

TITLE Food insecurity on a college campus: prevalence, determinants, and solutions

AUTHORS Emilie Adamovic¹, Veronica House², Peter Newton^{1,*}

¹ Environmental Studies Program, University of Colorado Boulder, Sustainability, Energy and Environment Community, 4001 Discovery Drive, Boulder, CO 80303.

² Program for Writing and Rhetoric, University of Colorado Boulder, 1060 18th Street, ENVD 1B60, Boulder, CO 80309

* **Corresponding author** Peter Newton, Environmental Studies Program, University of Colorado Boulder, Sustainability, Energy and Environment Community, 4001 Discovery Drive, Boulder, CO 80303; tel: 303 492 1611; fax: 303 492 5207

1 **ABSTRACT**

2 **Objective:** Students are at risk of food insecurity. We aimed to determine: the prevalence of food
3 insecurity among students; the variables associated with student food insecurity; and appropriate
4 solutions. **Participants:** We collected data from 339 students at a large state university in the
5 western United States between December 2016 and February 2017. **Methods:** We used an
6 anonymous online survey that incorporated the USDA U.S. Six-Item Short Food Security
7 Survey. **Results:** First, 54% of respondents had been food insecure within the last year. Second,
8 students in receipt of financial aid were significantly more likely to be food insecure. Third,
9 respondents proposed solutions to student food insecurity that included on-campus food
10 assistance programs, education initiatives, and off-campus food assistance programs.
11 **Conclusions:** Our paper contributes to a growing body of knowledge about the extent and causes
12 of, and solutions to, food insecurity among college students.

13

14 **KEYWORDS**

15 administration; community health; food security; mental health

16

17 INTRODUCTION

18 Food insecurity, which occurs for a plethora of reasons, is not just a problem of being
19 hungry; it also encapsulates a much broader spectrum of wellbeing. The Food and Agricultural
20 Organization of the UN (FAO) recognizes four components of food security: availability, access,
21 utilization, and stability ¹. Availability refers to the physical amount of food that is available to a
22 person, whether it is bought or grown; access refers to economic factors that determine whether a
23 person is able to buy food or not; and utilization refers to the ability of a person to utilize their
24 food through cooking practices that ensure they are eating enough calories, nutrients, and
25 micronutrients. Finally, stability refers to the consistency of availability, access, and utilization
26 over time. When one or more of these conditions are not met, then an individual is considered to
27 be food insecure ¹. Food insecurity can also be described as chronic or transitory. Chronic food
28 insecurity is when access to food is unavailable over an undefined period of time and usually
29 occurs in communities where there is inadequate access to productive or financial resources and
30 where poverty is deep-rooted within a community. Transitory food insecurity is when proper
31 access to food is intermittent and occurs when there is a sudden inability to produce or access
32 enough food ¹.

33 Food insecurity of any kind can be extremely detrimental to the parties involved. Health
34 consequences of food insecurity can include poor cognitive, social, and emotional development
35 among young children; depressive symptoms and suicidal ideation among adolescents; increased
36 risk of diet-related chronic diseases and associated effects among adults ²; and malnutrition
37 among all age groups ³. Malnutrition alone can have psychosocial effects of many kinds that are
38 often depictive of mental illness ⁴.

39 Food insecurity among students is prevalent across campuses in the US, as demonstrated
40 by multiple studies (Appendix 1). Thirty nine percent of college students from City University of
41 New York campuses across New York state were reported to have experienced food insecurity ⁷.
42 Similarly, 48% of students at the University of Ohio reported either having insufficient money to
43 buy enough food, having had to stretch their food budgets by eating cheaper and less nutritious
44 food, or having had to cut back on the amount of food they would normally eat ¹⁵. At the
45 University of Hawaii at Manoa, 21% of students were food insecure, while a further 24% of
46 students were reported to be at risk of food insecurity ⁶. A survey of four thousand students from
47 10 community colleges across the nation found 52% of those students to have experienced food
48 insecurity over the 30 days prior to taking the survey ⁸. Of that 52%: 13% were marginally food
49 insecure (defined as having problems at times, or anxiety about, accessing adequate food, but for
50 whom the quality, variety, and quantity of food intake were not substantially reduced) ¹⁶; 19%
51 were categorized as having low food security; and 20% were categorized as having very low
52 food security ⁸. A study at Western Oregon University found that 59% of students had been food
53 insecure within the past year ¹³, and research at George Washington University campus in
54 Washington D.C. found that 48% of respondents had experienced food insecurity ¹⁷.

55 College students are at risk of being food insecure as a consequence of a number of
56 unique factors ¹⁸. First, it can be challenging for college students to qualify for food assistance
57 programs that help to combat food insecurity among other demographics. Specifically, the
58 Supplemental Nutrition Assistance Program (SNAP; formerly known as food stamps) requires
59 that applicants work 20 hours per week for three or more months within the last 36 weeks prior
60 to application, if they are an able-bodied adult without dependents ¹⁹. This requirement can
61 disqualify most college students, most of whom are unable to work 20 hours or more per week

62 while in school. Second, college students face financial burdens that may restrict food access.
63 Financial assistance in the form of scholarships and grants has not always been able to keep up
64 with rising college costs. According to The Institute for College Access and Success, in 2016 the
65 average debt figures ranged from \$4,600 to \$59,100 among the 936 schools in the United States
66 ²⁰. This figure shows that financial constraints on college students can be severe. Third, some
67 authors have suggested that food insecurity among college students can be related to poor
68 financial budgeting and fiscal monitoring by this demographic ⁷. Budgeting is a skill developed
69 over time, and many students have not had prior experience with budgeting and personal
70 finances before college ²¹.

