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The struggle is real: a systematic review of food insecurity on post-secondary campuses

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Abstract

Background—Numerous international studies have examined cross-sectional correlates of food insecurity (FI) among post-secondary students; a study is needed to synthesize the findings of this work to support vulnerable students.

Objective—To systematically review peer-reviewed and gray literature to assess the prevalence of FI on post-secondary institutions, as well as factors related to FI among students and suggested/practiced solutions.

Design—Systematic literature review. MEDLINE, Web of Science, and PsycINFO databases were searched for peer-reviewed literature for FI research; a Google search was conducted to obtain gray literature on FI among post-secondary students.

Participants/Setting—Undergraduate and graduate students at post-secondary institutions of higher education.

Main outcome measures—Measures included 1) prevalence of FI; 2) socio-demographic, health, and academic factors related to FI; 3) solutions to address FI on post-secondary institutions.

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Results—Seventeen peer-reviewed studies and 41 sources of gray literature were identified (out of 11,476 titles). All studies were cross-sectional. Rates of FI were high among students, with average rates across the gray and peer-reviewed literature of 35% and 42%, respectively. FI was consistently associated with financial independence, poor health and adverse academic outcomes. Suggested solutions to address food security among post-secondary institutions addressed all areas of the socio-ecological model, but the solutions most practiced included those in the intrapersonal, interpersonal, and institutional levels.

Conclusions—FI is a major public health problem among post-secondary students. Studies are needed to assess the long-term impact of FI among this vulnerable population. More research is needed on the effectiveness of FI interventions.

Keywords

food insecurity; emerging adults; college campuses

While the traditional concept of the post-secondary student tends to include younger individuals coming from more affluent families, the modern post-secondary student reflects a paradigm shift in student demographics.[1,2] Students of low socio-economic status who may have once dismissed the possibility of degree attainment are now seizing opportunities to pursue post-secondary education.[3,4] Older men and women who may have abandoned college due to past financial hardship, or to raise a family, now have an opportunity to complete degree programs.[5–7] Single parents who may not have previously considered pursuing an education are realizing the advantage of obtaining a degree,[8] and are seeking to enroll in post-secondary institutions. These students, who vary so greatly in age, background, and socio-economic status, are all working towards the same goal: to gain crucial skills and position themselves in a place of greater prosperity and well-being. Yet adequate nutritious food, a basic need for human well-being, may not consistently be available to these students. As such, one emerging area of concern among college students and post-secondary institutions is food insecurity (FI),[9] or the lack of consistent access to safe and healthy foods. Among children and adolescents, FI has been shown to be related to higher stress and anxiety,[10] poorer academic outcomes,[10] and poorer nutritional status and health outcomes.[11,12] Among adults, FI is linked to lower work productivity[13,14] and chronic disease.[15,16] The long-term effects of FI among college students has yet to be explored.

Articles in the popular press about FI on college campuses have become more frequent, having been featured by outlets from the Chronicle of Higher Education[17] to the New York Times.[18,19] An active, national association for food pantries on college campuses, College and University Food Bank Alliance, now has over 375 members.[20] A clearer understanding of the scope of the problem of FI on college campuses is needed, as well as a better understanding of a comprehensive range of strategies that are being utilized to help college students facing FI. Thus, the aim of this study was to systematically review both the peer-reviewed and “gray” literature to obtain a holistic picture of what is known about FI and what is being done about FI on post-secondary institutions. By synthesizing the existing literature base on FI at post-secondary institutions, we can collectively design more effective prevention interventions for this vulnerable population.

Methods

To explore FI among post-secondary students in-depth, we conducted a systematic review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement guidelines. According to the United States Department of Agriculture (USDA), there are four thresholds of food security:[21] food security, marginal food security, low food security, and very low food security. Low food security and very low food security are the terms to describe FI. The notion that college students are increasingly FI has gained growing attention in recent years from governmental entities, educational entities, and faith-based and philanthropic organizations, among others. Considering the rate at which this issue is gaining popular attention, both peer-reviewed literature and gray literature were explored to present a more inclusive, broad picture of the issue at hand. Gray literature included published (non-peer reviewed) reports, student theses, conference presentations, newsletters, and data published on websites. Peer-reviewed literature was identified by searching MEDLINE (PubMed), Web of Science, and PsycINFO electronic databases. All text fields were searched (title, abstract, full-text), and papers published in English between January 2001 and August 2016 were eligible for consideration. To provide a more accurate representation of the subject matter, materials from all geographical regions were accepted. Search terms comprised of *hunger, food insecurity, food security, food hardship, food secure* in combination WITH/AND *tertiary education, university, college, college campus, community college, college students*. Gray literature was identified via Google search using the above search terms with the removal of WITH/AND in the search text. Lab notes, excel sheets, and citation managers were used in conjunction to manage the data selection and extraction records.

Selection Criteria

Two reviewers (KA, MB) independently screened peer-reviewed papers retrieved from electronic databases for eligibility. Studies were only included if they had assessed FI among post-secondary student populations (including vocational, undergraduate, graduate, and professional students). Animal studies, metabolism studies, and papers exploring satiety, eating motivation and behavior, and nutrition status (that did not measure FI and/or study a post-secondary student population) were excluded. Titles, abstracts, and full-text (when necessary) were reviewed to assess eligibility of studies based on these criteria.

To identify gray literature, Google search results were screened for any relationship to FI among college students for the first 250 results, or until two pages (50 possibilities) without any relevant results, before the next set of search terms were input. All search term combinations, page titles, and URLs for eligible results were documented for further assessment. After all search combinations were documented, URLs were then re-assessed to ensure that eligible sources contained new data not previously identified in the peer-reviewed literature search. All gray literature sources were screened, identified and documented between May 23, 2016 and July 20, 2016.

Data Extraction

MB, ML, and DCP reviewed the peer-reviewed literature and extracted the following data: data collection frame, study design and analytical approach, setting, sample demographics, FI measures, outcome measure(s), prevalence of FI and results. We extracted all results and categorized the results into demographic (e.g., race/ethnicity, age), health (e.g., eating behaviors, mental health, weight status), and academic (e.g., grade point average, retention) outcomes. MB and KA reviewed the gray literature for source type (report, student thesis, abstract, website, press article), year data were collected, sample size, prevalence of FI and factors associated with student FI. Themes for suggested solutions and interventions in practice were categorized across both the peer-reviewed literature and gray literature. We calculated unweighted mean prevalences of FI, low and very low food security in the respective types of studies. If more than one measure was used to assess food insecurity, the more comprehensive measure was used to calculate the average.

Results

Overview of included studies

A total of 18,608 records were identified through peer-reviewed electronic databases (n=15,538), Google searches (n=3,060), and other peer-reviewed sources (n=10) (see Figure 1). After removing duplicates, 11,476 titles were screened (n=10,636 peer-reviewed; n=840 gray literature). Of these articles, 11,394 were excluded after title and abstract analysis revealed they did not meet inclusion criteria outlined in the methods. The remaining 82 full-text articles (n=22 peer-reviewed; n=60 gray literature) were then screened. Fourteen peer-reviewed papers were excluded for not assessing prevalence of FI or providing new data, and nine gray literature sources were already included among the peer-reviewed literature resulting in a total of 23 excluded full-text articles. The remaining 18 peer-reviewed papers and 41 gray literature sources were found to meet all inclusion criteria and were included in the analysis. Two peer-reviewed papers used an identical sample,[22,23] so those are considered here as one study. In the gray literature, three gray literature items came from the University of Alaska, Anchorage,[24–26] and two studies came from Michigan Technical University;[27,28] these were combined for two items from each respective institution. Gray literature was further divided to explore current (n=17) and proposed solutions (n=24) addressing student FI. In total, this systematic review examined the findings from 59 peer-reviewed and gray literature papers assessing the prevalence of and factors contributing to FI among higher education students, as well as provides an in-depth exploration of current and proposed interventions and solutions. In general, many similarities were observed among the peer-reviewed and gray literature. Similarly, major differences were not observed between US-based and international studies.

Description of institutions

Of the peer-reviewed studies, nine were based in the US,[29–37] and nine were international (Table 1): three were based in South Africa,[38–40] three were based in Australia,[41–43] two were based in Canada[22,23] (these were counted as one) and one was based in Malaysia[44] (Table 2). Most peer-reviewed studies were conducted at public, 4-year institutions in urban

settings. A little less than a quarter (22%) of peer-reviewed studies were conducted at minority-serving institutions (Table 1)

Among the sources of gray literature, all but four were based in the US: two were based in Canada,[45,46] one was based in New Zealand,[47] and one was based in Mexico[48] (Table 3). The majority of the gray literature was derived from public, 4-year US-based institutions also in urban settings.

