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# Food insecurity in California's public university system: What are the risk factors?

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**ABSTRACT**

Food insecurity among college students has become a public health concern, yet few studies have examined the sample prevalence in a statewide public university system. We determined the sample prevalence of food insecurity and associated factors among students in a large California university system. In Spring 2015, a sample of graduate and undergraduate students ($n$ = 8705) at 10 University of California campuses completed an online survey of demographic information and a range of student life–related factors, including food access and food security. The majority of participants were undergraduates age 18–24 years; 67% were female. Forty percent experienced food insecurity (42% when weighted). Age, race and ethnicity, childhood food insecurity, and receiving financial aid were risk factors for food insecurity. Food insecure students were more likely than food secure students to face difficulties including insufficient money to purchase food, eating unhealthy food, experiencing food access barriers, difficulty concentrating, and lower academic performance. Food insecurity was high among college students in a California public university system and was associated with factors that may be used to identify students at risk for food insecurity who may benefit from additional information and resources. These findings also provide empirical support to strengthen support systems.

**KEYWORDS**

Food insecurity; college students; food access; hunger; disparities



## Introduction

Food insecurity is defined as the limited or uncertain ability to obtain nutritionally adequate food due to lack of financial resources, resulting in disrupted eating patterns and/or reduced food intake.[1,2] In 2015, 13% of U.S. households had experienced food insecurity in the previous 12 months,[1] with a higher prevalence among households with children (19%), households at or below the federal poverty line (42%), single-parent households (26%), and black or Hispanic households (~20%).[1]

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Contrary to the notion that college students occupy a privileged environment and are protected against hunger, several studies conducted since 2006 have reported a food insecurity prevalence ranging from 14% to 59% among students.[3–15] Food insecurity may result in hunger—a physiological state resulting in discomfort due to lack of food. Hunger resulting from food insecurity affects the ability to focus, which in turn can affect academic performance.[16,17] Some evidence suggests that students who experience food insecurity are at increased risk for poor academic performance[12] and are more likely than food secure students to experience longer times to graduate.[9] Recently, Bruening et al. reported that 37% of freshman students from a large university experienced food insecurity in the past 3 months, higher odds of depression, and lower odds of eating breakfast and home-cooked meals compared to freshman who were food secure.[18]

Given the potential consequences of food insecurity for college students, it is important to identify contextual risk factors that may increase their vulnerability. To date, however, there is limited knowledge about risk factors that could potentially screen for and identify students who experience food insecurity. Therefore, we aimed to document the sample prevalence of and risk factors for food insecurity in a large sample of college students enrolled in California's statewide public university system. Study findings will alert other higher education institutions to the problem and may inform institutional, state, and federal responses, policies, and programs to prevent food insecurity among college students.



## Methods

### Study context

The University of California (UC) is a statewide public university system, with a total of 242 326 students enrolled in 2015 (34% graduate and 66% undergraduate). About 85% of undergraduate students were California residents, and roughly 42% received Pell grants (federal financial aid for students from low-income families) and were first-generation college students.[19] In 2014, UC President Janet Napolitano launched the UC Global Food Initiative, in part to document the number of students experiencing food insecurity, provide solutions to food insecurity on UC campuses, and be a resource for other universities.[20] This study was part of the Global Food Initiative.

### Survey development

We developed a 50-item online survey to determine the sample prevalence of and risk factors for food insecurity among students. The survey included the U.S. Department of Agriculture's validated 6-item short form food security

module (for self-administration)[2] and items about potential risk factors for food insecurity. Item selection was guided by a conceptual framework of putative influences on food insecurity tailored for college students[21] and included items about access to food, food sources, barriers to food access, use of and access to on- and off-campus food resources (e.g., food pantries, food programs), and potential consequences of food insecurity (e.g., academic, financial responsibilities, health).

The survey was pilot-tested with 10 students at each of 3 geographically diverse UC campuses ($n$ = 30). Students completed the survey and participated in a cognitive interview regarding the relevance and clarity of each survey item. Student feedback and time taken to complete the survey informed modifications and refinements to the final survey tool. The final survey was estimated to take 10 minutes to complete.

