArthur et al., 2018; Mirabitur et al., 2016; Patton-López et al., 2014; Payne-Sturges et al., 2018; Seligman et al., 2007, 2010; Wattick et al., 2018).

There has been a recent increase in the number of studies published looking at food insecurity among college and university students. Among peer-reviewed studies of US college and university students, which has consisted of predominately convenience samples, the prevalence of food insecurity has ranged from 14.1% to 58.8 (Bruening et al., 2017). A recent systematic review found an average prevalence of nearly 32.9% (Bruening et al., 2017). A variety of factors have been associated with food insecurity among college and university students. One set are demographic characteristics such as gender and race/ethnicity, with men and
Food insecurity and it is an open question as to whether policies to address food insecurity for one are appropriate for the other. Undergraduate students reporting very low food security, we combined the low and very low food security groups for the analyses.

Students who had proactively requested the university keep their contact information confidential and not available via the University Directory were therefore not included. To prevent duplicate responses, students were sent personal survey links that could only be submitted once. No student records were accessed; all information was self-reported. Students who completed the survey could choose to go to a separate web address and enter a drawing for a $100 Amazon gift card. This study was reviewed and considered exempt by the UNC Chapel Hill institutional review board.

Survey respondents were included if they were an undergraduate or graduate student with complete data for all variables included in the models. We excluded responses from students who reported their year in school as “other” or implausible values for height or weight. Of the 29,895 students invited to participate, 5502 agreed to participate and 5430 responded to at least one question beyond the screener. A total of 4819 students were included in the analyses (579 excluded for missing variables included in the models, 26 excluded for reporting year in school as "other," and 6 excluded for implausible values for height or weight).

2.1. Participants

This study included students from the University of North Carolina (UNC) at Chapel Hill, which is a large public flagship university in the Southeastern US. This study benefited from the opportunity to invite the entire student population to participate, allowing a sufficiently large and diverse resulting dataset to study potential differences between undergraduate and graduate students. In October and November of 2016, all students with a publicly available email address were sent an email invitation and link to an anonymous online questionnaire through Qualtrics online survey software four times over a six-week period. Students who had proactively requested the university keep their contact information confidential and not available via the University Directory were therefore not included. To prevent duplicate responses, students were sent personal survey links that could only be submitted once. No student records were accessed; all information was self-reported. Students who completed the survey could choose to go to a separate web address and enter a drawing for a $100 Amazon gift card. This study was reviewed and considered exempt by the UNC Chapel Hill institutional review board.

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The questionnaire was originally used in a study at Appalachian State University, where it was also pilot-tested with a small group of students and determined to have content validity (Laura Helena McArthur et al., 2018). It is currently being employed at additional universities nationally. Individual food security status over the past 12 months was assessed using the 10-item US Adult Food Security Survey Module, which has been shown to be valid and reliable (Bickel et al., 2006). It typically refers to household food security, however, the questions can be asked using the terms “I,” “my,” and “you,” when there is a single adult in the household (US Department of Agriculture, Economic Research Service, 2017). In this study, we consistently phrased the questions for a single adult. Because many college students either live on their own or with roommates they are unrelated to and each have their own separate financial situation, we felt this wording was the best fit for the study. The questions have been asked this way in other studies of college students, including the study at Appalachian State University (Laura Helena McArthur et al., 2018).

The US Department of Agriculture’s scoring system was used to determine food security status (US Department of Agriculture, Economic Research Service, 2017). The number of affirmative responses was added together to create a score. A score of zero indicated high food security, 1–2 marginal food security, 3–5 low food security, and 6–10 very low food security (US Department of Agriculture, Economic Research Service, 2017). Due to the low number of graduate students reporting very low food security, we combined the low and very low food security groups for the analyses.