71 Food insecurity is a multi-dimensional concept that can be challenging to measure ^{22,23}
72 and that can be influenced by a large number of variables ²². However, studies of food insecurity
73 among college students have identified a narrower number of factors that can lead to some
74 students being at greater risk of experiencing food insecurity than others (Appendix 1). These
75 factors include students' race and/or ethnicity ^{7,8,12,14}, gender ^{10,15}, degree level ¹², income ^{7,13},
76 financial (in)dependency ^{9,14}, spending habits ⁵, and housing arrangements ^{6,8,11,15} (Appendix 1).
77 Despite the elevated risk for college students of being food insecure, relative to the national
78 average, and despite the concern that food insecurity can have major impacts on students' lives,
79 food security research on college campuses is relatively scarce. Indeed, there have been calls for
80 an improved understanding of the prevalence and causes of food insecurity from college
81 campuses across the United States ^{6,18}. In particular, there is a need for additional work to
82 determine a) the factors that might make students particularly vulnerable to food insecurity, and
83 b) the solutions to campus food insecurity that might be most attractive to, and appropriate for,
84 food insecure students. Therefore this study addresses three related questions: 1) What is the

85 prevalence of food insecurity among college students?; 2) What are the determinants of food
86 insecurity among college students?; and 3) What are the solutions to food insecurity that are
87 perceived as being most appropriate or useful to food insecure college students? We address
88 these questions using the case study of a large state university in the western United States.

89 **METHODS**

90 We addressed our research question using a descriptive study that utilized a cross-
91 sectional design. We used an online survey to collect quantitative and qualitative data on the
92 prevalence and causes of food insecurity among college students.

93 **Data Collection**

94 We collected data from 339 undergraduate and graduate students using an anonymous
95 online survey (Appendix 2). Our survey included questions to identify: the prevalence of food
96 insecurity; student characteristics associated with food insecurity; and the perceptions of students
97 about appropriate on-campus solutions to food insecurity.

98 ***Food insecurity***

99 We used the USDA U.S. Six-Item Short Food Security Survey to define and evaluate the
100 prevalence of food insecurity. This survey has been widely used to assess the food security of
101 different populations ²⁴. The USDA website provides a descriptive step-by-step guide on how to
102 perform a survey using their six questions and how to assess the results ²⁵. The survey asks six
103 questions about the respondent's experience of food security within the past 12 months.
104 Questions are all of the nature, "'[I] couldn't afford to eat balanced meals.' In the past 12
105 months was this often, sometimes, or never true for you?'. The responses to the survey questions
106 code to an affirmative answer ("often true", "sometimes true", "almost every month", "some
107 months but not every month", or "yes", depending on the question) or a non-affirmative answer

108 (“never true”, “no”, or “only one or two months”). Respondents with no affirmative answers to
109 any of the six questions are considered highly food secure; those with one affirmative answer are
110 considered marginally food secure; those with 2-4 affirmative answers are considered to have
111 low food security; and those with 5-6 affirmative answers are considered to have very low food
112 security. The USDA considers respondents in the categories of low food security and very low
113 food security to be food insecure (Table 1).

114 ***Student characteristics***

115 Our survey also included questions that would help us determine whether there were
116 particular student characteristics that were associated with food insecurity, or whether certain
117 groups of students were at greater risk of food insecurity. Our choice of which variables to
118 collect data on was guided by our review of findings of previous studies that have explored food
119 insecurity among college students (Appendix 1). As such, we collected data for each respondent
120 on their gender, race, dependents, housing, academic level, grade point average (GPA), financial
121 aid, and employment status (Appendix 2). Our decision to be guided by the findings of previous
122 research meant that we could explore those factors most likely to be associated with food
123 insecurity while maintaining a short survey that would not overwhelm respondents. However,
124 this approach did leave open the possibility that additional unmeasured factors could also be
125 associated with food insecurity.

126 ***Proposed solutions to food insecurity***

127 We also asked respondents for their suggestions for, and perceptions of, actions that
128 could help to address food insecurity among students. The optional question enabled students to
129 indicate what they feel would be most beneficial for students at the focal university, if the
130 university were to provide assistance of any sort.

131 ***Survey design and dissemination***

132 We used Qualtrics software to administer the survey and collate the results. The survey
133 was open for two months, between December 5, 2016 and February 5, 2017. A link to the online
134 survey was disseminated using two mechanisms. First, the survey link was included in a bulletin
135 email to the entire student population of the focal university, which is approximately 32,000
136 students. Second, the survey link was distributed through the mailing lists of several campus
137 organizations and class lists. Therefore, all students on campus were exposed to the opportunity
138 to complete the survey, and some students were exposed to the opportunity to complete the
139 survey more than once. However, there was no intentional or expected bias in the strength of this
140 exposure relative to the outcome of interest (i.e. food security).