Study samples

Across the peer-reviewed and gray literature, the average sample was 442 participants. The smallest study was a qualitative study from the gray literature with 15 participants, and the largest study was also from the gray literature with a sample of 4972, including participants from several post-secondary institutions. With few exceptions, more females tended to participate in FI studies as compared to males (Tables 2 and 3). The age range of studies varied greatly, as one focused on university freshmen, two others excluded freshmen, and three studies included graduate students.

Study measures

All of the peer-reviewed studies utilized a cross-sectional design. In assessing prevalence of FI, the majority of the peer-reviewed studies used the 10-item USDA food security questionnaire for adults (n=9), three studies used the 18-item USDA Food Security Module, [32,41,43] two studies used validated food security screeners,[31,36] and the remaining studies used newly developed FI assessment measures.[30,35,38] The gray literature rarely reported measurement tools.

Study rigor

Most of the peer-reviewed studies used basic descriptive or bivariate analyses. Only half of the studies assessed results using multivariate regressions to adjust for potentially confounding variables.[30,31,33,34,36,40,42,43] In addition, the majority of studies used convenience samples. Two peer-reviewed studies invited a random sample of students enrolled in specific academic courses to participate in the study,[29,33] but the participation among faculty leading these courses was low. In fact, response rates were relatively low across most studies that reported response rates.

Prevalence of FI

The peer-reviewed literature tended to report more detailed results for the prevalence of FI, with an average rate of FI as 42.0% (range: 12.5–84%). For nine peer-reviewed studies from the U.S. only, the average rate of FI was 32.9% (range: 14.1–58.8%). Within the gray literature, the average FI prevalence was 35.6% (range: 12.4–56%). Amongst the peer-reviewed studies that differentiated between low and very low food security, the average prevalence was 18.1% (range: 8.9–26%) and 22.4% (range: 5.1–59%), respectively.

Socio-demographic, health, and academic factors related to FI

When examining factors related to FI, themes were identified across socio-demographic, health, and academic outcomes. Almost all studies examined relationships between FI and

socio-demographics. Students of color, younger students, students with children, and students who were financially independent were more likely to report FI. The most common demographic factors related to FI were: independence among students (including living, financial, and food independence from parents) assessed in six peer-reviewed studies[29,33,34,40–42] and eight gray literature findings;[26,27,45,49–53] receiving loans and governmental support was assessed by four peer-reviewed studies[33,37,38,42] and two gray literature findings,[45,54] respectively. Over half of the peer-reviewed studies (n=9) and 24% (n=10) of the gray literature findings reported health related outcomes.

FI was associated with lower overall self-reported health among four out of four peer-reviewed studies that examined this issue,[23,30,31,41] and poorer eating behaviors (e.g., lower fruit and vegetable consumption) were reported in three out of three peer-reviewed studies that examined this issue.[23,36,43] A total of eight peer-reviewed studies and six gray literature findings examined academic outcomes related to FI.. Among those studies, five studies (three peer-reviewed and two gray literature) reported that lower GPA was associated with FI,[31,34,37,55,56] and eight studies (three peer-reviewed and five gray literature) reported adverse academic outcomes ranging from having difficulty concentrating in class to higher prevalence of withdrawing from class or the institution.

Suggested and practiced solutions to addressing FI at post-secondary institutions

No efficacy or effectiveness studies were identified that addressed FI on post-secondary campuses in either peer-reviewed or gray literature (Table 4). However, in the discussion sections of many published papers included in this review, authors suggested solutions for addressing FI among post-secondary students across each level of the socio-ecological model. The most commonly suggested interventions included individual financial coaching (suggested in six peer-reviewed studies and five gray literature works), implementation of institutional-level interventions including on-campus food pantries (suggested by seven peer-reviewed and two gray literature studies), and policy/systems level changes to increase financial aid/create a basic living stipend for students (suggested by nine peer-reviewed studies and two gray literature works) and allowing students to receive Supplemental Nutrition Assistance Program (SNAP) benefits.

Further, a portion of the gray literature reported on ongoing interventions on campuses, the most common being campus food pantries (n=7) and financial coaching (n=6). The gray literature that described solutions was the only literature that addressed interpersonal interventions. For example, two projects described an app for mobile phones in which students can share excess meal plans points with peers in need.

Discussion

FI is a complex problem and is understudied among post-secondary students. This study sought to systematically review peer-reviewed and gray literature to examine the prevalence of FI on post-secondary institutions, factors related to FI among students, and describe solutions to address FI for students in need. Over 11,000 peer-reviewed manuscripts and sources of gray literature were screened, and ultimately a total of 59 works were included in the review. Just nine of those studies included peer-reviewed papers from the US, which is a

limited amount of research. Across the globe, students attending post-secondary institutions experience high rates of FI. FI appears to be alarmingly high at post-secondary institutions, and the limited evidence available to date suggests that it is experienced by an average of approximately one-third to one-half of students across the institutions assessed. More research is needed to effectively support the students in need.

Compared to FI prevalence data among the general US population, the data from the US-based studies suggest almost a two-fold higher rate of FI among post-secondary students.[57] Higher rates compared to national levels were also observed in Canada, Australia,[58] and New Zealand.[59] The studies conducted in South Africa showed similar or lower rates than their respective countries' national averages.[60] Given the high rates, more interventions are needed to assist students struggling with access to food.

In studies among children and adults, FI has been associated with poorer nutrition and health outcomes,[11,61,62] higher stress and depression,[62,63] and adverse learning,[10] academic outcomes,[10,64] and/or productivity.[62] The results from the reviewed studies indicated that post-secondary students facing FI report similar negative outcomes; findings were generally consistent across the peer-reviewed and gray literature, despite using different metrics. Attention to this public health problem has grown dramatically, particularly given all of the gray literature published in recent years. It appears that the most common approach to addressing on-campus FI is focused on "quick wins" at the intrapersonal level (e.g., educational programming) and interpersonal level (food donation among peers, faculty, and staff), and institutional level (food pantries). Interestingly, no identified studies on FI in post-secondary settings described the role of families as a means of solutions in addressing FI, which may be because families have limited capacity to support struggling students. Moving forward, it would be helpful for investigators to use a consistent set of metrics for outcomes for any FI evaluation study. Multiple metrics for health and academic outcomes may also be needed. For example, in examining academic impacts of FI, ideally objective GPA would be included, but also items such as number of credits, dropping classes, and time to graduation would be assessed.

Overall, there was a lack of variation among the types of colleges and student populations assessed in the peer-reviewed FI studies: most-peer reviewed studies were urban-based, public, 4-year institutions. In order to have a better understanding of the severity of FI among post-secondary students, studies are needed on the prevalence, determinants, and consequences of food insecurity in rural and small-town post-secondary settings, Hispanic-serving institutions, Historically Black Colleges and Universities, community and technical colleges, and for-profit universities. There needs to be more studies that include graduate students, professional students, male students, students from underserved backgrounds, and non-traditional students. Given that most studies used convenience samples and simple descriptive analyses, future research is needed using more rigorous study designs and analyses (i.e., larger, representative samples) focusing on both predictors and consequences of FI. As more studies are published on FI in college students, there may be some hesitation among some university administrators to come to terms with the depth and breadth of FI among students. Qualitative and quantitative research is needed on how students perceive, live, and survive with FI. Ultimately, research on how FI affects student retention, academic

success, and costs to the university is critical to having systemic buy-in to address the problem.

Furthermore, there is a dearth of studies examining longitudinal effects of FI; there are no such studies in post-secondary settings. As such, it is unclear as to why the prevalence of FI on post-secondary campuses is so high. Are these students experiencing FI prior to arriving on campus? Do they struggle in managing their resources once they arrive? Do younger students report higher rates of FI as a result of transitioning to having more responsibilities? How does FI impact student retention in representative samples? Does the current literature under- or over-represent FI as a problem among students due to reliance, to a large extent, on convenience sampling? How does struggling with FI while a student impact one's career? Do problems of FI improve or resolve after graduation? Much more research is needed to better understand the systemic root causes of FI and how prevalence of FI changes throughout the post-secondary years and beyond.