### Recruitment and data collection

Students were randomly sampled from each campus and the sample size for each campus was based on a 95% confidence level with a confidence interval of ±3% for a survey response rate of 18% (per the American College Health Association).[21] Using a cross-sectional study design, data were collected from all 10 campuses in the UC system in Spring 2015 (Figure 1). A total of 67 645 randomly sampled students were invited to participate in an online survey in one of 2 ways: (1) through the National College Health Assessment II (NCHA), administered by the American College Health Association and scheduled to occur at 4UC campuses in Spring 2015,[22] or (2) by an independent survey, administered by the UC Institutional Research and Program Planning at the 6 other UC campuses (where the NCHA was not scheduled for Spring 2015). Students were sent an e-mail containing an informed consent letter and an online link to the survey that was delivered using Qualtrics (LLC Research Suite) to collect and manage online data. Students electronically consented to participate for both modes. Participating students were entered into a lottery to be awarded prizes (i.e., $25–125 gift cards, computer monitors, tablets), an incentive structure found to be effective in increasing college student participation.[23]

The NCHA is administered at the request of interested universities; the focus is on student health and risk behaviors, such as diet, alcohol and drug use, mental health and academic performance, and sociodemographic information (i.e., sex, race/ethnicity, receipt of need-based financial aid/grants/scholarships, academic year, housing). The invitation e-mail requested students to participate in a survey about student health. For this study, the food security module[2] and items regarding food access and campus resource use were added to the end of the NCHA. The NCHA (without the food security module) takes 25–30 minutes to complete. Students had a 3-week period to

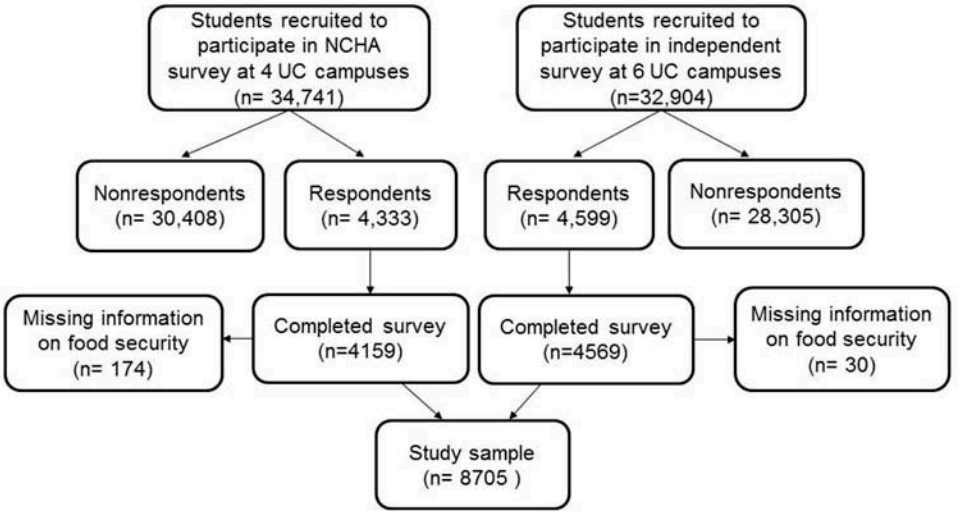


**Figure 1.** Study flowchart summarizing survey administration and survey participation at 10 campuses in the UC system in Spring 2015.



complete the survey during which weekly e-mail reminders were sent to encourage participation. The number of students who participated by this method was 4333 (13% completion rate).

The independent survey included the same NCHA items regarding student health behaviors, mental health, academic performance, and sociodemographic information, along with the food security module. The invitation e-mail requested students to participate in a study about student health and food access. Students had a 4-week period to complete the survey during which weekly e-mail reminders were sent. An additional week was allowed for completion of the independent survey because it was administered toward the end of the spring semester or quarter when students were taking final exams. The survey took about 10 minutes to complete. The number of students who completed the independent survey was 4599 (15% completion rate).

Of the 8932 total student participants, 8705 provided complete data on food insecurity and were included in the analytic sample. Participants excluded from the analysis due to incomplete food security data did not differ from those included in the analysis in terms of sex and academic year, but a greater proportion of students with missing data on food insecurity were mixed raced/other (37%), enrolled part-time (2%), and international students (14%) compared to students with complete data on food security (11, 0.6, 9%; $p < 0.05$).

## Measures

Food insecurity in the past 12 months

The food security items asked about running out of food and not having money to buy more, affordability of eating balanced meals, cutting the size of or skipping meals, eating less than the student felt should be eaten, and going hungry because of a lack of money for food. We used the U.S. Department of Agriculture option of the item about cutting meals in which an affirmative response of *yes, almost every month* or *yes, some months but not every month* is scored as 2 affirmative responses, a response of *yes, only 1 or 2 months* is scored as 1 affirmative response, and a no response is scored as 0.[2] The sum of affirmative responses to the resulting 5 questions on food insecurity generated a raw score of 0 or 1 (food secure), 2 to 4 (low food secure), or 5 to 6 (very low food secure; U.S. Department of Agriculture coding scheme). Low and very low food insecure were coded as food insecure.