141 The survey took approximately three minutes to complete. The survey was designed such
142 that all respondents, whether food insecure or not, could respond to the questions. No students
143 were pressured to take the survey, so data was only obtained from students who voluntarily
144 chose to complete it. The first question of the survey was a consent agreement, to fully inform
145 respondents about the purpose and scope of the survey. Respondents had the option to skip any
146 questions that they did not feel comfortable answering. Participants were offered the opportunity
147 to enter a random draw for a gift card, as incentive to complete the survey. To enter the draw,
148 they had to elect to enter their email address, but it was explicitly clear that these email addresses
149 were never associated with the data and were discarded after the gift card winners were selected.

150 **Data Analysis**

151 We analyzed the data using the R statistical software²⁶. We assigned respondents into
152 USDA categories of high food security (zero affirmative responses), marginal food security (one
153 affirmative response), low food security (two, three or four affirmative responses), and very low

154 food security (five or six affirmative responses) (Table 1). From there, we grouped respondents
155 into USDA categories of food secure (i.e. high and marginal food security) or food insecure (i.e.
156 low or very low food security) (Table 1). We then conducted three separate analyses.
157 We conducted a multivariate logistic regression analysis to determine which student
158 characteristic variables were most associated with food insecurity. This analysis enabled us to
159 identify the relative strength of association between food security and different student
160 characteristics. We used a significance level $P < 0.001$. We used this more conservative
161 significance level to avoid multiple testing bias.

162 Finally, we analyzed the qualitative data from question 20 of the survey (“What other
163 food assistance programs would you find useful for the focal university to offer to students?”) to
164 determine the types of solutions to food insecurity most favored by students. We coded these
165 responses into three categories: on-campus food assistance programs, education initiatives, and
166 off-campus food assistance programs. We quantified the frequency of responses that fell into
167 each of these three categories. Finally, we extracted representative quotes from the data to
168 illustrate the types of solutions that respondents proposed.

169 **RESULTS**

170 Three hundred and thirty-nine students responded to the survey. This represented
171 approximately 1% of the focal university student population of 32,000 students, all of whom had
172 access to the survey. Four surveys were incomplete. Seventy seven percent of respondents were
173 female. Eighty six percent of respondents were undergraduate students as opposed to the
174 fourteen percent of graduate student respondents. Additionally, thirty percent of respondents
175 were living on campus at the time of the study vs seventy percent who were living off campus.
176 Here, we report the key findings that emerged from our analysis of the survey data.

177 **Prevalence of food insecurity**

178 One hundred and eighty-four respondents, or 54% of students that completed the survey,
179 were food insecure. Categorized according to the USDA Six-Item Short Form Food Security
180 Survey, 89 of these food-insecure students (26% of all respondents) had low food security, while
181 95 of these food-insecure students (28% of all respondents) had very low food security (Table 1).
182 Of the 184 students that were food insecure (i.e. those that responded in the affirmative to two or
183 more of the six USDA questions), more students (76 individuals) responded in the affirmative to
184 all six questions than to any other count of responses (i.e. two to five affirmative responses)
185 (Table 1).

186 **Determinants of food insecurity**

187 Our multivariate logistic regression model revealed that students that received financial
188 aid that required repayment were statistically significantly more likely to be food insecure than
189 students that did not receive financial aid that required repayment ($P < 0.001$; Table 2). Of all of
190 the demographic, financial, and education variables included in our model, this was the only
191 statistically significant predictor of food insecurity in the multivariate logistic regression (Table
192 2).

193 **Solutions to food insecurity on a college campus**

194 Seventy respondents suggested policy and programmatic solutions that they perceived
195 could be useful ways to address food insecurity on the focal university campus. These
196 suggestions fell into three broad themes. First, a majority of respondents (47/70; 67%) suggested
197 solutions related to *on-campus food assistance programs*. These suggestions related principally
198 to discounted or free meal plans. For example, one respondent suggested: “Free lunches for those
199 who cannot afford to buy food when on campus”. Another suggested: “A limited amount of meal

200 swipes per semester to use for on-campus dining”. And a third respondent suggested: “With all
201 the food they [the campus dining services] throw away, they could use to give to students who
202 really need it.”

203 Other respondents (14/70; 20%) suggested solutions that fell into a second theme: that of
204 *education initiatives*. These suggestions related to assisting students in learning how to cook
205 cheaply, learning how to budget, and understanding whether and how they might access food
206 assistance programs. For example, one respondent suggested: “Outreach programs for students
207 with these problems. Many are unwilling to reach out for themselves so having a system that will
208 give students who are known to be financially at risk will receive the necessary help and
209 resources.” Another suggested: “Knowledge about food stamp programs.” And a third
210 respondent suggested: “Cooking on a budget classes.”