Many of the interventions identified in the gray literature to address FI on campus were led by students themselves. However, because no studies have been published from ongoing interventions, the efficacy of these interventions at reducing rates of FI is unclear. For example, three studies were not included in this review because they did not assess the prevalence of FI or examine the national quality of student food pantries, the cost of food pantries, and the acceptability of food pantries.[65,66] However, to our knowledge, not a single study has examined the effectiveness of food pantries at decreasing FI on post-secondary institutions. While it appears that these interventions are being implemented on a variety of university settings (urban and rural, public and private, 4-year institutions and community colleges), more research is needed if these interventions can realistically be effective across an array of university settings and across the socio-ecological model.

The College and University Food Bank Alliance is tracking and supporting the development of food pantries on campus.[20] Only a few studies have examined the effectiveness of food pantries among other populations.[67,68] Based on this review, there are differences in what has been discussed and suggested in the peer-reviewed literature and to what is practiced in the field. For example, many authors of peer-reviewed studies suggested systems and policies changes for addressing FI (e.g., additional financial support systems such as improved SNAP eligibility for students). Eligibility for college students into the SNAP program can be a challenge; according to USDA, US citizens enrolled at least half time in a post-secondary institution are not eligible for SNAP.[69] SNAP benefits cannot be used for students who receive more than half of their meals from a meal plan, excluding most students living in residence halls (a notable population in which FI has been reported,[36] though the contributing factors for FI in this group are largely unknown). However, if students work at least 20 hours per week, participate in a financed work-study program, have dependents under the age of 6 (or do not have adequate childcare that inhibits their ability to work 20 or more hours), and/or receive benefits under a Title IV-A program, they would be SNAP eligible.[69]

Notably, only one piece of gray literature reported policy-level changes to address FI. In 2015, the state of California passed a bill that is aimed at improving FI among post-

secondary students.[70] In this bill, activities include improving coordination between food banks and college food pantries and increasing access to funds supporting CalFresh (SNAP) outreach to students. In order to address the systemic issue of FI, national systems solutions may be needed and tested. Again, more research is needed to understand how to best support post-secondary students with FI. If FI can be addressed on campuses, the lessons learned can be applied to support other communities facing FI.

Study strengths and limitations

Given the variability in the measures used, we were unable to conduct a meta-analysis through this review. In addition studies used a variety of tools to measure FI; however, most studies used validated tools of FI. Many of the reviewed studies used descriptive study designs and analyses were often limited to bi-variate associations. Unmeasured confounding may explain some of the findings reported by authors. Most studies used a convenience sample of post-secondary students; it is possible that participation in studies may have been more enticing to food insecure risk students, biasing the samples. In conclusion, FI is a major problem among students at post-secondary institutions. More research is needed among representative samples to understand which students are at greatest risk of FI, and to understand how FI changes over time. Studies with rigorously designed interventions are needed so that resources can be targeted to the interventions most effective at improving rates of FI.

References

1. Hurtado S, Carter DF, Spuler A. Latino student transition to college: Assessing difficulties and factors in successful college adjustment. Res High Educ. 1996; 37(2):135–157.
2. Macilwain C. US higher education: The Arizona experiment. Nature. 2007; 446(7139):968–970. [PubMed: 17460637]
3. Rubin M, Denson N, Kilpatrick S, et al. “I Am Working-Class” subjective self-definition as a missing measure of social class and socioeconomic status in higher education research. [published online ahead of print March 19 2014]. Educ Res. 2014; 43(4):196–200.
4. Devlin M. Bridging socio-cultural incongruity: Conceptualising the success of students from low socio-economic status backgrounds in Australian higher education. Stud High Educ. 2013; 38(6): 939–949.
5. Kahu ER, Stephens C, Leach L, Zepke N. The engagement of mature distance students. Int J FYHE. 2013; 32(5):791–804.
6. Wladis C, Hachey AC, Conway KM. The representation of minority, female, and non-traditional STEM majors in the online environment at community colleges a nationally representative study. [published online ahead of print November 24 2014]. Community Coll Rev. 2015; 43(1):89–114.
7. Taylor, L. Can I do both? Be employed and graduate? Adult non-traditional learners who combine employment and higher education enrollment-A look at persistence and best practices to overcoming barriers to improve success and retention; Adult Education Research Conference; 2015.
8. Nelson B, Froehner M, Gault B. College students with children are common and face many challenges in completing higher education. Briefing Paper# C404. Institute for Women's Policy Research. 2013
9. Dubick, J; Mathews, B; Cady, C. [Accessed October 24, 2016] Hunger on campus, the challenge of food insecurity for college students. CUFBA Web site. Published October 2016. Available at: http://www.cufba.org/report-hunger-on-campus/
10. Jyoti DF, Frongillo EA, Jones SJ. Food insecurity affects school children’s academic performance, weight gain, and social skills. J Nutr. 2005; 135(12):2831–2839. [PubMed: 16317128]

11. Chilton M, Chyatte M, Breaux J. The negative effects of poverty & food insecurity on child development. Indian J Med Res. 2007; 126(4):262–272. [PubMed: 18032801]
12. Rose-Jacobs R, Black MM, Casey PH, et al. Household food insecurity: associations with at-risk infant and toddler development. Pediatrics. 2008; 121(1):65–72. [PubMed: 18166558]
13. Borre K, Ertle L, Graff M. Working to eat: vulnerability, food insecurity, and obesity among migrant and seasonal farmworker families. Am J Ind Med. 2010; 53(4):443–462. [PubMed: 20196097]
14. Devine CM, Jastran M, Jabs J, et al. "A lot of sacrifices:" Work-family spillover and the food choice coping strategies of low-wage employed parents. Soc Sci Med. 2006; 63(10):2591–2603. [PubMed: 16889881]
15. Seligman HK, Laraia BA, Kushel MB. Food insecurity is associated with chronic disease among low-income NHANES participants. J Nutr. 2010; 140(2):304–310. [PubMed: 20032485]
16. Laraia BA. Food insecurity and chronic disease. Adv Nutr. 2013; 4(2):203–212. [PubMed: 23493536]
17. Kolowich, S. [Accessed October 24, 2016] How many college students are going hungry? The Chronicle of Higher Education Web site. Published 2015. Available at: http://www.chronicle.com/article/How-Many-College-Students-Are/234033?cid=trend_right
18. Saul, S. [Accessed October 24, 2016] Food pantries address a growing hunger problem at colleges. The New York Times Web site. Published 2016. Available at: http://www.nytimes.com/2016/06/23/education/food-pantries-address-a-growing-hunger-problem-at-colleges.html?_r=1
19. Pappano, L. [Accessed October 24, 2016] Leftover meal plan swipes: No waste here. The New York Times Web site. Published 2016. Available at: http://www.nytimes.com/2016/08/07/education/edlife/what-to-do-with-those-leftover-meal-plan-swipes.html
20. [Accessed 24 October, 2016] College and University Food Bank Alliance Web site. Available at: http://www.cufba.org/
21. Definitions of food security. [Accessed October 24, 2016] USDA Economic Research Service Web site. Updated October 4 2016. Available at: https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security.aspx
22. Farahbakhsh J, Ball GD, Farmer AP, et al. How do student clients of a university-based food bank cope with food insecurity? Can J Diet Pract Res. 2015; 76(4):200–203. [PubMed: 26280467]
23. Farahbakhsh J, Hanbazaza M, Ball GD, et al. Food insecure student clients of a university-based food bank have compromised health, dietary intake and academic quality. Nutr Diet. 2016; doi: 10.1111/1747-0080.12307
24. Lindsley, K; King, C. [Accessed July 10, 2016] Food insecurity of campus-residing Alaskan college students. [poster]. Published 2013. Available at: https://www.researchgate.net/publication/277300658_Food_Insecurity_of_Campus-Residing_Alaskan_College_Students_Poster_Session
25. Nelson, M. [Accessed July 17, 2016] Food insecurity among Anchorage Alaskan campus-residing college students. Academia Web site. Published 2015. Available at: https://www.academia.edu/22325211/Food_Insecurity_Among_Anchorage_Alaskan_Campus-Residing_College_Students
26. Wintz, R; Chriest, N. [Accessed June 4, 2016] Food insecurity within the University student population A survey at the University of Alaska Anchorage. Available at: https://www.uaa.alaska.edu/academics/honors-college/ours/opportunities/research/_documents/wintz-rachel-and-chriest-nathaniel-ugr.pdf
27. [Accessed May 27, 2016] Spring 2015 Food Insecurities Survey Results. Published 2015. Available at: http://www.mtu.edu/huskyfan/learn/survey-spring-2015.pdf
28. [Accessed June 13, 2016] Food insecurity: Results and progress. Michigan Tech. Available at: http://megaslides.com/doc/7847141/
29. Chaparro MP, Zaghloul SS, Holck P, Dobbs J. Food insecurity prevalence among college students at the University of Hawai'i at Mānoa. Public Health Nutr. 2009; 12(11):2097–2103. [PubMed: 19650961]
30. Lin MT, Peters RJ Jr, Ford K, et al. The relationship between perceived psychological distress, behavioral indicators and African-American female college student food insecurity. Am J Health Stud. 2013; 28(3):127–133.