Childhood history of family food insecurity

Students were asked the validated 2 items about family food insecurity (i.e., during my childhood, in my family, we worried whether food we bought just didn't last; and worried whether our food would run out before we got money to buy more).[24] An affirmative response (*sometimes true* or *often true*) to one or both questions was characterized as childhood food insecurity.

Food sources, consequences and coping mechanisms, circumstances and barriers to getting food, and access to information

Students were asked to report how often they got groceries or prepared foods from a list of common sources (e.g., grocery store, campus meal plan, restaurants) and to report on barriers to food access (e.g., lack of foods for dietary needs, lack of transportation), with response options ranging from *very often* to *never*. Students were asked about having received information from the university or student groups about how to apply for food assistance, where to access food, and how to prepare healthful meals on a budget. Response options for each of these included: *received and used, received but didn't need, not received but would like*, and *not received and don't need*. Students were also asked about potential consequences of food insecurity (e.g., having to ask parents/friends for money, buying inexpensive but unhealthful food), with response options ranging from *every month* to *never*.

## Analysis

Descriptive statistics were obtained on student participants, including the sample prevalence of food insecurity with and without using sample weights. Constructed sample weights were a function of the reported fall enrollment for academic year 2014–2015 for each campus divided by the sample size obtained for that campus. These weights were then rescaled so that the sum of the rescaled weights was equivalent to the total sample size.

Differences by food insecurity status (food secure, food insecure) were computed using chi-square tests for categorical variables and independent *t*

tests for continuous variables, with significance at $p < 0.05$. Linear regression analysis was performed at the level of the campus to examine whether individual campus response rates were associated with food insecurity with and without controlling for race/ethnicity and academic year; the response rates were not associated with the sample prevalence of food insecurity. Complex sample logistic regression (to account for clustering by campus) was performed to examine the relationship between student factors and food insecurity. The model included the following student factors: sex, age, race/ethnicity, socioeconomic factors (e.g., childhood history of food insecurity and having received need-based financial aid), academic year, living situation, and barriers to getting food. Factors were omitted from the model for parsimony when $p > 0.20$. Data for these analyses were not weighted by campus enrollment or gender. All analyses were conducted using IBM SPSS 22 Statistics for Windows (IBM Corp., Armonk, NY).

## Results

The actual 2014–2015 UC student population was compared with the 2015 study sample (weighted and unweighted) confirming that the samples were similar (Table 1). Two thirds or more of respondents were undergraduates, female, age 17–24 years, and received financial aid (Table 2). Students were 34% non-Hispanic white (hereafter referred to as white), 31% Asian, 21% Hispanic, 11% mixed race/other, and 2% non-Hispanic black (hereafter referred to as black). A greater proportion of students participating in the NCHA survey were female (70% vs. 65%), Hispanic (19% vs. 24%), or international students (94% vs. 89%) and a lower proportion were married (9% vs. 17%) compared to the independent survey participants ($p < 0.05$).

Forty percent of participating UC students experienced food insecurity in the past year (unweighted), and the number was higher among undergraduate students than graduate students (Table 2). The sample prevalence of food insecurity was highest among Hispanic students, followed by black, mixed race, Asian, and white students. About one fifth of students reported a childhood history of family food insecurity; this was significantly higher among food insecure students compared to food secure students. A significantly higher proportion of food insecure students received financial aid and/or need-based grants, scholarships, or loans; had suspended their studies in the past due to financial hardship; and had a lower cumulative grade average compared to food secure students ($p < 0.001$). The prevalence of food insecurity with sample weights was 2% higher (42%) than the sample prevalence calculated without sample weights (40%; Table 1).