Self-reported information on demographic variables and student characteristics were also collected. Body mass index was calculated using self-reported height and weight and students were classified as experiencing underweight (< 18.5), normal weight (18.5–24.9), overweight (25–29.9), or obesity (≥30) (Centers for Disease Control and Prevention, 2016). Most other information was collected using multiple choice questions. Variables and response options are shown in Table 1.

| Food security status | Undergraduate students (n = 2881), n (%) | Graduate students (n = 1938), n (%) | Overall (n = 4819), n (%) |
|----------------------|----------------------------------------|-----------------------------------|------------------------|
| High food security    | 1514 (52.6)                            | 1192 (61.5)                        | 2706 (56.2)            |
| Marginal food security| 642 (22.3)                             | 401 (20.7)                         | 1043 (21.6)            |
| Food insecurity       | 725 (25.2)                             | 345 (17.8)                         | 1070 (22.2)            |
2.3. Statistical analysis

Our analysis included both descriptive and inferential statistics, in line with our study objectives. For descriptive analysis, we calculated various standard statistics of the food security status categories overall and separately for undergraduate and graduate students. We then used analysis of variance to compare mean age of students (continuous variable) across food security status categories and Monte Carlo estimation of exact p-values to compare the proportion of students reporting various characteristics (categorical variables) by food security status.

We then used multinomial logistic regression to examine the association between food security status and student status (undergraduate versus graduate student). Covariates included in the model were age, gender, race/ethnicity, marital status, having dependent children, international student status, enrollment status (full-time versus part-time), residency (off-campus versus on-campus), employment status, having a car, financial aid, perceived health rating, body mass index, cooking frequency, perceived cooking skills, and having an on-campus meal plan. These covariates were identified a priori. They were informed by past research and selected based on factors thought to influence food security status (Chaparro et al., 2009; Coleman-Jensen et al., 2017; Forman et al., 2018; Hagedorn and Olfert, 2018; Laura Helena McArthur et al., 2018; Mirabitude et al., 2016; Morris et al., 2016; Payne-Sturges et al., 2018).

We also used multinomial logistic regression to examine the association of food security status with various characteristics separately for undergraduate and graduate students. The characteristics included in the model were those previously described as covariates for the prior multinomial logistic regression model except that the undergraduate model also included year in school and the graduate student model did not include whether students had an on-campus meal plan due to small cell sizes. For all analyses conducted using multinomial logistic regression, high food security was used as the reference group. All analyses were conducted using SAS version 9.4. Statistical significance was considered \( p < .05 \).

3. Results

Among students in the sample, 59.8% were undergraduate students and 40.2% were graduate students. This is fairly similar to the proportion of undergraduate (62.9%) and graduate students (37.1%) at UNC Chapel Hill during the 2016–17 academic year (UNC Chapel Hill Office of Institutional Research and Assessment, n.d.). Our sample had a larger proportion of female students (72% vs. 57%) and full-time students (95% vs. 85%) than the overall UNC Chapel Hill student population (UNC Chapel Hill Office of Institutional Research and Assessment, n.d.).

Table 1 presents the distribution by food security status across the two populations. A lower proportion of undergraduate students had high food security status and a higher proportion were considered food insecure than graduate students. Compared with undergraduate students, graduate students were significantly less likely to experience marginal food security (OR: 0.75, 95% CI: 0.59, 0.95) or food insecurity (OR: 0.47, 95% CI: 0.37, 0.60). There are also notable differences in the characteristics associated with food insecurity for the different groups of students.

Table 2 shows the characteristics of students in the sample by food security status. For both undergraduate and graduate students, age, race/ethnicity, dependent children, enrollment status, employment status, having a car, financial aid, and perceived health rating were significantly associated with food security status. Additional characteristics that were significantly associated with food security status for undergraduate students were year in school, residency, body mass index, cooking frequency and having a meal plan. Among graduate students, marital status and perceived cooking skills were significantly associated with food security status.

Table 3 shows the results of the multinomial logistic regression. There were significant differences by race/ethnicity and food security status for both undergraduate and graduate students. Among undergraduate students Hispanic and African American students had a greater adjusted odds of experiencing marginal food security and food insecurity, American Indian students had a greater adjusted odds of experiencing marginal food security, and multiracial/other students had a greater adjusted odds of experiencing food insecurity compared with white, non-Hispanic students. African American graduate students had a greater adjusted odds of experiencing food insecurity.