31. Patton-López MM, López-Cevallos DF, Cancel-Tirado DI, Vazquez L. Prevalence and correlates of food insecurity among students attending a midsize rural university in Oregon. J Nutr Educ Behav. 2014; 46(3):209–214. [PubMed: 24406268]
32. Hanna L. Evaluation of food insecurity among college students. Am Int J Contemp Res. 2014; 4(4):46–49.
33. Gaines A, Robb CA, Knol LL, Sickler S. Examining the role of financial factors, resources and skills in predicting food security status among college students. Int J Consum Stud. 2014; 38(4): 374–384.
34. Maroto ME, Snelling A, Linck H. Food insecurity among community college students: Prevalence and association with grade point average. Community Coll J. 2015; 39(6):515–526.
35. Silva, MR; Kleinert, WL; Sheppard, AV; , et al. The relationship between food security, housing stability, and school performance among college students in an urban University [abstract]. [published online ahead of print December 14 2015}. J Coll Stud Ret. 2015. http://csr.sagepub.com/content/early/2015/12/11/1521025115621918.abstract
36. Bruening M, Brennhofer S, van Woerden I, et al. Factors related to the high rates of food insecurity among diverse, urban college freshmen. J Acad Nutr Diet. 2016; 116(9):1450–1457. [PubMed: 27212147]
37. Morris LM, Smith S, Davis J, Null DB. The prevalence of food security and insecurity among Illinois University students. J Nutr Educ Behav. 2016; 48(6):376–382.e1. [PubMed: 27118138]
38. Munro N, Quayle M, Simpson H, Barnsley S. Hunger for knowledge: food insecurity among students at the University of KwaZulu-Natal. Perspect Educ. 2013; 31(4):168–179.
39. Kassier S, Veldman F. Food security status and academic performance of students on financial aid: the case of the University of KwaZulu-Natal. Alternation (Durb). 2013; 9:248–264.
40. Van den Berg L, Raubenheimer J. Food insecurity among students at the University of the Free State, South Africa. South Afr J Clin Nutr. 2015; 28(4):160–169.
41. Hughes R, Serebryanikova I, Donaldson K, Leveritt M. Student food insecurity: The skeleton in the university closet. Nutr Diet. 2011; 68(1):27–32.
42. Micevski DA, Thornton LE, Brockington S. Food insecurity among university students in Victoria: A pilot study. Nutr Diet. 2014; 71(4):258–264.
43. Gallegos D, Ramsey R, Ong KW. Food insecurity: is it an issue among tertiary students? J High Educ. 2014; 67(5):497–510.
44. Nur Atiqah A, Norazmir M, Khairil Anuar M, et al. Food security status: It's association with inflammatory marker and lipid profile among young adult. Int Food Res J. 2015; 22(5):1855–1863.
45. Nugent, MA. Journeys to the food bank: Exploring the experience of food insecurity among post-secondary students [thesis]. Lethbridge, Alberta, Canada: University of Lethbridge; 2011.
46. Booth, A. [Accessed July 26, 2016] Anybody could be at risk: Food (in)security within the University of Northern British Columbia [report]. Published March 2016. Available at: http://www.cupe3799.ca/wp-content/uploads/2016/03/Food-Security-at-UNBC-Final-2016-Report-2.pdf
47. Walsh, K. Understanding students' accessibility and barriers to nourishing food [internship project]. University of Canterbury; 2014.
48. Anaya-Loyola M, Gonzalez-Martinez M, Aguilar-Galarza B, et al. Food insecurity is related to obesity and lipid alterations in Mexican college students [abstract]. FASEB J. 2014; 28(1)
49. Koller, K. Extent of BGSU student food insecurity and community resource use [honors project]. Bowling Green State University; 2014.
50. Goldrick-Rab, S; Broton, K; Eisenberg, D. [Accessed July 16, 2016] Hungry to learn: Addressing food & housing insecurty among undergraduates. University of Wisconsin-Madison. Published 2015. Available at: http://wihopelab.com/publications/Wisconsin_hope_lab_hungry_to_learn.pdf
51. Gorman, A. Food insecurity prevalence among college students at Kent State University [thesis]. Kent State University; 2014.
52. Espinoza, A. Assessing differences in food security status among college students enrolled at a public California State University campus [thesis]. Fresno, California State University; 2013.

53. Burns-Whitmore, B; Carmona, V. [Accessed July 15, 2016] The prevalence of food insecurity among students at California State Polytechnic University (Cal Poly Pomona) [abstract]. Published 2012. Available at: http://sccur.csuci.edu/abstract/viewabstract/the-prevalence-of-food-insecurity-among-students-at-california-state-polytechnic-university-cal-poly-pomona.htm
54. Maguire, J; O'Neill, M; Aberson, C. [Accessed July 13, 2016] California State University Food and Housing Security Survey: Emerging patterns from the Humboldt State University data. Published 2016. Available at: http://hsuohsnap.org/wp-content/uploads/2016/01/ExecutiveSummary.docx1-14-16.pdf
55. Maroto, M. Food insecurity among community college students: prevalence and relationship to GPA, energy, and concentration [dissertation]. Morgan State University; 2012.
56. MacDonald, A. Food insecurity and educational attainment at the University of Arkansas [honors thesis]. University of Arkansas; 2016.
57. Key Statistics & Graphics. [Accessed June 23, 2016] USDA Economic Research Service Web site. Published 2016. Available at: https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics/#foodsecure
58. Rosier, K. [Accessed October 24, 2016] Food insecurity in Australia: What is it, who experiences it and how can child and family services support families experiencing it? Australian Institute of Family Studies Web site. Published 2011. Available at: https://aifs.gov.au/cfca/publications/food-insecurity-australia-what-it-who-experiences-it-and-how-can-child
59. Food Security & Systems. [Accessed October 24, 2016] Activity & Nutrition Aotearoa Web site. Available at: http://ana.org.nz/resource-category/food-security/
60. du Toit, D. [Accessed October 24, 2016] Food Security agriculture, forestry, and fisheries. Directorate Economic Services Web site. Published 2011. Available at: http://www.nda.agric.za/docs/genreports/foodsecurity.pdf
61. Cook JT, Frank DA, Berkowitz C, et al. Food insecurity is associated with adverse health outcomes among human infants and toddlers. J Nutr. 2004; 134(6):1432–1438. [PubMed: 15173408]
62. Chilton M, Booth S. Hunger of the body and hunger of the mind: African American women's perceptions of food insecurity, health and violence. J Nutr Educ Behav. 2007; 39(3):116–125. [PubMed: 17493561]
63. Cook JT, Frank DA. Food security, poverty, and human development in the United States. Ann N Y Acad Sci. 2008; 1136(1):193–209. [PubMed: 17954670]
64. Alaimo K, Olson CM, Frongillo EA. Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. Pediatrics. 2001; 108(1):44–53. [PubMed: 11433053]
65. Willows ND, Au V. Nutritional quality and price of university food bank hampers. Can J Diet Pract Res. 2006; 67(2):104–107. [PubMed: 16759439]
66. Jessri M, Abedi A, Wong A, Eslamian G. Nutritional quality and price of food hampers distributed by a campus food bank: a Canadian experience. J Health Popul Nutr. 2014; 32(2):287–300. [PubMed: 25076666]
67. Riches G. Food banks and food security: welfare reform human rights social policy. Lessons from Canada? Soc Policy Adm. 2002; 36(6):648–663.
68. Martin KS, Wu R, Wolff M, et al. A novel food pantry program: food security, self-sufficiency, and diet-quality outcomes. Am J Prev Med. 2013; 45(5):569–575. [PubMed: 24139769]
69. Supplemental Nutrition Assistance Program (SNAP). [Accessed October 24, 2016] USDA Food and Nutrition Service Web site. Published 2016. Available at: http://www.fns.usda.gov/snap/facts-about-snap
70. [Accessed July 15, 2016] Assembly passes higher education measures. Published 2016. Available at: http://asmdc.org/members/a17/news-room/press-releases/assembly-passes-higher-education-measures