Both food insecure and food secure students most commonly reported getting food from a grocery store or supermarket (Table 3). A higher proportion of food insecure students obtained food from parent(s)' or

**Table 1.** Characteristics of the 2014–2015 UC student population and the study sample of UC students surveyed in the spring of 2015, weighted and unweighted.[a]

| Characteristics | 2014–15 UC student population | 2015 Study sample, weighted | 2015 Study sample, unweighted |
|---|---|---|---|
| Total *N* | 242 326 | 8705 | 8705 |
| Gender (%) | | | |
| Female | 48 | 66[b] | 67[b] |
| Male | 52 | 33[b] | 32[b] |
| Race/ethnicity (%) | | | |
| Non-Hispanic white | 29[c] | 31 | 34 |
| Non-Hispanic black | 3[c] | 2 | 2 |
| Hispanic | 25[c] | 21 | 21 |
| Asian | 31[c] | 34 | 31 |
| Mixed race or other | 8[c] | 12 | 11 |
| Academic level (%) | | | |
| Undergraduate | 78[c] | 73 | 66 |
| Graduate | 22[c] | 27 | 34 |
| Received financial aid, need-based scholarship, grant, loan (%) | 65 | 65 | 65 |
| Total food insecure (%) | — | 42 | 40 |

[a]UC indicates University of California. Not all students had complete data on demographic characteristics (UC study sample with weights using full sample and current study sample without weights); therefore, percentages may not add up to 100%.
[b]A total of 48 (<1%) students were transgender in the current study sample.
[c]Proportion does not include data for health and nursing professions campus due to different breakdown of demographic information.



friend(s)' homes, fast food restaurants, free food events, corner/convenience stores, and on/off-campus food pantries compared to food secure students.

Coping mechanisms, such as buying cheap unhealthful food, asking family/friends for money to cover costs, difficulty studying due to hunger, and prioritizing living expenses and educational expenses, were significantly higher among food insecure students compared to food secure students ($p < 0.001$). Slightly more food secure than food insecure students reported lack of food for dietary needs, cultural foods, facilities to cook/store foods, and transportation ($p$ values ranged from 0.01 to 0.001). Slightly more food insecure than food secure students lacked time to prepare foods ($p < 0.05$).

Students most commonly reported that they had not received information about food access and assistance from campus resources or student groups (Table 4) but wanted to receive information on how to cook and live on a budget and to whom to speak on campus about not having enough food. The proportion of food insecure students who had received and used information about how to apply for federal food assistance, location of food pantries/banks/free food, how to budget living expenses and healthy meals, and who to go to on campus about not having enough food was low but slightly higher than for food secure students. A significantly higher proportion of food insecure students were interested in receiving information on these topics compared to food secure students ($p < 0.001$).

**Table 2.** Characteristics of University of California students surveyed in Spring 2015 about food insecurity and differences by food security status in the past 12 months.[a]

| Characteristics | Total sample ($n$ = 8705) | Food secure ($n$ = 5267) | Food insecure ($n$ = 3438) |
|---|---|---|---|
| Total | 100% | 60% | 40% |
| Age group[b] (years) | | | |
| 17–24*** | 72% | 67% | 79% |
| 25–34*** | 24% | 29% | 17% |
| 35+*** | 4% | 5% | 3% |
| Age (years), mean ± SD*** | 23 ± 6 | 24 ± 5 | 23 ± 5 |
| Gender[c] | | | |
| Female | 67% | 67% | 67% |
| Male | 32% | 33% | 32% |
| Race/ethnicity | | | |
| Non-Hispanic white*** | 34% | 41% | 24% |
| Non-Hispanic black*** | 2% | 2% | 3% |
| Hispanic*** | 21% | 15% | 31% |
| Asian*** | 31% | 31% | 31% |
| Mixed race or other*** | 11% | 11% | 12% |
| Marital status | | | |
| Single*** | 85% | 83% | 88% |
| Married or living with a partner*** | 13% | 15% | 10% |
| Divorce or separated* | 1% | 1% | 2% |
| Other | 1% | 1% | 1% |
| Enrollment status | | | |
| Full-time | 97% | 97% | 97% |
| Part-time/other | 3% | 3% | 3% |
| Year in school | | | |
| First-year undergraduate | 17% | 17% | 17% |
| Second-year undergraduate*** | 15% | 13% | 18% |
| Third-year undergraduate*** | 18% | 15% | 23% |
| Fourth-year undergraduate*** | 14% | 12% | 17% |
| Fifth-year undergraduate or more*** | 3% | 2% | 5% |
| Graduate or other professional | 34% | 42% | 21% |
| Academic level | | | |
| Undergraduate*** | 66% | 57% | 79% |
| Graduate*** | 34% | 43% | 22% |
| International student | 9% | 9% | 8% |
| Cumulative grade average | | | |
| A*** | 41% | 49% | 29% |
| B*** | 43% | 39% | 49% |
| C*** | 13% | 9% | 19% |
| D/F*** | 1% | <1% | 1% |
| N/A | 3% | 4% | 3% |
| Living situation | | | |
| Off-campus housing*** | 58% | 60% | 55% |
| Campus residence hall* | 23% | 22% | 25% |
| Other campus housing* | 10% | 10% | 11% |
| Parent/guardian's home | 5% | 5% | 6% |
| Other housing[d**] | 2% | 2% | 2% |
| Fraternity/sorority house* | 1% | 1% | 1% |
| Time working (hours/week) | | | |
| 0** | 48% | 49% | 46% |
| 1–9** | 12% | 11% | 14% |
| 10–19*** | 19% | 16% | 22% |
| 20–29 | 10% | 10% | 10% |
| 30–39** | 2% | 2% | 3% |