International students had a greater adjusted odds of experiencing food insecurity among undergraduate and graduate students and marginal food security among graduate students. Undergraduate and graduate students with one or more part time jobs had a higher adjusted odds of experiencing food insecurity. Among undergraduate students, having one or more part time jobs was also associated with a greater adjusted odds of marginal food security and having a full-time job was associated with experiencing food insecurity. Receiving financial aid was associated with a greater adjusted odds of experiencing marginal food security among both undergraduate and graduate students, as well as food insecurity among undergraduate students. Compared with a perceived health rating of excellent, there was a greater adjusted odds of experiencing marginal food security among students reporting health ratings of good and fair and a greater adjusted odds of experiencing food insecurity for students reporting good, fair, and poor health for both undergraduate and graduate students. Undergraduate students were less likely to experience food insecurity if they reported fair compared with poor cooking skills and graduate students were less likely to experience marginal food security if they reported excellent cooking skills.

Among undergraduate students, males had a higher odds of experiencing food insecurity compared with females. Undergraduate students also had a greater adjusted odds of experiencing both marginal food security and food insecurity if they sometimes or often cooked. Undergraduate students with an on-campus meal plan had a lower adjusted odds of marginal food security and food insecurity. Food security status was also significantly related to year in school.

Among graduate students, age was negatively associated with experiencing marginal compared with high food security. The adjusted odds of experiencing food insecurity were lower for married graduate students, but higher for graduate students with dependent children. Part-time graduate students had a lower adjusted odds of experiencing both marginal food security and food insecurity. Graduate students with overweight or obesity were more likely to experience marginal food security.

4. Discussion

The rate of food insecurity among both undergraduate and graduate students in our sample was higher than the national prevalence, however, falls within the range found by other studies of US college and university students (Bruening et al., 2016, 2018; Chaparro et al., 2009; Forman et al., 2018; Gaines et al., 2014; Hagedorn and Olfert, 2018; Martinez et al., 2018; Laura Helena McArthur et al., 2018; Mirabitude et al., 2016; Morris et al., 2016; Patton-López et al., 2014; Payne-Sturges et al., 2018; Wattick et al., 2018). A survey conducted with UNC Chapel Hill undergraduate students in the Spring of 2017 found that 29.1% reported at least occasionally skipping or cutting the size of meals because there wasn't enough money for food, which further supports the need to address food insecurity among students (UNC Chapel Hill The Office of Institutional Research and Assessment, 2017).

Despite higher rates of food insecurity among US college and university students, there are typically less food assistance resources available to this population compared with other groups. For example,
Table 2
Characteristics of undergraduate and graduate students at the University of North Carolina at Chapel Hill by food security status, October–November 2016.