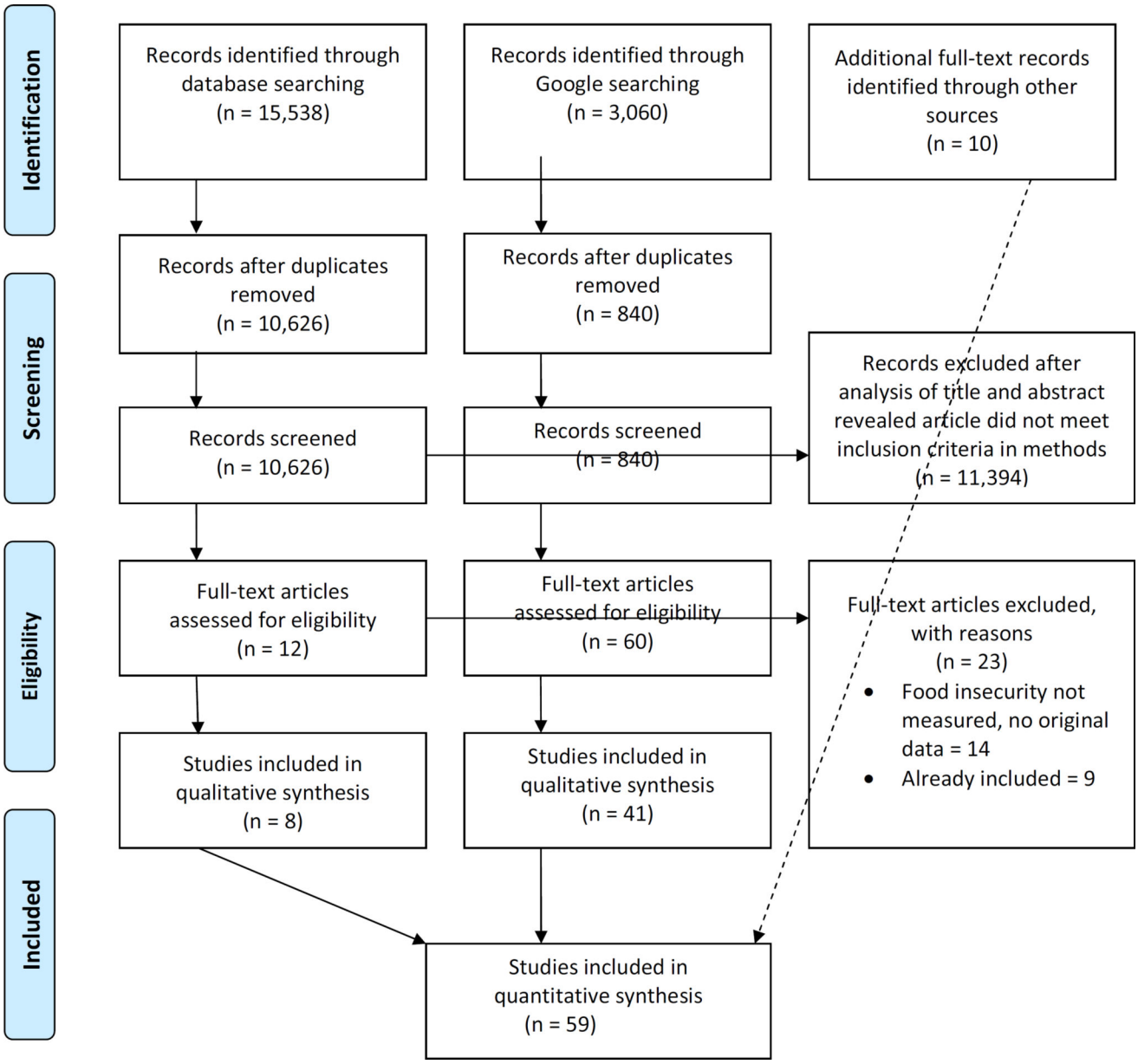

Figure 1.
Flow diagram of peer-reviewed and gray literature on food insecurity in higher education settings

Table 1

Descriptive summary of post-secondary institutions included in this systematic review by study[1]

	Peer-reviewed n=17	**Gray literature n=41**
Location %*(n)*		
US-based	52.9% (9)	90.2% (37)
International	47.1% (8)	9.8% (4)
Type %*(n)*		
Vocational school	--	--
Community college	5.9% (1)	7.3% (3)
4-year institution + PhD	76.5% (13)	85.4% (35)
Mixed	--	7.3% (3)
Unknown	17.6% (3)	--
Demographic %*(n)*		
Hispanic Serving Institution	17.6% (3)	19.5% (8)
Historically Black College and University	5.9% (1)	--
Other	35.3% (6)	68.3% (28)
N/A (e.g., international)	41.2% (7)	9.8% (4)
Unknown	--	2.4% (1)
Funding status %*(n)*		
Public	82.4% (14)	90.2% (37)
For-profit	--	9.8% (4)
Unknown	17.6% (3)	--
Locale %*(n)*		
Urban	76.4% (13)	63.4% (26)
Rural	5.9% (1)	29.3% (12)
Mixed	11.8% (2)	7.3% (3)
Unknown	5.9% (1)	--

[1]Some studies included multiple institutions

Table 1

Summary of peer-reviewed studies on food insecurity (FI) among post-secondary students (years 2000–2016)

First author, publication date	Data collection time frame	Setting	Sample demographics	Study design *Analytical approach*	FI measures	Results			
						Prevalence of FI	**Socio-demographics and related factors**	**Physical and mental health**	**Academic**
Chaparro, 2009	Fall 2006	University of Hawai'i at Manoa, US	n=410 Female: 56.3% Undergraduate (non-freshmen): 62.7% Place of birth: • 41.2% Hawai'i • 28.0% Mainland US • 28.3% Other	CS[1] Representative random sample of sophomore, junior, senior and graduate-level courses. Inclusion criteria: Non-freshman student status, classified student status, not being on a special diet, not pregnant and completing all relevant questions Response rate: 99% of present students agreed to participate Chi-square tests	10-item Adult Food Security Module	• 21.0% FI – 15% low food security – 6% very low food security • 24% marginal food security	• Those living with parents/relatives were less likely to be food insecure (p<0.001) • Native Hawaiian or Pacific Islander Ethnicity (p=0.004) and living arrangement (p<0.001) were positively associated with FI	NA[2]	NA[2]
Hughes, 2011	NA[2]	Gold Coast Campus, Australia	n=399 Female: 60.8% Full-time students: 96.2% Domestic residency: 70.2%	CS[1] Convenience sample of undergraduate and graduate students Response rate: 69.4% Chi-square tests	18-item USDA Food Security Module	• 12.7–46.5% FI[4] – 25.3% very low food security	• Personal finances (p=0.001) and time management (p=0.005) were associated with student FI • Cooking own meals (0.012) and take away food consumption (p=0.003) were related to FI • FI was significantly associated with year of study (p=0.027). living arrangement (p=0.02) • Those living with parents were less likely to report FI (p=0.02)	• FI students were more likely to report losing weight (p=0.001) • FI students reported poorer health (p=0.003)	NA[2]
Micevski, 2013	2012	Deakin University, Australia	n=124 Female: 75.8% Age: • 70.2% 19–24 yrs • 29.8% ≥25 yrs	CS[1] Convenience sample of students (not specified) Inclusion criteria: > 18 years old	10-item Adult Food Security Module	• 47.6% FI – 17.7% low food security – 29.8% very low food security	• FI was inversely related to living with family (OR=0.35; 95% CI: 0.12–0.99) • FI was positively associated with receiving government support	NA[2]	NA[2]