(*Continued*)

**Table 2.** (Continued).

| Characteristics | Total sample ($n$ = 8705) | Food secure ($n$ = 5267) | Food insecure ($n$ = 3438) |
|---|---|---|---|
| 40+*** | 10% | 13% | 6% |
| Received financial aid, need-based scholarship, grant, loan*** | 65% | 57% | 77% |
| Has had to suspend studies due to financial hardship*** | 6% | 3% | 10% |
| Childhood history of family food insecurity[e]*** | 22% | 9% | 43% |
| | | Food insecurity ($n$ = 3438) | |
| Total food insecure | 40% | — | — |
| Total food insecure by academic level | | | |
| Undergraduate | 47% | — | — |
| Graduate | 24% | — | — |
| Total food insecure by race/ethnicity | | | |
| Non-Hispanic white | 28% | — | — |
| Non-Hispanic black | 52% | — | — |
| Hispanic | 57% | — | — |
| Asian | 39% | — | — |
| Mixed race/other | 41% | — | — |

[a]Not all students had complete data on demographic characteristics; therefore, percentages may not add up to 100%.
[b]A total of 3 students were 17 years old.
[c]A total of 48 (<1%) students were transgender.
[d]Other housing refers to living temporarily with a friend, homeless, or other unknown.
[e]Includes *often/sometimes true* response options.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, for $\chi^2$ post hoc test comparisons between food secure and food insecure groups.

In the regression analysis, compared to students age ≥35 years, students between the ages of 17 and 24 years and 25 and 34 years had higher odds of food insecurity (17–24 years: odds ratio [OR] = 1.6; 95% confidence interval [CI], 1.1, 2.3; 25–34 years: OR = 1.6; 95% CI, 1.1, 2.3; Table 5). Compared to white students, Hispanic students had the highest odds of experiencing food insecurity (OR = 1.9; 95% CI, 1.5, 2.3) followed by black students (OR = 1.7; 95% CI, 1.2, 2.5), mixed race/other students (OR = 1.4; 95% CI, 1.2, 1.7), and Asians students (OR = 1.3; 95% CI, 1.1, 1.6). For students with a childhood history of food insecurity, the odds of food insecurity were 7 times higher compared to students who were food secure as children (OR = 7.4; 95% CI, 5.8, 9.4). The odds of food insecurity among students receiving need-based financial aid was nearly twice that of students who had not received need-based financial aid (OR = 1.6; 95% CI, 1.3, 2.0). Compared to the odds of graduate/other professional students being food insecure, fifth-year students had 4 times the odds of being food insecure (OR = 4.1; 95% CI, 2.8, 6.2), second- to fourth-year students had about 3 times the odds (second year: OR = 2.7; 95% CI, 2.0, 3.5; third year: OR = 3.0; 95% CI, 2.5, 3.7; fourth year: OR = 2.6; 95% CI, 1.8, 3.7), and first-year students had twice the odds (OR = 2.0; 95% CI, 1.4, 2.8). For students living with a friend/homeless/

**Table 3.** Food sources, consequences, and coping mechanisms of not having enough food and circumstances and barriers to getting food among University of California students surveyed in Spring 2015 and differences by food security status.