| Characteristic                      | Undergraduate students | Graduate students |
|-------------------------------------|------------------------|-------------------|
|                                     | Mean ± SD              | Mean ± SD         |
| Age, y                              | 19.6 ± 1.8             | 28.0 ± 5.6        |
|                                     | 20.0 ± 2.0             | 26.5 ± 4.2        |
|                                     | 20.4 ± 3.6             | 27.3 ± 5.8        |
| Gender                              |                        | p-Value<sup>a</sup> |
| Female                              | 1101 (72.7)            | 827 (69.4)        |
| Male                                | 401 (26.5)             | 360 (30.2)        |
| Other                               | 12 (0.8)               | 5 (0.4)           |
| Race/ethnicity                      |                        | 1 (0.3)           |
| White, non-Hispanic                 | 1110 (73.3)            | 875 (73.4)        |
| Hispanic                            | 217 (14.3)             | 12 (1.1)          |
| African American                    | 3 (0.2)                | 6 (0.5)           |
| American Indian                     | 56 (3.7)               | 4 (4.4)           |
| Marital status                      |                        | 17 (4.2)          |
| Not married                         | 25 (1.7)               | 842 (70.6)        |
| Married                             | 1489 (98.3)            | 309 (25.9)        |
| Dependent children                  | 1509 (99.7)            | 279 (22.9)        |
| Year in school                      | 1468 (97.0)            | 329 (25.5)        |
| Freshman                            | 531 (35.1)             | 316 (91.6)        |
| Sophomore                           | 325 (21.5)             | 94 (11.9)         |
| Junior                              | 337 (22.3)             | 41 (11.9)         |
| Senior                              | 321 (21.2)             | 41 (11.9)         |
| International student               |                        | 41 (11.9)         |
| No                                  | 1110 (73.3)            | 875 (73.4)        |
| Yes                                 | 217 (14.3)             | 12 (1.1)          |
| Enrollment status                   | 56 (3.7)               | 6 (0.5)           |
| Full-time                           | 1493 (98.6)            | 17 (4.2)          |
| Part-time                           | 21 (1.4)               | 842 (70.6)        |
| Residence                           | 557 (36.8)             | 309 (25.9)        |
| Off-campus                          | 557 (36.8)             | 329 (22.9)        |
| On-campus                           | 597 (36.3)             | 16 (1.1)          |
| Employment status                   | 839 (55.4)             | 344 (28.9)        |
| Unemployed                          | 695 (43.5)             | 110 (27.4)        |
| ≥ 1 Part-time jobs                  | 16 (1.1)               | 88 (25.5)         |
| Full-time job                       | 16 (1.1)               | 19 (4.9)          |
| Have car                            | 816 (53.9)             | 9 (2.2)           |
| Yes                                 | 698 (46.1)             | 38 (1.2)          |
| Financial aid                       | 729 (48.2)             | 75 (21.7)         |
| Financial aid                       | 785 (51.8)             | 75 (21.7)         |
| Perceived health rating             | 663 (43.8)             | 105 (14.5)        |
| Excellent                           | 763 (50.4)             | 601 (90.0)        |
| Good                                | 80 (5.3)               | 67 (5.6)          |
| Poor                                | 8 (0.5)                | 7 (0.6)           |
| Body mass index                     | 53 (3.5)               | 34 (2.9)          |
| Underweight                         | 1103 (72.9)            | 9 (2.2)           |
| Normal weight                       | 275 (18.2)             | 112 (27.9)        |
| Overweight                          | 83 (5.5)               | 118 (9.9)         |
| Cooking frequency                   | 411 (27.2)             | 25 (2.1)          |
| Never                               | 724 (47.8)             | 9 (2.2)           |
| Sometimes                           | 379 (25.0)             | 7 (2.0)           |
| Perceived cooking skills            | 140 (9.3)              | 7 (2.0)           |
| Poor                                | 10 (0.6)               | 241 (71.5)        |
| Meal plan                           | 650 (42.9)             | 110 (15.2)        |
| Yes                                 | 864 (57.1)             | 429 (59.2)        |

<sup>a</sup> ANOVA for continuous variables and Monte Carlo estimation of exact p-values for categorical variables.
there is no equivalent to federal child nutrition programs, such as the National School Lunch and Breakfast Programs, for college and university students, and most are not eligible for other federal nutrition assistance programs such as the Supplemental Nutrition Assistance Program (USDA Food and Nutrition Service, 2016). Even these widely-available programs are not fully successful in addressing food insecurity and its complex inter-relationship with health outcomes as they do not address the underlying problem of lack of adequate financial resources.

Our finding that graduate students were less likely to experience food insecurity than undergraduate students agrees with the finding by Mirabilitur and colleagues that among students from a large Midwestern public university living in housing without food provision, PhD/graduate-professional students were less likely to experience lower food security than undergraduate students (Mirabilitur et al., 2016). We found many of the characteristics associated food security status differed between the two groups. For characteristics associated with food security status in both groups, there were some differences in the particular associations found. Differences in associations may be related to