211 A third but smaller set of respondents (9/70; 13%) suggested solutions that fell into a
212 third theme: that of *off-campus food assistance programs*. These suggestions related to coupons
213 or financial aid with groceries. For example, one respondent suggested: “Discounts for CU
214 students at grocery stores.” And another suggested: “Coupons for healthy food options in nearby
215 grocery stores.”

216 **COMMENT**

217 We found a high prevalence of food insecurity among student respondents at the focal
218 university, including a high prevalence of students classified as having very low food security.
219 We found that students in receipt of financial aid that had to be repaid were more likely to be
220 food insecure. And we found that student respondents proposed a diversity of possible solutions,
221 focused primarily on on-campus food assistance initiatives. Here, we discuss the implications of
222 these findings, and situate them within the broader literature.

223 **Prevalence**

224 Food insecurity was highly prevalent among the focal university students that responded
225 to our survey. Fifty-four percent of respondents were categorized as being food insecure, with
226 28% categorized as the lowest level of food security. This statistic is comparable to findings
227 reported at other universities across the US: 39% across City University of New York campuses
228 ⁷; 48% at the University of Ohio ¹⁵; 21% at the University of Hawaii at Manoa ⁶; 52% across 10
229 US community colleges ⁸; 59% at Western Oregon University ¹³; 48% at George Washington
230 University campus in Washington D.C. ¹⁷, and 36% at a mid-sized private university in the
231 midwestern U.S. ⁵ While we cannot know to what degree food-insecure students self-selected
232 into completing our survey, and therefore to what degree our respondent sample was
233 representative of the larger focal university student population, prevalence among the focal
234 university student respondents was extremely similar to most previous studies of food insecurity
235 on college campuses.

236 Food insecurity among students at the focal university and elsewhere may be detrimental
237 to student wellbeing in multiple ways. Food-insecure high-school students in Iran consumed
238 healthy foods less frequently than food-secure students ²⁷. Grade 5 students living in food-
239 insecure households in Canada had poorer diets, higher BMI, and poorer psychosocial outcomes
240 than food secure students ²⁸. And college students with very low food security may be more
241 likely to show signs of clinical depression and severe anxiety ⁸. Poor health outcomes that result
242 from food insecurity can perpetuate unless the student becomes food secure ⁸.

243 **Students in receipt of financial aid were more likely to experience food insecurity**

244 The most significant indicator of food insecurity in our study was whether students
245 received financial aid that required repayment. Students that fell into this category were much

246 more likely to be food insecure than those not on financial aid. At the focal university,
247 “approximately 15,000 undergraduate students received over \$255M in federal, state, and
248 university aid in 2014-15. Of that total, almost \$100M was in the form of grants, scholarships
249 and work-study.”²⁹. While some forms of financial aid, including grants, scholarships and work-
250 study, do not require repayment, the majority of financial aid received by students at the focal
251 university does require repayment. At a national level, a National Student Financial Wellness
252 Study, which surveyed 18,795 undergraduate students at 52 colleges and universities across the
253 country, found that 64% of students used loans to help pay for college³⁰.

254 Understanding the size of the population, both at the focal university and nationally, that
255 receives financial aid therefore gives us a better insight to the possible number of students at
256 higher risk of food insecurity. Decision-makers on the focal university campus, and on other
257 campuses where financial aid is a good indicator of student vulnerability to food insecurity,
258 might consider targeting policy or programmatic responses towards this group of students.
259 Students in receipt of financial aid that must be repaid are likely to be less financially secure than
260 other students. Students that take out loans that require repayment likely do so because they do
261 not have access to other financial capital to fund their education. Students who are dependents
262 within a family that has an income in the lowest income quartile are expected to pay roughly
263 40% of the family yearly income for one year of community college. Students in the lowest
264 income quartile who are independents are expected to pay well over 100% of their yearly income
265 to afford a year of community college⁴. Four-year universities are more expensive than
266 community colleges, and so the financial burdens of attending universities for low-income
267 families and low-income independent students can be even higher. Students from low-income
268 families who do not have financial support from their family often experience financial hardships

269 in college³¹. Financial difficulties can be extremely stressful and cause students to perform less
270 well or to drop out of college^{4,7,30}. Roughly 60% of students in a national survey said they
271 worried about having enough money to pay for school, while 50% said they were concerned
272 about paying their monthly expenses³⁰. Food is a large part of monthly expenses, so students
273 who struggle to pay day-to-day expenses may prioritize other expenses over food and may be at
274 risk of food insecurity³².

275 **Policies and actions to reduce food insecurity on campus**

276 Food insecurity can be associated with social stigma³³, and so an important objective
277 may be to develop solutions that are accessible and that make students feel empowered.
278 Therefore, it may be important to develop solutions that are acceptable and appropriate to food-
279 insecure students. For this reason, we asked open-ended questions that enabled respondents to
280 state their preferences and ideas for solutions, rather than asking for their opinions on a pre-
281 defined list of solutions.