| | Total sample ($n$ = 8705) (%) | Food secure ($n$ = 5267) (%) | Food insecure ($n$ = 3438) (%) |
|---|---|---|---|
| Total | 100 | 60 | 40 |
| Food sources[a] | | | |
| Grocery store, supermarket*** | 68 | 71 | 64 |
| Non–fast food restaurant | 28 | 28 | 30 |
| Warehouse/superstore*** | 24 | 22 | 27 |
| University outlet (meal plan)** | 23 | 22 | 25 |
| Parent(s)'/friend(s)' home*** | 21 | 17 | 27 |
| Fast food restaurant*** | 13 | 9 | 20 |
| University outlet (no meal plan)*** | 14 | 13 | 15 |
| Free food events on/off campus*** | 12 | 8 | 17 |
| Co-op grocery*** | 10 | 9 | 12 |
| Farmers' market | 10 | 10 | 9 |
| Corner or convenience store*** | 8 | 6 | 12 |
| On/off-campus food pantry/free food program*** | 7 | 3 | 12 |
| Garden or other outdoor*** | 4 | 3 | 5 |
| Fraternity or sorority*** | 2 | 2 | 3 |
| Coping mechanisms in past 12 months[b] | | | |
| Bought cheapest food knowing it wasn't the healthiest*** | 41 | 23 | 68 |
| Asked family/friends for money to cover my costs*** | 20 | 9 | 37 |
| Difficulty concentrating because of hunger and no money for food*** | 11 | 1 | 28 |
| Had to choose between paying for food or educational expenses[c]*** | 10 | 1 | 24 |
| Went hungry to use food money to go out with friends*** | 10 | 2 | 22 |
| Had to choose between paying for food or housing/ utilities*** | 10 | 1 | 23 |
| Had to choose between paying for food or medicine/ care*** | 6 | 1 | 15 |
| Circumstances (barriers) to getting food the food[a] | | | |
| Lack of foods for my dietary needs*** | 44 | 46 | 40 |
| Lack of cultural foods** | 43 | 45 | 41 |
| Lack of facilities to cook/store food*** | 45 | 48 | 42 |
| Lack of reliable transportation** | 45 | 46 | 42 |
| Location of food outlets on campus*** | 44 | 46 | 42 |
| Hours of operation of campus outlets* | 40 | 42 | 39 |
| Cost of food | 40 | 40 | 41 |
| Lack of time to prepare* | 45 | 44 | 47 |
| Lack of time to shop | 45 | 45 | 45 |

[a]Proportion includes response options of *often* and *very often*, excludes responses of *sometimes, rarely*, or *never*.

[b]Proportion includes response options of *every month* and *some months during the year*, excludes responses of *1 to 2 times a year* or *never*.

[c]Educational expenses included loans and tuition.

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, for $\chi^2$ post hoc tests.

other, the odds of food insecurity were double that of students living at home (OR = 2.1; 95% CI, 1.4, 3.3). Indicators of barriers to getting food were not significant in the final model. The variables in this model explained 29% of the variance in food insecurity.

**Table 4.** Prevalence of having received information about food assistance from university or student groups among University of California students surveyed in Spring 2015, by food security status.

| | Total sample ($n$ = 8705) (%) | Food secure ($n$ = 5267) (%) | Food insecure ($n$ = 3438) (%) |
|---|---|---|---|
| How to apply for federal food assistance | | | |
| Received and used*** | 4 | 2 | 6 |
| Received but didn't need* | 7 | 7 | 8 |
| Not received but would like*** | 23 | 13 | 37 |
| Not received and don't need*** | 67 | 78 | 48 |
| Location of food pantries, banks, or free food | | | |
| Received and used*** | 6 | 4 | 10 |
| Received but didn't need | 13 | 13 | 12 |
| Not received but would like*** | 26 | 15 | 43 |
| Not received and don't need*** | 55 | 68 | 36 |
| How to cook simple or cheap healthy meals | | | |
| Received and used*** | 10 | 9 | 12 |
| Received but didn't need | 12 | 12 | 13 |
| Not received but would like*** | 45 | 40 | 54 |
| Not received and don't need*** | 33 | 40 | 22 |
| How to budget monthly living/college costs | | | |
| Received and used*** | 9 | 7 | 11 |
| Received but didn't need | 11 | 11 | 11 |
| Not received but would like*** | 44 | 37 | 55 |
| Not received and don't need*** | 37 | 45 | 23 |
| Campus resources about whom to talk to about not having enough food | | | |
| Received and used*** | 5 | 3 | 7 |
| Received, but not needed | 12 | 13 | 11 |
| Not received, but would like*** | 29 | 17 | 47 |
| Not received, not needed*** | 55 | 68 | 34 |

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, for $\chi^2$ post hoc tests.