First author, publication date	Data collection time frame	Setting	Sample demographics	Study design *Analytical approach*	FI measures	Results			
						Prevalence of FI	**Socio-demographics and related factors**	**Physical and mental health**	**Academic**
				Response rate: NA Chi-square tests and Multinomial logistic regression			(OR=2.26; 95% CI: 0.77–6.64)		
Lin, 2013	Spring 2011	Historically Black College or University in Texas, US	n=112 Female: 100% Age: • 35.7% 18–20 yrs • 58.0% 21–24 yrs • 3.6% 25–29 yrs • 2.7% 30+ yrs	CS[1] Convenience sample of undergraduate students Inclusion criteria: female Response rate: 70% T-tests[a] and hierarchical linear regression[b]	"In the past month, have you experienced problems with food insecurity?"	NA[2]	NA[2]	• Substance use[a] and conflict with partner[a,b] (β=0.30) were positively associated with FI (p<0.05) • Future orientation[a] (p<0.05) and self-esteem[a,b] (β=−0.24; p<0.01) was inversely related with FI	NA[2]
Munro, 2013	2007–2010	University of KwaZulu-Natal, South Africa	n=1083 Female: 52.4% South African nationality: 88.6%	CS[1] Convenience sample of undergraduate and post graduate students Response rate: NA Descriptive and t-tests	University Students Food Insecurity Questionnaire, developed by the authors	• 20.8% FI – Serious: 16.1% – Severe: 4.3% – Critical: 0.4% • Students were more likely to go hungry at the end of the semester than at the beginning (p<0.001) • 10.7% worry often/almost always in their capacity to access food/meals	• There was a relationship of receiving financial aid and reporting FI (p<0.001)	• 12.2% reported often/almost always being fatigued in relation to being hungry	• 32.8% reported lower concentratio n as a result of hunger happens often/almost always/some times
Kassier, 2013	Spring 2012	University of KwaZulu-Natal, South Africa	n=269 non-first year students on financial aid Female: 58.4% Mean age: 18.1 yrs	CS[1] Convenience sample of undergraduate students on financial aid Inclusion criteria: non-freshman student status Response rate: NA Descriptive, correlations, and chi-square tests	Household Food Insecurity Access Scale	• 12.5% FI • 53.1% moderately food secure • Average time students went without a substantial meal=2.8 days; for food insecure students = 6.6 days. (not sure if statistical difference between FI categories)	NA[2]	• No relationship between FI and dietary diversity, body mass index, or food coping strategies	• No relationship between FI and academic performance
Patton-Lopez, 2014	Spring 2011	Rural university in Oregon, US	n=354 Female: 72.9%	CS[1]	USDA 6-Item Short Form Food Security Survey Module	• 58.8% FI	• FI was positively associated with being employed	• FI was positively associated with having fair/poor	• FI was inversely related with

First author, publication date	Data collection time frame	Setting	Sample demographics	Study design *Analytical approach*	FI measures	Results			
						Prevalence of FI	**Socio-demographics and related factors**	**Physical and mental health**	**Academic**
			Age: • 72.0% 18–24 yrs • 28.0% ≥25 yrs Latino: 8.2%	Convenience sample of undergraduate and graduate students Response rate: 7% Chi-square tests and Multivariate logistic regression			(OR=1.73; 95% CI: 1.04–2.88), and having incomes < $15000/yr (OR=2.23; 95% CI: 1.07–4.63)	health (OR=2.08; 95% CI: 1.09–03.95),	GPA > 3.1(OR=0.4 0; 95% CI: 0.22–0.69)
Gallegos, 2014	Fall 2009	Brisbane, Australia	n=810 Female: 75.3% Age: • 74.4% 17–24 yrs • 11.7% 25–29 yrs • 5.7% 30–34 yrs • 8.1% >35 yrs Australian-born: 91.7% Indigenous status: 0.4%	CS[1] Convenience sample Response rate: 6.7% Chi-square tests[a] and multivariate logistic regression[b]	18-item USDA Food Security Module	• 25.5% FI – 17.7% low food security – 5.6% very low food security – 2.3% very low food security among children	• FI was associated with being low-income [a,b] (OR=1.81; 95% CI: 1.04, 3.15), renting [a,b] (OR=3.40; 95% CI: 1.88, 6.16),	• FI was associated with lower fruit [a,b] (OR=0.65; 95% CI: 0.45, 0.95) and vegetable consumption [a,b] (OR=0.65; 95% CI: 0.33, 0.61), fair/poor general health [a,b] (OR=2.07; 95% CI: 1.28, 3.34),	• FI was associate with deferment of studies because of financial difficulties [a,b] (OR=2.99; 95% CI: 1.83, 4.88)
Hanna, 2014	NA	California college campuses	n=67 Female: 61.2% Race/ethnicity: • 34.3% White • 6.0% African American • 29.6% Asian/ Pacific Islander • 94% Hispanic • 4.5% Latino • 6.0% Other	CS[1] Convenience sample of undergraduates Response rate: NA Descriptive	18-item USDA Food Security Module	• 19.4% FI	• Students reported insufficient money (100%), insufficient time for shopping and preparation (38.5%), it was too hard to get to the store (30.8%)	NA[2]	• Students enrolled in more than 13 units were significantly more likely to be FI
Gaines, 2014	Fall 2011	Large, public university in the Southeastern United States *Conducted shortly after a tornado.	n=557 undergraduate students Female: 75.8% Race/ethnicity: • 82.2% White • 17.8% Other	CS[1] Random + convenience sample of 16 sophomore, junior and senior-level courses Inclusion criteria: sophomores, juniors and seniors 19–25 years of age Response rate: 87.4%	10-item Adult Food Security Module	• 14.1% FI – 8.9% low food security – 5.2% very low food security	• FI was positively related to: receiving financial aid (0.35; 95% CI: 0.08, 0.62), receiving food assistance (0.63; 95% CI: 0.21, 1.05), being financially independent (0.59; 95% CI: 0.23, 0.96), not actively budgeting (0.43; 95% CI: 0.17, 0.69), and not experiencing exogenous economic	• FI was significantly associated with lower cooking self-efficacy, but these results were not significant in fully adjusted models.	NA[2]

First author, publication date	Data collection time frame	Setting	Sample demographics	Study design *Analytical approach*	FI measures	Results			
						Prevalence of FI	**Socio-demographics and related factors**	**Physical and mental health**	**Academic**
				Probit regressions, simultaneously adjusted			shock (0.49; 95% CI: 0.24, 0.46). • FI was inversely related to: not having familial financial support (−0.51; 95% CI: −0.90, −0.12), not having credit card use (−0.35; 95% CI: −0.61, −0.10), and resource adequacy (−0.09; 95% CI:- 0.14, −0.04)		
Van den Berg, 2015	2013	University of the Free State, South Africa	n=1416 Female: 37.5% Race/ethnicity: • 67.9% African • 23.0% White • 5.8% Colored • 0.9% Indian • 0.6% Other	CS[1] All registered students were invited to participate in the survey Response rate: 4.6% Chi-square tests and multivariate logistic mutually adjusted regression	10-item Adult Food Security Module 1-item from the Australian National Nutrition Survey	• 84% FI[3,4] – 25% low food security – 59% very low food security	Race (−0.50; SE=0.14; p=0.003), having enough money for food (1.05; SE=0.14; p<0.001), asking others for money for food (1.20; SE=0.20; p<0.001), selling positions to obtain food (1.45; SE=0.4627; p=0.002), and borrowing money from parents for food (−0.58; SE=0.27; p=0.032) were associated with FI.	NA[2]	NA[2]
Nur Atiqah, 2015	NA	University Teknologi MARA Puncak Alam, Malaysia	n=124 Female: 87.9% Age: • 18: 62.9% • 19: 11.3% • 20: 7.3% • 21: 8.1% • 22: 4.0% • 23: 2.4% • 24: 2.4% • 25: 1.6%	CS[1] Convenience sample Inclusion criteria: students from departments of Health Sciences, Pharmacy, Hotel/Tourism Management, Foundation of Basic Science, Art and Design and Business and Office Management; disease free students, not pregnant Response rate: NA Independent t-test	10-item Adult Food Security Module	• 43.5% FI	NA[2]	• Fat mass index was higher among students with FI (p=0.016) • No significant differences found between FI and inflammator y marker, lipid profile, or body composition.	NA[2]
Maroto, 2015	Fall 2012	Two community colleges in Maryland, U.S. (one college in an extremely affluent suburban area and one in a lower-income urban area	n=301 Female: 55% Mean age: 23 yrs Race/ethnicity:	CS[1] Convenience sample Inclusion criteria: enrolled student, >18 years of age.	10-item Adult Food Security Module	• 56% FI – 26% low food security – 30% very low food security	• There were significant differences in food security status by race/ethnicity (p=0.005), but no significant	NA[2]	• FI students more likely to report lower GPA (OR=0.39; p=0.042), compared to non FI students.