282 In our survey, student respondents suggested on-campus food assistance programs,
283 education initiatives, and off-campus food assistance programs as their preferred ways to tackle
284 food insecurity among students at the focal university. The most common suggestion was for the
285 university to offer free or reduced cost meal plans (e.g. “free meal swipes”) for students at the
286 on-campus dining halls. Such programs have been implemented elsewhere: for example, Oregon
287 State University enacted a policy to address food insecurity: the university offers dining center
288 meals to low-income, high-need students for less than \$3 per meal³¹.

289 Respondents also suggested on-campus education initiatives. Strategies of this sort have
290 also been tested elsewhere. For example, the City University of New York’s *Healthy CUNY*
291 program included an initiative to address food insecurity through on-campus centers that

292 screened students for eligibility for federal benefits, including food assistance programs.
293 Students who may not otherwise have known about federal benefits were able to receive the
294 assistance they needed and qualified for ⁷. Searching and applying for federal benefits can be
295 time-consuming and difficult, and so this program also alleviated these stresses from students.
296 One way in which many colleges in the US are trying to address food insecurity among students
297 is by establishing food pantries on campus ^{15,18}. For example, George Washington University in
298 Washington D.C. opened an anonymous food pantry that any student could access by providing
299 only minimal personal information. Within one month, 150 students accessed the pantry, and the
300 university reported positive feedback from the students who needed the assistance ¹⁷. However,
301 only two respondents in our survey explicitly suggested a food bank as a useful response. While
302 it is possible that our student respondents did not consider a food pantry or food bank as a
303 possible option, it is also possible that they considered it but that it was not their preferred
304 response. As with other federally funded programs, food banks are often associated with social
305 stigma ^{33,34}. This may cause students to feel that a food bank is not the best option.

306 **Limitations**

307 One limitation to consider is that, although the survey was equally advertised to all
308 students, there was not an equal distribution of students who took the survey. That is, it is
309 possible that the survey could have been more intriguing to students who felt that they were
310 struggling with food security. One of our goals was to get a variety of students on all spectrums
311 of food security to take the survey. However, students who are food insecure could have felt that
312 by taking the survey they were helping themselves or other students in similar situations. In
313 addition, the survey was sent out through mailing lists of certain campus organizations and

314 certain class lists. This was a more direct approach to reaching students; however, this was a
315 more targeted method and not every student received this direct email.

316 **Conclusions**

317 Our study found a high prevalence of food insecurity on the focal university campus.
318 This finding adds to a growing body of evidence that students are vulnerable to food insecurity in
319 unique ways and that food insecurity is common across US campuses. Students in receipt of
320 financial aid that needed to be repaid were particularly vulnerable to food insecurity. Students
321 suggested that on-campus food assistance programs such as free or reduced meal swipes were a
322 preferred way to address food insecurity. We therefore suggest that decision-makers at the focal
323 university and other universities who are concerned with reducing food insecurity among
324 students could consider programs that award reduced meal costs for food-insecure students. Such
325 students could be identified through broad application of a survey such as the USDA U.S. Six-
326 Item Short Food Security Survey. Alternatively, food assistance programs could be targeted at
327 students in receipt of financial aid that requires repayment.

328

329 **REFERENCES**

- 330 1. FAO. *An introduction to the basic concepts of food insecurity*. EC - FAO Food Security
331 *Programme* (2008). doi:10.1007/s11524-010-9491-z
- 332 2. Knowles, M., Rabinowich, J., Gaines-Turner, T. & Chilton, M. Witnesses to hunger:
333 methods for photovoice and participatory action research in public health. *Hum. Organ.*
334 **74**, 255–265 (2015).
- 335 3. Saunders, J. & Smith, T. Malnutrition: causes and consequences. *Clin. Med.* **10**, 624–7
336 (2010).
- 337 4. Goldrick-Rab, S. & Kendall, N. *Redefining college affordability: securing America’s*
338 *future with a free two year college option*. *EduOptimists* (2014).
- 339 5. Cuy Castellanos, D. & Holcomb, J. Food insecurity, financial priority, and nutrition
340 literacy of university students at a mid-size private university. *Journal of American*
341 *College Health* (2018). doi:10.1080/07448481.2018.1515762
- 342 6. Chaparro, M. P., Zaghoul, S. S., Holck, P. & Dobbs, J. Food insecurity prevalence among
343 college students at the University of Hawai’i at Mānoa. *Public Health Nutr.* **12**, 2097
344 (2009).
- 345 7. Freudenberg, N. *et al.* Promoting the health of young adults in urban public universities: a
346 case study from City University of New York. *J. Am. Coll. Heal.* **61**, 422–430 (2013).
- 347 8. Goldrick-Rab, S., Broton, K. & Eisenberg, D. *Hungry to learn: addressing food and*
348 *housing insecurity among undergraduates*. (2015).
- 349 9. Goldrick-Rab, S., Richardson, J. & Hernandez, A. *Hungry and homeless in college:*
350 *results from a national study of basic needs insecurity in Higher Education*. *Wisconsin*
351 *Hope Lab* (2017).