## Discussion

Four in 10 students in this sample from California's public university system experienced food insecurity in the past year, exceeding the 13% prevalence in the general U.S. population but within the range reported in other studies of college students (14%–59%).[6–14] We found that food insecure students reported sacrificing food for educational expenses and that hunger got in the way of their studies. Moreover, food insecure students reported a lower grade point average and were more likely to have suspended studies due to financial difficulties compared to food secure students, which is consistent with the report by Patton-Lopez et al.[12] These findings suggest that food insecurity negatively impacts academic success, as studies of younger children have shown.[15,16]

More than half of our total sample of food insecure students did not report childhood food insecurity, suggesting a new exposure to food insecurity at college, where students are unable to leverage support and manage limited resources. Childhood food insecurity was also more pronounced among undergraduates than graduate students. Furthermore, we found that students, particularly food insecure students, wanted information on how to

**Table 5.** Odds ratios of student risk factors on food insecurity among University of California students surveyed in Spring 2015 ($n$ = 8554).[a]

| Student factors | OR | 95% CI |
|---|---|---|
| Age group (in years) | | |
| 17–24 | 1.6 | 1.1, 2.3 |
| 25–34 | 1.6 | 1.1, 2.3 |
| 35+ | 1.00 | Reference |
| Race/ethnicity | | |
| Non-Hispanic black | 1.7 | 1.2, 2.5 |
| Hispanic | 1.8 | 1.5, 2.3 |
| Asian | 1.3 | 1.1, 1.6 |
| Mixed race/other | 1.4 | 1.2, 1.7 |
| Non-Hispanic white | 1.0 | Reference |
| Socioeconomic status | | |
| Childhood history of food insecurity | 7.4 | 5.8, 9.4 |
| No childhood history of food insecurity | 1.0 | Reference |
| Received need-based financial aid, grant, scholarship, loan | 1.6 | 1.3, 2.0 |
| Did *not* receive need-based financial aid, grant, scholarship, loan | 1.0 | Reference |
| Academic year | | |
| First-year undergraduate | 2.0 | 1.4, 2.8 |
| Second-year undergraduate | 2.7 | 2.0, 3.5 |
| Third-year undergraduate | 3.0 | 2.5, 3.7 |
| Fourth-year undergraduate | 2.6 | 1.8, 3.7 |
| Fifth-year or more undergraduate | 4.1 | 2.8, 6.2 |
| Graduate or other professional | 1.0 | Reference |
| Living situation | | |
| Campus residence hall | 1.1 | 0.8, 1.7 |
| Other campus housing | 1.3 | 1.0, 1.7 |
| Fraternity/sorority house | 1.4 | 0.8, 2.7 |
| Off-campus housing | 1.4 | 1.0, 1.8 |
| Other/homeless/living with a friend | 2.1 | 1.4, 3.3 |
| Parent or guardian(s)' home | 1.0 | Reference |
| Model statistics | | |
| F | 266.0 | — |
| $R^2$ | 0.3 | — |

[a]Analysis based on complex sample multivariable logistic regression.



cook and live on a budget and guidance on whom to contact on campus about not having enough food. This new struggle with food insecurity during college may occur for several reasons. Typical college students are young adults, many of whom are away from home and managing financial responsibilities for the first time, lacking knowledge and skills for efficiently managing limited resources. Students may purchase inexpensive foods of poor nutritional quality due to limited access to both affordable food markets and/or facilities for storing and preparing foods. These findings are consistent with qualitative research conducted among students at UC Los Angeles reporting the lack of access to kitchen space and that healthful food was expensive or not "filling," whereas "affordable and filling" food was unhealthy and low quality.[25] Additionally, student resources may be stretched by increases in college tuition and other college attendance costs due to reduced state contributions to higher education and federal financial aid policies.[26,27] Since the 1980s, state spending per student has steadily

decreased, resulting in rising tuition.[28] To ensure that students have the basic needs to succeed in higher education, it is critical not to understate institutionally estimated living costs and financial aid estimations and to encourage states to make a greater investment in higher education.[27]

The socioeconomic status of California students may also partly explain the high sample prevalence of food insecurity observed relative to other studies of college students. Most first-year UC students (82%) are from California,[29] a state with high unemployment and food insecurity rates.[30] In 2014, nearly half of California households with children were low-income (<$48 016 for a family of 4 with 2 children).[31] In 2013, about 40% of UC students received Pell grants (need-based federal grants), 44% were first-generation college students, and 42% came from low-income families (UC definition is family income <$50 000/year).[29] Thus, the high sample prevalence of student food insecurity could be attributed to the UC's concerted outreach to disadvantaged students. Though we did not capture student or parent income, need-based financial assistance and childhood food insecurity were significantly related to students' food insecurity. Consistent with other reports,[9,10] receiving financial assistance was a risk factor for food insecurity.

The largest risk factor for student food insecurity was childhood history of food insecurity. Screening incoming students for childhood food insecurity may be an extremely effective way to ensure that vulnerable students have access to student support resources and services. For example, connecting students to a campus contact who can help facilitate how to enroll in the Supplemental Nutrition Assistance Program, the federally funded food assistance program, could be beneficial in helping them be successful students.