### Table 3

| Undergraduate students | Graduate students |
|------------------------|-------------------|
| Marginal food security adjusted OR (95% CI) | Marginal food security adjusted OR (95% CI) |
| Gender | | |
| Female | 1 (Ref) | 0.95 (0.92, 0.98) |
| Male | 1 (Ref) | 0.98 (0.95, 1.01) |
| Race/ethnicity | | |
| White, non-Hispanic | 1 (Ref) | 1 (Ref) |
| Asian | 0.94 (0.69, 1.23) | 0.67 (0.44, 1.03) |
| Hispanic | 2.10 (1.45, 3.05) | 1.12 (0.70, 1.77) |
| African American | 2.14 (1.36, 3.35) | 1.42 (0.79, 2.55) |
| American Indian | 5.18 (1.27, 21.24) | 0.85 (0.16, 4.61) |
| Multiracial/Other | 1.22 (0.74, 2.00) | 1.00 (0.56, 1.80) |
| Marital status | | |
| Not married | 1 (Ref) | 1 (Ref) |
| Married | 1.15 (0.57, 2.33) | 0.94 (0.49, 1.77) |
| Year in school | | |
| Freshman | 1 (Ref) | 1 (Ref) |
| Sophomore | 1.34 (0.98, 1.84) | 1.17 (0.60, 2.27) |
| Junior | 1.74 (1.20, 2.52) | 1.27 (0.95, 1.69) |
| Senior | 1.92 (1.24, 2.96) | 1.26 (0.90, 1.77) |
| International student | | |
| No | 1 (Ref) | 1 (Ref) |
| Yes | 1.51 (0.88, 2.59) | 1.69 (1.01, 2.80) |
| Enrollment status | | |
| Full-time | 1 (Ref) | 1 (Ref) |
| Part-time | 0.96 (0.44, 2.08) | 0.56 (0.33, 0.94) |
| Residency | | |
| Off-campus | 1 (Ref) | 1 (Ref) |
| On-campus | 1.09 (0.81, 1.47) | 1.17 (0.60, 2.27) |
| Employment status | | |
| Unemployed | 1 (Ref) | 1 (Ref) |
| ≥ 1 Part-time jobs | 1.26 (1.02, 1.55) | 1.27 (0.95, 1.69) |
| Full-time job | 0.84 (0.31, 2.26) | 1.26 (0.90, 1.77) |
| Have car | | |
| No | 1 (Ref) | 1 (Ref) |
| Yes | 0.99 (0.78, 1.24) | 0.79 (0.52, 1.20) |
| Financial aid | | |
| No | 1 (Ref) | 1 (Ref) |
| Yes | 1.23 (1.00, 1.50) | 1.32 (1.00, 1.74) |
| Perceived health rating | | |
| Excellent | 1 (Ref) | 1 (Ref) |
| Good | 2.13 (1.71, 2.65) | 1.83 (1.40, 2.39) |
| Fair | 3.45 (2.36, 5.05) | 2.81 (1.77, 4.44) |
| Poor | 1.55 (0.40, 6.02) | 1.47 (0.29, 7.46) |
| Body mass index | | |
| Underweight | 1.35 (0.82, 2.24) | 0.81 (0.38, 1.75) |
| Normal weight | 1 (Ref) | 1 (Ref) |
| Overweight | 1.11 (0.87, 1.42) | 1.36 (1.03, 1.80) |
| Obese | 1.00 (0.68, 1.50) | 1.49 (1.00, 2.21) |
| Cooking frequency | | |
| Never | 1 (Ref) | 1 (Ref) |
| Sometimes | 1.52 (1.15, 2.02) | 1.34 (0.96, 1.84) |
| Often | 1.48 (1.03, 2.12) | 1.32 (0.85, 2.03) |

(continued on next page)
differences the demographics and characteristics of undergraduate and graduate students. Few undergraduate students reported being married or having dependent children, for example. Only 2% of graduate students among all food security status categories reported never cooking compared with approximately 16% of undergraduate students reporting marginal food security or food insecurity and 27.2% of undergraduates reporting high food security.

Similar to other studies of factors associated with food insecurity among college and university students, we found students receiving financial aid (Laura Helena McArthur et al., 2018; Munro et al., 2013) were more likely to be food insecure. Numerous studies agree with our findings that food insecure students have lower perceived health ratings (Gallegos et al., 2014; Hagedorn and Oliff, 2018; Hughes et al., 2011; Laura Helena McArthur et al., 2018; Laura H McArthur et al., 2018; Patton-López et al., 2014). As with other studies, we also found males were more likely to be food insecure than females (Laura Helena McArthur et al., 2018; van den Berg and Raubenheimer, 2015) in our undergraduate student group. Other studies have also found race/ethnicity (Chaparro et al., 2009; Forman et al., 2018; Mirabitur et al., 2016; Morris et al., 2016; Payne-Sturges et al., 2018; van den Berg and Raubenheimer, 2015) and employment status (Patton-López et al., 2014) to be associated with food insecurity.