- 352 10. Goldrick-Rab, S., Richardson, J., Schneider, J., Hernandez, A. & Cady, C. *Still hungry*
353 *and homeless in college. Wisconsin HOPE Lab* (2018).
- 354 11. Hughes, R., Serebryanikova, I., Donaldson, K. & Leveritt, M. Student food insecurity: the
355 skeleton in the university closet. *Nutr. Diet.* **68**, 27–32 (2011).
- 356 12. Mirabitor, E., Peterson, K. E., Rathz, C., Matlen, S. & Kasper, N. Predictors of college-
357 student food security and fruit and vegetable intake differ by housing type. *J. Am. Coll.*
358 *Heal.* **64**, 555–564 (2016).
- 359 13. Patton-López, M. M., López-Cevallos, D. F., Cancel-Tirado, D. I. & Vazquez, L.
360 Prevalence and correlates of food insecurity among students attending a midsize rural
361 university in Oregon. *J. Nutr. Educ. Behav.* **46**, 209–14 (2014).
- 362 14. Payne-Sturges, D. C., Tjaden, A., Caldeira, K. M., Vincent, K. B. & Arria, A. M. Student
363 Hunger on Campus: Food Insecurity Among College Students and Implications for
364 Academic Institutions. *Am. J. Heal. Promot.* **32**, 349–354 (2018).
- 365 15. Twill, S. E., Bergdahl, J. & Fensler, R. Partnering to Build a Pantry: A University Campus
366 Responds to Student Food Insecurity. *J. Poverty* **20**, 340–358 (2016).
- 367 16. USDA. USDA ERS - Measurement. (2017). Available at:
368 [https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-](https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/measurement/)
369 [us/measurement/](https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/measurement/). (Accessed: 10th May 2018)
- 370 17. NPR. George Washington University opens food pantry for students. *NPR*, (2016).
371 Available at: [https://www.npr.org/2016/10/06/496911617/george-washington-university-](https://www.npr.org/2016/10/06/496911617/george-washington-university-opens-food-pantry-for-students)
372 [opens-food-pantry-for-students](https://www.npr.org/2016/10/06/496911617/george-washington-university-opens-food-pantry-for-students).
- 373 18. Cady, C. L. Food insecurity as a student issue. *J. Coll. Character* **15**, (2014).
- 374 19. USDA. Am I eligible for SNAP? | Food and Nutrition Service. (2018). Available at:

375 <https://www.fns.usda.gov/snap/eligibility>. (Accessed: 11th May 2018)

376 20. Cheng, D., Cochrane, D. & Gonzalez, V. *Student debt and the class of 2016*. (2017).

377 21. Morrissey, J. Financial socialization and its effects on food insecurity among college
378 students. (University of Nebraska-Lincoln, 2019).

379 22. Barrett, C. B. Measuring food insecurity. *Science* **327**, 825–8 (2010).

380 23. Jones, A. D., Ngure, F. M., Pelto, G. & Young, S. L. What Are We Assessing When We
381 Measure Food Security? A Compendium and Review of Current Metrics. *Adv. Nutr.* **4**,
382 481–505 (2013).

383 24. USDA. USDA ERS - Key Statistics & Graphics. (2017). Available at:
384 [https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-](https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx)
385 [statistics-graphics.aspx](https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx). (Accessed: 11th May 2018)

386 25. Blumberg, J., Bialostosky, K., Hamilton, W. L. & Briefel, R. R. U.S. Household Food
387 Security Survey Module: Six-Item Short Form Economic Research Service, USDA. *Am.*
388 *J. Public Health* **89**, 1231–34 (2012).

389 26. R Core Team. R: A language and environment for statistical computing. (2013).

390 27. Mohammadzadeh, A., Dorosty, A. & Eshraghian, M. Household food security status and
391 associated factors among high-school students in Esfahan, Iran. *Public Health Nutr.* **13**,
392 1609–1613 (2010).

393 28. Kirk, S. F. *et al.* Food security status among grade 5 students in Nova Scotia, Canada and
394 its association with health outcomes. *Public Health Nutr.* **18**, 2943–2951 (2015).

395 29. Office of Financial Aid. Financial aid. *University of Colorado Boulder* Available at:
396 <https://www.colorado.edu/financialaid/>.

397 30. Grabmeier, J. 70 percent of college students stressed about finances. *Ohio State News*

- 398 (2015). Available at: <https://news.osu.edu/news/2015/07/01/financial-wellness/>.
- 399 31. Cady, C. Starving for knowledge: why campuses need to address student food insecurity.
400 *About Campus* **21**, 27–31 (2016).
- 401 32. Broton, K. & Goldrick-Rab, S. The dark side of college (un)affordability: food and
402 housing insecurity in higher education. *Chang. Mag. High. Learn.* **48**, 16–25 (2016).
- 403 33. Bacon, C. M. & Baker, G. A. The rise of food banks and the challenge of matching food
404 assistance with potential need: towards a spatially specific, rapid assessment approach.
405 *Agric. Human Values* **34**, 899–919 (2017).
- 406 34. Tarasuk, V. S. & Beaton, G. H. Household food insecurity and hunger among families
407 using food banks. *Can. J. Public Heal.* **90**, 109–113 (1999).

Table 1. Number of student respondents categorized in each level of food security, as defined by the USDA.