In this study, age was a factor for food insecurity, suggesting that younger students would benefit from nutrition education on low-cost but nutritious foods, including food preparation.[25] Hispanic and black students were at increased risk for food insecurity compared to white students. This finding is consistent with other studies of college students,[10,13,14] suggesting ethnoracial disparities in student food insecurity. However, our finding of the increased risk of food insecurity among undergraduate students compared with graduate/professional students stands in contravention to the report of Morris et al., who did not find an association between academic year and food insecurity in a sample that was limited to undergraduates.[13] This discordance may be for several reasons. First-year students may arrive with financial aid packages and financial savings that are quickly depleted. Living on campus, which is common among first-year students but less common among returning students, may reduce risk of food insecurity because first-year students are required to purchase a meal plan. Yet, access to a meal plan does not guarantee food security.[25] Some UC meal plans, for example, offer as few as 10 of 21 meals per week, which alone would be insufficient to meet dietary needs and thus may partially explain why 25% of students

experiencing food insecurity lived in a campus residence hall and had a meal plan. This issue was also noted among UC Los Angeles students who reported that tiered meal plans were chosen based on financial means and not nutritional needs; thus, some students chose the most limited meal plan.[25] Furthermore, the increased odds of food insecurity among third-year students compared with the odds of graduate students could be explained by incoming transfer students learning to live on their own for the first time. Among fifth-year students, the high risk could have been due to loss of eligibility for the state-funded financial aid Cal grant, which has a 4-year limit. Among fifth-year students, however, about two thirds received financial aid and had enrolled as freshmen and 38% were food insecure as children. These proportions were higher compared to first- through fourth-year undergraduates (data not shown).

We also found that compared to living at home/with parents, living off-campus was a risk factor for food insecurity, whereas living on-campus (i.e., apartments, residence halls) was not. This is consistent with studies reporting that not living with parents[7,13] increases risk for food insecurity compared to students living with parents. Perhaps living off-campus can be unpredictable with unanticipated expenses, such as utilities or roommate moving out, compared to living at home or on campus where such costs are either covered by parents or part of the housing package, which may result in better access to food. Unsurprisingly, students experiencing housing insecurity—living with a friend, homeless, or other—were at higher risk for food insecurity compared to those living at home. According to Free Application for Federal Student Aid 2012–2013 data, there were 58 000 homeless college students nationwide. Also unsurprising, a California State University study reported that students who experienced food and/or housing instability reported high levels of stress and the need for campus points of contact to access services.[32] These issues related to student basic needs are reflective of the struggle to afford higher education.



## Limitations

To our knowledge, this is the first study to assess food insecurity in a large state university system, making it the largest study of food insecurity on college campuses and one of few studies that used random sampling. The response rate, however, was relatively low; the extent to which this response rate biased the findings is unknown. A recent study of surveys conducted in higher education found no significant bias with response rates as low as 5% and up to 25% as long as sample sizes were over 1000 participants.[33] We tested the possibility that campus response rates could be related to food insecurity, with and without controlling for race/ethnicity and academic year in this sample. We did not find an association

(data not shown), suggesting that variation in response rates across campuses did not bias the estimated food insecurity prevalence. It is possible, however, that students who participated in the NCHA survey were less inclined to complete the survey given that it took 3 times longer to complete. It is also possible that nonresponders were systematically different from responders in food insecurity. Students experiencing food insecurity may have been more likely to complete a survey about food access or health. Underestimation of food insecurity is also possible if lower-income and food insecure students had limited access to the survey (e.g., less time, computer/smartphone). The time frame for assessing food insecurity was the "last 12 months," which makes it possible that first-year students experienced food insecurity prior to coming to college, rather than during college. We also were not able to distinguish seasonal variation in food insecurity such as over academic breaks versus when school was in session. Finally, this was a cross-sectional study and cannot infer causality.

## Conclusions

This study found a high sample prevalence of food insecurity in a statewide public university system and that having a university meal plan did not guarantee food security. Food insecurity risk factors included childhood history of food insecurity, being an undergraduate, receiving financial aid, minority background, being a young adult, living off-campus, and housing instability. Future research should focus on testing the effectiveness of programs that aim to provide nutrition education and skills on how to eat and prepare healthy food on a budget. These findings point to possible ways to support and inform future programs, funding, and policy to prevent and reduce food insecurity among at-risk college students.

### *Human participant protection*

The study was approved by the Institutional Research Board at the University of California, Davis.

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