First author, publication date	Data collection time frame	Setting	Sample demographics	Study design *Analytical approach*	FI measures	Results			
						Prevalence of FI	**Socio-demographics and related factors**	**Physical and mental health**	**Academic**
			• 71% African American • 4% Hispanic • 15% White • 3% Asian	Response rate: 1.8% Chi-square tests[a] and multivariate logistic regression[b]		• 20% marginally food secure	differences by gender. [a] • Higher FI was observed[a] in those living alone (p=0.007); being single parents (0.011)		[b] This relationship continued to be significant when adjusted for gender and income, but not race and living situation
Silva, 2015	Fall 2014–Spring 2015	UMass Boston, US	n=390 Female: 60% Race/ethnicity: • 13% African American • 43% White • 9% Hispanic • 26% Asian • 9% Other	CS[1] Random sample of undergraduate and graduate student courses. Of the instructors contacted, 15% agreed to allow their students to participate. Response rate: NA Descriptive and t-tests	Worry about having enough money for food, skipping meals due to a lack of money to buy food, inability to eat nutritious meal due to monetary struggles, did not eat for more than 1–2 days	• 26.9–27.4% FI[4] – 6.4% severe FI (Often/ sometimes did not eat for a day or two because they did not have enough money for food)	NA[2]	NA[2]	• FI students were significantly very affected in their ability to attend class and to do perform in class (p<0.01) • FI students were more likely to withdraw from the university (no significance testing conducted)
Farahbakhsh, 2016a, 2016b	2013–2014	University of Alberta, Canada	n=58 food bank users Female: 60.3% Mean age: 30.0 yrs	CS[1] Convenience sample of students recruited at the Campus Food Bank Response rate: NA Descriptive Chi-square tests[a] multivariate logistic regression[b], and t tests[c]	10-item Adult Food Security Module	• 82.8% FI, based on USDA classification for very low or low food security • 44.8% were moderately food insecure and 44.8% were severely food insecure Based on the Health Canada scoring method	• Loans or assistantships were primary sources of income for clients. • Participants were more likely to be graduate students (50.0%) than the general student food bank clientele (33.3%). • Reported strategies for coping with FI were: applying for a loan or bursary (86.2%), seeking employment or working more hours (84.5%), purchasing food using a credit card (77.6%), delaying or avoiding buying university supplies (75.9%), receiving food from a friend/relative (75.9%) or delaying bill payments (60.3%).	• Students with severe FI were more likely to report that their health was fair/ poor (OR=4.03; 95% CI=1.10, 14.78)[b] • Students with severe FI consumed fewer fruits and vegetables, and legumes daily (p=0.009) [c]	• 60% of participants reported at least one adverse academic experience as a result of FI. • Students with severe food insecurity were more likely to report an adverse academic experience (p = 0.02), and were less likely to be able to concentrate in class or during an exam (p = 0.01).

First author, publication date	Data collection time frame	Setting	Sample demographics	Study design *Analytical approach*	FI measures	Results			
						Prevalence of FI	**Socio-demographics and related factors**	**Physical and mental health**	**Academic**
Bruening, 2016	2014–2015	Arizona State University, US	n=209 freshmen Female: 62% Mean age: 18.8 yrs Race/ethnicity: • 46% Non-Hispanic White • 27% Hispanic • 6% Non-Hispanic Black • 12% Asian • 8% Mixed/Other	CS[1] Convenience sample Inclusion criteria: College freshmen living in residence halls Participation rate among invited students: 79.5%. Response rate from the two residence halls: 41.5%. Mixed multivariate logistic regressions	Two-item screener	• 32–37% FI, with 32% reporting inconsistent access to food in the past month and 37% in the past 3 months.	• FI status did not vary significantly by gender, age, race/ethnicity, meal plan, Pell grant status or parental education. • FI status did differ significantly between the two residence halls (p=0.02).	• FI students were less likely to regularly consume breakfast (OR=0.41; 95% CI: 0.22, 0.77) or home cooked meals (OR=0.34; 95% CI: 0.16, 0.72) • Parents were less likely to purchase/sen d food to FI students (OR=0.51; 95% CI: 0.28, 0.94) • FI students were less likely to report healthy eating habits off campus (OR=0.46; 95% CI: 0.24, 0.88) • FI students had higher levels of depression (OR=2.97; 95% CI: 1.58, 5.60)	NA[2]
Morris, 2016	Spring 2013	4 public universities in Illinois, US (Eastern Illinois University, Northern Illinois University, Southern Illinois University, and Western Illinois University)	n=1882 undergraduate students Female: 66.6% Academic level: • 14.3% Freshmen • 15.9% Sophomore • 28.2% Junior • 41.6% Senior Race/ethnicity: • 9.6% African American • 4.9% Hispanic • 77.4% White • 8.1% Other	CS[1] Convenience sample Inclusion criteria: enrolled undergraduate student, access to university email, ability to read and respond in English, 18+ years of age. Response rate: 3.9% Chi-square tests	10-item Adult Food Security Module	• 35.0% FI – 16.6% low food security – 18.4% very low food security • 23.1% marginal food security	• FI was significantly associated with race (p<0.001), living location (p<0.001), and receiving support from student loans and other repayment programs (p<0.001)	NA[2]	• FI was significantly associated with GPA (p<0.001)

[1]Cross sectional

[2] Not available

[3] The terminology in the reviewed manuscript used food insecurity with and without hunger. We updated to low and very low food insecurity, respectively, in order to have consistency.

[4] Rates of food insecurity vary based on using a single item versus multiple item scale

Table 3

Gray literature reporting prevalence and factors related to food insecurity (FI) on post-secondary campuses, Years 2000–2015

Institution, Country	First author, date published	Source	Year data collected	Sample size	FI prevalence	Factors associated with student FI		
						Socio-demographics	Physical and mental health	Academic
City University of New York, US	2011	Report	2010	n=1086 18–25 years: 65.7% Female: 58.7% Race/ethnicity: • 20.0% White • 24.2% American/ Black • 29.5% Hispanic • 17.3% Asian US Born: 58.1%	39.2% FI	• Higher rates of FI were observed among black and Latino students, working more than 20 hours per week, household income of less than $20000, housing instability	• FI students reported higher rates of fair/poor health, symptoms of depression	NA
San Jose State University, US	2014	Report	NA	n=4972 18–24 years: 67.9%	39.0% FI	• FI students more likely to choose between food and living expenses, and food and academic expenses	NA	• FI students more likely to choose between food and academic expenses
Autonomous University of Queretaro, Mexico	Anaya-Loyola, 2014	Abstract	NA	n=66	50.5% FI	NA	• Higher prevalence of overweight/obesity among those with severe FI • Inverse relationship between high body fat and severe FI • Anemia, hypertriglyceridemia and hypercholesterolemia (among severe FI)	NA
University of Alaska Anchorage, US	Lindsley	Student poster	Fall 2013	n=63	55% FI	NA	NA	NA
	Nelson	Student thesis	2015	NA	12.3–31% FI[1]	NA	NA	NA
	Wintz	Report	NA	n=454	31% FI	• Minority students were more likely to report FI	• FI students reported to perceive food prices too high for too little value	NA

Institution, Country	First author, date published	Source	Year data collected	Sample size	FI prevalence	Factors associated with student FI		
						Socio-demographics	**Physical and mental health**	**Academic**
						• Living on campus or independently off campus was associated with FI		
10 US Community Colleges	Wisconsin HOPE Lab, 2015	Report	2015	n=4312 18–25 years: 50% Female: 55% Race/ethnicity: • 54% White • 15% African American • 20% Hispanic/ Latino • 4% Southeast Asian • 6% Other Asian/ Pacific Islander	39% FI • 19% low food security • 20% very low food security	• FI students were more likely to report housing insecurity and homelessness	• FI students were more likely to report depression, anxiety, possible eating disorders, and serious thoughts of suicide	NA
Humboldt State University, California, US	Maguire, 2015	Report	NA	n=1554	53% FI • 23% low food security: • 30% very low food security	• Freshmen and graduate students were more likely to report FI • 16% received CalFresh on campus • 19% received CalFresh benefits • 27% used on-campus food pantry • 5% used off-campus food pantry • 15% reported experiencing homelessness since starting college	NA	NA
University of Canterbury, New Zealand	Walsh, 2014	Student thesis	NA	n=305	NA	NA	• 60% of respondents skipped meals – 52% indicated cost as the reason • 70% indicated barriers to healthy, nourishing food – 87% selected cost as a barrier	• 77% indicated access to food would increase productivity