Number of USDA U.S. Six-Item Short Food Security Survey questions answered in the affirmative	Level of food security	Food secure or food insecure	Number of respondents
0	High food security	Food secure	106
1	Marginal food security	Food secure	49
2	Low food security	Food insecure	39
3	Low food security	Food insecure	32
4	Low food security	Food insecure	18
5	Very low food security	Food insecure	19
6	Very low food security	Food insecure	76
Total			339

Table 2. Multivariate logistic regression model that used a suite of demographic and financial characteristics to predict the likelihood of students experiencing food insecurity.

Demographic and financial characteristics	Estimate	Standard Error	t value	P value
Intercept	6.887	2.93	2.351	0.0194
Gender				
Male	-0.55	0.299	-1.84	0.067
Other	0.461	0.962	0.479	0.632
Race				
Asian	-2.232	1.65	-1.353	0.177
Black or African American	-1.593	1.729	-0.921	0.358
Hispanic or Latino	-2.2	1.645	-1.336	0.183
Native Hawaiian or Pacific Islander	-1.317	2.213	-0.595	0.552
Other	-1.7	1.74	-0.977	0.329
Prefer not to respond	-2.763	1.802	-1.533	0.126
White	-2.778	1.624	-1.711	0.088
Have Children				
Yes	-0.418	1.39	-0.302	0.762
Living Arrangement				
Off-campus alone	-0.214	2.239	-0.096	0.924
Off-campus with parents	-1.357	2.215	-0.613	0.541
Off-campus with roommates	0.216	2.175	0.099	0.921
Off-campus with spouse and/or children	-0.521	2.386	-0.218	0.827
On-campus	-0.845	2.196	-0.385	0.701
Other	0.69	2.361	0.292	0.77
Year in School				
2nd year	0.142	0.479	0.296	0.767
3rd year	-0.145	0.548	-0.265	0.791
4th year	-0.768	0.562	-1.366	0.173
5th year	-0.023	0.812	-0.028	0.978
Graduate student	-0.043	0.604	-0.071	0.944
GPA				

2.00-2.75	-0.306	0.888	-0.344	0.731
2.76-3.49	-0.802	0.811	-0.989	0.324
3.5-4.00	-1.43	0.815	-1.754	0.081
Receives Financial Aid That DOES NOT Require Repayment				
Yes	-0.071	0.251	-0.285	0.776
Receives Financial Aid That DOES Require Repayment				
Yes	1.083	0.255	4.244	<.001
Current Job				
No job	-1.155	0.789	-1.464	0.144
Part-time over 20 hours a week	0.496	0.821	0.604	0.546
Part-time under 20 hours a week	-1.15	0.765	-1.503	0.134
Part-time work-study	-0.12	0.863	-0.139	0.889

Appendix 1. Summary of published studies that describe the prevalence and drivers of food insecurity among college students

Reference	University	Sample size	Student population surveyed	Prevalence of food insecurity	Measure of food insecurity	Factors associated with a greater likelihood of a student experiencing food insecurity
This study	University of [name retracted for peer review]	339	Undergraduate and graduate students	54%	USDA Household Food Security Survey Module: 6-item short form	Being in receipt of financial aid
5	"a mid-sized private university in the Midwestern USA"	560	Undergraduate and graduate students	35.80%	USDA 6-question food insecurity screener	Prioritizing spending money on alcohol or tuition
6	University of Hawai'i at Mānoa, USA	441	Non-freshman students	21%; an additional 24% at risk of food insecurity	USDA Household Food Security Survey Module	Living on-campus; Living off-campus with room-mates; Identifying as Hawaiians and Pacific Islanders, Filipinos, or mixed
7	City University of New York, USA	1,086	Undergraduate students	39.20%	Custom 4-question survey	Race (Black) and ethnicity (Latino); having an income of <\$20k; being financially self-supported; working >20hrs per week; having health problems
8	10 community colleges in seven states	4,312	Undergraduate students	39% food insecure; plus 13% with marginal food security	USDA Household Food Security Survey Module: 6-item short form	Ethnicity (Hispanic and Latino); being a first generation college student; experiencing housing insecurity
9	70 higher education institutions	33,934	Students	67%	USDA 6-item Adult Food Security Survey Module	Pell-grant eligible students; being financially independent; being an undergraduate student with children; being a US citizen or permanent resident; having been in foster care
10	66 higher education institutions	43,000	Undergraduate students	42% (community colleges); 36% (4-year universities)	USDA 10-item Adult Food Security Survey Module	Pell-grant eligible students; being financially independent; having been in foster care; females and non-binary students; bisexual students; black students
11	"a Queensland-based University", Australia	399	Undergraduate and graduate students	12.7% (by a single measure); 46.5% "food insecure without hunger"; 25.3% "food insecure with hunger"	Custom 39-question survey, derived from USDA Community Food Security Assessment Toolkit	Renting accommodation; having a low income; receiving government assistance
12	"a large, Midwestern, public university"	514	Undergraduate, graduate, and non-degree-seeking students	16.4% very low, 25.1% low, and 12.2% marginal food security	USDA 6-item Short Form of the Food Security Survey Module	Among students in housing without food provision: underrepresented minorities; being without car access; being an undergraduate student
13	"a midsize rural university in western Oregon", USA	354	Undergraduate and graduate students	58.80%	USDA Household Food Security Survey Module: 6-item short form	Having fair/poor health; being employed; having an income <\$15k
14	"a large mid-Atlantic publicly funded university"	237	Undergraduate students	15%; an additional 16% at risk of food insecurity	USDA 18-item Household Food Security Survey Module	African American or other race/ethnicity; receiving multiple forms of financial aid; experiencing housing problems
15	"a university in southwestern Ohio"	~150	Undergraduate students	48%	Custom survey	Food pantry users were more likely to be: women; African American; living in poverty; unemployed; living off campus