A prior study of undergraduate students from a large mid-Atlantic university also found that a lower percentage of food insecure students participated in on-campus meal plans, however, their results were not significant after controlling for other variables in the model as ours did (Payne-Sturges et al., 2018). It is important to note the university where our study took place does not require students to purchase meal plans regardless of whether or not they live in on-campus housing. Having a meal plan may indicate familial support, which may make students less vulnerable to food insecurity. Students who may be at higher risk to food insecurity may not purchase meal plans due to their cost. Meal plans may also help to protect students against food insecurity as regardless of how much money a student currently has, they are able to receive meals through their meal plan once they have it.

Cooking frequency may reflect access to and the ability to afford food and supplies for cooking. Unlike McArthur and colleagues who found students who never cooked were more likely to be food insecure (Laura Helena McArthur et al., 2018), however, we found undergraduate students who sometimes or often cook are more likely to be food insecure. It is possible food insecure students in our sample were cooking out of necessity because they were unable to afford a meal plan or to eat out, or did not have others to cook for them. As previously mentioned students with meal plans were less likely to be food insecure, and since they have access to these meals probably cook less often. Residence halls at UNC Chapel Hill include kitchen facilities for students to use, which may make it easier for food insecure students living in university housing to cook. Combined with the association between financial aid receipt and food insecurity, the results suggest financial aid awards are not sufficient to bring eligible students up to parity with other undergraduates.

It is possible that married graduate students were less likely to experience food insecurity because they may have two incomes in their household (or at least one for graduate students who are not working), which could result in more money available to purchase food. Graduate students with dependent children may be more likely to experience food insecurity because of greater expenses due to more individuals in the household who need to be supported by their income, which may leave them less money to spend on food. A study of college students in South Africa found that unmarried students were more likely to be food insecure, although this association did not remain significant in adjusted models (van den Berg and Raubenheimer, 2015). We are not aware of other studies of US college and university students finding significant associations among these characteristics and food security status, although past studies did not focus specifically on graduate students. These results are similar to that found among the general noninstitutionalized US civilian population, where households with children have been shown to have a higher food insecurity rate and married-couple families with children and households with no children and more than one adult have food insecurity rates lower than the national average (Coleman-Jensen et al., 2017). It is possible that part-time graduate students have careers outside of their academic program that allows them to earn enough income to achieve high food security status.

### 4.1. Strengths and limitations

This study has a variety of strengths. To our knowledge, this is the first study looking at characteristics associated with food security status in university students separately for undergraduate and graduate students, and indeed, while some factors were common to both groups, there were specific factors impacting the food security status of undergraduates as opposed to graduate students, and vice versa. Compared with other studies of college and university students from a single university within the United States, we had a larger sample size. To our knowledge, this study is also the first to stratify the results by...
whether students were an undergraduate or graduate student. In addition, we are not aware of other US studies that have examined differences in food security status among international and non-international students.

One of the limitations of this study is that it is limited to one large public university in the Southeast, so results may not be widely generalizable to students from all universities. The cross-sectional nature of the study also does not allow for causality to be determined. Because all measures were self-reported, it is possible that there was response bias. These limitations are similar to those of past studies on food insecurity among college and university students, however.

5. Conclusion

We argue studies focused solely on an undergraduate or graduate sample or subset thereof should not be used to generalize broadly to all higher education students. This may be apparent in consideration of a traditional college or university versus community colleges or technical schools, but our results show it is important within the more traditional structures. For example, while in general the odds of being food insecure were lower for graduate students, this was not true for African Americans. In fact, at the graduate level, the odds of being food insecure increased greatly for this sub-population. This demonstrates that blanket policies and efforts to fight food insecurity at an institutional level, or just at the undergraduate level, could miss the particular barriers faced by sub-populations at higher risk.

Research has clearly shown that strategies for successfully addressing food insecurity among college and university students are needed. We know that additional research is needed around the connections between food insecurity, housing, poverty, and educational and health outcomes for students. However, we also need to recognize that not all students are alike. For a start, we suggest the most effective way to address food insecurity in the short-term is to carefully consider undergraduate and graduate students as separate groups with different situations and behavioral responses. Because different factors are associated with food security status, likely tied to different educational, living, financial and relationship situations, different strategies may be needed to most effectively improve food security status among undergraduate and graduate students. Successful solutions are ones which fit the problems.

Acknowledgment

This study was supported by a University of North Carolina at Chapel Hill Food for All micro-grant.

Conflicts of interest

None.

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