Institution, Country	First author, date published	Source	Year data collected	Sample size	FI prevalence	Factors associated with student FI		
						Socio-demographics	Physical and mental health	Academic
							• 53% reported lacking fruit in the diet • 58% reported lacking vegetables in the diet • 48% felt they were lacking vitamins • 39% felt they were lacking iron	
University of Lethbridge, Canada	Nugent, 2011	Student thesis	Fall 2010–Spring 2011	n=15 Female: 66.7% Mean age: 26.8 years Undergraduate: 86.7% First generation university students: 60%	NA	NA	NA	NA
Pacific University, US	Moore, 2014	Student thesis	NA	n=160 Female: 44% Mean age: 20.4 years	• 13.1% SNAP users • 40.6% SNAP eligible	NA	Among SNAP users: • 43% cut size of meals • 62% ate less because not enough money for food • 67% buy most of food for the household • 81% track food budget • 33% reported having enough of the kinds of food they wanted • 48% have enough food, but not what they want • 19% sometimes don’t have enough to eat • SNAP users spent a higher percentage of their monthly expenditures on groceries, with 57% of users spending between 50–100% of their monthly budget	NA

Institution, Country	First author, date published	Source	Year data collected	Sample size	FI prevalence	Factors associated with student FI		
						Socio-demographics	Physical and mental health	Academic
							• only 5% of SNAP users spent more than 50% of their monthly budget on entertainment compared to the 53% and 60% of SNAP eligible, non-users • 100% of SNAP users agree SNAP makes it easier to afford nutritious meals, while only 55% of non-users agreed	
Maryland community colleges, US	Maroto, 2013	Student thesis	Fall 2012	n=301 Female: 55% Mean age: 23 years Race/ethnicity: • 15% White: • 71% African-American • 4% Hispanic • 3% Asian	56% FI • 26% low food secure • 30% very low food secure 20% marginal food secure	• FI status was related to race/ethnicity (p=0.005) and living situation (0.007) and being a single parent (0.011)	• Energy level was lower among FI students after adjustment (p<0.001)	• A lower GPA was significantly related to FI status (0.040), but not after adjustment • FI students reported lower concentration levels (p<0.001)
University of Arkansas, US	MacDonald, 2016	Student thesis	2016	n=467 Mean age: 23.2 years Female: 70.9% White: 78.8% Undergraduate: 80.1%	40% FI	• FI was higher among graduate students (42.4%) as compared to undergraduate students (39.3%)	NA	• Higher food insecurity was related to lower GPA (p<0.01)
University of Central Florida, US	Loftin, 2013	Student thesis	2012	n=51 participants of a college food pantry Female: 72.5% Mean age: 21 years	NA	Factors preventing students from receiving help: • 12.0% embarrassment • 17.8% time restraints • 2.0% quality of food • 37.3% nothing	NA	NA

Institution, Country	First author, date published	Source	Year data collected	Sample size	FI prevalence	Factors associated with student FI		
						Socio-demographics	Physical and mental health	Academic
Bowling Green State University, US	Koller, 2014	Student thesis	Spring 2014	n=53 Female: 72.0% 18–22 years: 92% White: 77.0%	19% FI 44% marginal food security	• FI students (62.5%) reported more financial dependence • Among FI students, the highest rated reason for FI was lack of employment (37.5%) • Reasons for not utilizing community food resources among FI: – 37.5% embarrassed – 37.5% did not know the location – 37.5% believed they were ineligible – 12.5% not allowed by mother	NA	NA
Kent State, US	Gorman, 2014	Student thesis	Spring 2014	n=298 Undergraduate: 86%	49.7% FI • 25.2% low food security • 7.0% very low food security 18.0% Marginal food security	• An association with FI was observed with living arrangement living location (off campus)	NA	NA
California State University, US	Espinoza, 2013	Student thesis	Fall 2012	n=597 Under 21 years: 39.4% Undergraduate: 81.4% Race/ethnicity: • 29.5% White • 3.9% African American/Black: • 40.7% Hispanic/ Latino • 15.2% Asian • 0.8% Native American	30.7% FI • 14.9% Low food security: • 15.7% very low food security	• Living with parents was inversely related to FI ($p<0.001$) • Income ($p<0.001$) and credit card debt ($p<0.001$) was associated with student FI	• Self-reported health status ($p<0.001$) and use of food coping strategies ($p<0.001$) were associated with student FI	NA

Institution, Country	First author, date published	Source	Year data collected	Sample size	FI prevalence	Factors associated with student FI		
						Socio-demographics	Physical and mental health	Academic
				• 0.2%Alaska native • 1.0% Pacific Islander				
Humboldt State University, US	Chappelle, 201S	Student thesis	Fall 2014	n=231 Mean age: 22.6 years	35% FI • 19% Low food security • 16.0% very low food security 35.0% marginal food security	NA	• FI students reported lower mental health score (p<0.001), higher unhappiness (p=0.02) and more restless sleep (p<0.01)	NA
University of California San Francisco, US	Office of Intuitional Research	Report	Spring 2015	n=921	13% FI	NA	• 31% rated stress as tremendous	• 69% reported difficulty concentrating on studies
Michigan Technical University, US	Gorman	Report	NA	n=1011	26% FI	NA	NA	NA
	Husky Food Access Network	Report	Spring 2015	n=1011	26% FI	• 34% have financial support from family • 61% have a paying job • 94% have circumstances that take priority over purchasing necessary, daily food	NA	NA
University of New Hampshire, US	Davidson, 2015	Abstract	Fall 2014	n=418	12.4% FI	• On-campus housing was related to FI • No differences in race, sex, marital status, or parents' education among FI and non-FI students	NA	NA
California State Polytechnic University, US	Burns-Whitmore, 2012	Abstract	NA	n=131	46% FI	• FI was associated with being a minority student, students' major, and living situation with roommates	NA	NA
Fresno State, US	NA	Press article	NA	n=674	30.7%	NA	NA	NA

Institution, Country	First author, date published	Source	Year data collected	Sample size	FI prevalence	Factors associated with student FI		
						Socio-demographics	Physical and mental health	Academic
Gavilan College, US	Institutional Research, 2013	Report	Fall 2013	n=155	38.8–45.2%[1]	NA	NA	NA
University of Northern British Columbia, Canada	Booth, 2016	Report	Fall 2015	n=216 Female: 77% 18–25 years: 71.3% Undergraduate: 75.9%	39%	• On campus living was associated with FI	NA	• Lower learning was associated with FI
Wisconsin Public Colleges, US	Broton, 2014	Report	Fall 2008	n=1413	Approximately 20%	NA	NA	NA

NA=Not available

CalFresh=The name for the Supplemental Nutrition Assistance Program in California

[1]Ranges indicate multiple measures of FI

Table 4

Themes of suggested solutions and solutions in practice to address post-secondary food insecurity by socio-ecological construct[1]

Socio-ecological construct	Common examples	Peer-reviewed literature, suggested (n=18)	Gray lit, suggested (n=24)	Gray literature, practiced (n=17)
Intrapersonal	• Food and/or financial literacy educational programs	33.3% (6)	20.8% (5)	35.3% (6)
	• Vouchers for meals	5.5% (1)	--	23.5% (4)
Interpersonal	• Peer-to-peer mentoring	--	--	5.9 % (1)
	• Student, staff, and faculty donating meals plans or financial support to students in need	--	--	23.5% (4)
	• Apps: allows students in need of a meal to connect with another student who has excess meals	--	--	11.8% (2)
Organizational/ institutional	• Campus food pantries	38.9% (7)	8.3% (2)	41.2% (7)
	• Increase employment opportunities	5.5% (1)	--	
	• Alter meals plans (cost)	27.8% (5)	12.5% (3)	--
Community	• Community gardens	22.2% (4)	--	11.8% (2)
	• Network stakeholders	5.5% (1)	16.7% (4)	
	• Increase healthy retailers in and around campus	22.2% (4)	16.7% (4)	5.9 % (1)
Policy/systems	• Change eligibility to SNAP for college students/ provide on campus retailers that accept EBT	27.8% (5)	20.8% (5)	11.8% (2)
	• Enact laws to increase student access to healthy foods (e.g., California State College Student Hunger Relief Act of 2015)	--	8.3% (2)	5.9 % (1)
	• Increase financial aid/create a basic living stipend for students	50.0% (9)	8.3% (2)	--

[1] To date, solutions were as suggested by authors.