Appendix 2. Survey used to collect data from University of [*name retracted for peer review*] students on the prevalence and determinants of food insecurity

Thank you for your participation!

This research will help us improve our understanding of student food security at the University of [*name retracted for peer review*]. It will give us insight to whether food insecurity is an issue for University of [*name retracted for peer review*] students, and how we can take action to improve the quality of life and education for University of [*name retracted for peer review*] students.

It is entirely your choice whether or not to participate in this survey.

If you agree to take part in this survey, you will be asked a series of questions, related to demographics and food security. The survey will likely take 3-5 minutes to answer. The researcher will have access to your responses, however, the responses will not be traceable to your email or any other form of your identity.

If you participate in this study fully, you will have the option of being entered into a prize draw to win one of two \$50 gift certificate.

Risks associated with this study are minimal, but include the chance of emotional discomfort due to the subject content of some of questions.

You have the right to skip questions during the survey if you choose. You can end your participation at any time with no negative consequences.

Your identity will in no way be connected to the information received in the survey, or information used in the research project in its entirety.

If you should have questions or concerns before, during, or after your participation, please contact [*name retracted for peer review*] at [*email address retracted for peer review*] or [*name retracted for peer review*] at [*email address retracted for peer review*].

If you have questions regarding your rights as a participant, any concerns regarding this project or any dissatisfaction with any aspect of this study, you may report them -- confidentially, if you wish -- to the Institutional Review Board, [*address retracted for peer review*].

agree (1)

disagree (2)

Q1 What gender do you identify as?

Male (1)

Female (2)

Other (3) _____

Q2 Ethnicity origin (or Race): Please specify your ethnicity

White (1)

Black or African American (2)

American Indian or Alaska Native (3)

Asian (4)

Native Hawaiian or Pacific Islander (5)

Hispanic or Latino (6)

Other (7) _____

Prefer not to respond (8)

Q3 Do you have children?

yes (1)

no (2)

Q4 What is your current living arrangement?

on-campus (1)

off-campus alone (2)

off-campus with roommates (3)

off-campus with parents (4)

off-campus with spouse and/or children (5)

no current arrangement (6)

other (7) _____

Q5 What academic level are you?

1st year (1)

2nd year (2)

3rd year (3)

4th year (4)

5th year (5)

graduate student (6)

Q6 What is your GPA?

0.00-1.99 (1)

2.00-2.75 (2)

2.76-3.49 (3)

3.5-4.00 (4)

Q7 Do you receive financial support through student loans or any other funding that DOES NOT require repayment?

Yes (1)

No (2)

Q8 If yes, how much in the past 12 months?

(USD) (1) _____

Not applicable (2)

Q9 Do you receive financial support through student loans or any other funding that DOES require repayment?

Yes (1)

No (2)

Q10 If yes, how much in the past 12 months?

(USD) (1) _____

Not applicable (2)

Q11 Besides being a student, do you currently hold a part-time or full-time job?

part-time under 20 hours a week (1)

part-time over 20 hours a week (2)

part-time work-study (3)

full-time (4)

no job (5)

Q12 Based on the statement “The food that (I) bought just didn’t last, and (I) didn’t have money to get more.” In the last 12 months was this

often true (1)

sometimes true (2)

never true (3)

Q13 Based on the statement “(I) couldn’t afford to eat balanced meals.” In the past 12 months was this

often true (1)

sometimes true (2)

never true (3)

Q14 In the last 12 months, did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

yes (1)

no (2)

Q15 If yes to the above question, how often did this happen?

almost every month (1)

some months, but not every month (2)

only 1 or 2 months (3)

not applicable (4)

Q16 In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

yes (1)

no (2)

Q17 In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?

yes (1)

no (2)

Q18 If provided with on-campus food assistance in the form of free groceries, would you use this?

yes (1)

maybe (2)

no (3)

Q19 If provided with on-campus food assistance in the form of free cooked meals, would you use this?

yes (1)

Maybe (2)

No (3)

Q20 What other food assistance programs would you find useful for the University of [*name retracted for peer review*] to offer to students?

Q21 Are you familiar with the SNAP program, formerly known as food stamps?

yes (1)

maybe (2)

no (3)

Q22 If you knew that you were qualified for food assistance through SNAP, would you use this?

yes (1)

Maybe (2)

No (3)

Q32 Would you like to enter your email address in order to be in the drawing to win a \$50 giftcard?

yes (1) _____

no (2)