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Food Insecurity and Dietary Intake among College Students with Unlimited Meal Plans at a Large, Midwestern University

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Abstract

Background: Food insecurity, a state of not being able to consistently access nutritious food due to financial constraints, has been associated with poor dietary intake among college students. The extent to which campus food resources contribute to this association is unknown.

Objectives: This study examined the association between food insecurity and dietary intake in a sample of undergraduate students with unlimited meal plans and dining hall access at a large, public Midwestern university.

Design: The study design is cross-sectional. The data used are baseline data from part of a broader sugar-sweetened beverage intervention study that were collected using a Qualtrics survey prior to the intervention.

Participants/setting: The sample consisted of 1,033 undergraduate students recruited from three dining halls. The data were collected in November 2018.

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Author contributions: JM and CL designed the original research question. CL conducted the statistical analysis and JM drafted the original manuscript. AF, CL, and JW provided critical manuscript revisions. All authors viewed and approved the final draft of the manuscript.

Conflicts of interest: JM – none. AF – none. JW – none. CL – none.

Main outcome measures: Food security was assessed using the 6-item Short Form Food Security Survey Module. Dietary intake was assessed using the National Cancer Institute 26-item Dietary Screener Questionnaire and the Beverage Intake Questionnaire-15.

Statistical analyses performed: Generalized linear regression models were used to examine differences in dietary intake by students' food security status, adjusting for students' sociodemographic characteristics.

Results: In the sample, 14% of students were food-insecure. After adjusting for sociodemographic variables, food-insecure students reported 9% lower intake of fruits (*P=0.02*), 9% lower intake of vegetables (*P<0.001*), 10% higher intake of dairy (*P=0.002*), 6% higher intake of total added sugars (*P=0.01*), 10% higher intake of added sugars from sugar-sweetened beverages (*P= 0.01*), 4% higher intake of calcium (*P=0.01*), and 4% lower intake of fiber (*P=0.01*), compared to food-secure students. With respect to beverage intake, food-insecure students had 56% higher intake of total sugar-sweetened beverages (*P=0.002*), which was driven by 185% higher intake of energy and sports drinks (*P=0.001*), and 121% higher intake of sweetened teas (*P=0.001*).

Conclusions: Despite having identical food resources within campus dining halls, there were significant differences in the diets of college students by food security status.

Keywords

dietary quality; food insecurity; poverty; United States; college students

INTRODUCTION

Food insecurity is the state of being unable to access sufficient nutritious food due to financial constraints and is influenced by sociodemographic factors including race/ethnicity, income, and household size.[1, 2] In the United States, 10.5% of households experienced food insecurity during 2019.[3] Compared to the general population, the high prevalence of food insecurity among the college student population is striking with approximately 14–59%[4–7] of students on college campuses reporting food insecurity at some point in their college career, with an average food insecurity rate of 42% across peer-reviewed studies.[4] These estimates for food insecurity prevalence refer to one given year within the multi-year college time period. In the U.S. population, food insecurity has been linked to a multitude of risk factors and negative health outcomes, including cardiovascular disease risk,[8, 9] obesity,[10] and depression and mental health issues.[11] Food insecurity has also been associated with poor dietary intake in U.S. adults,[12] which is a major health concern due to the link between poor diet and chronic disease risk.[13] Hanson and Connor found that food insecurity in adults was adversely associated with dietary intake, especially lower fruit, vegetable, and dairy intake.[14] Leung et al. also found that food insecurity was associated with poor dietary intake in low-income adults.[15] In a systematic review of 24 studies, food-insecure adult women had lower intakes of some food groups (e.g. dairy, fruits, vegetables, grains) and nutrients (e.g. protein, vitamins, iron, magnesium) compared to food-secure women.[16] Furthermore, food insecurity has been associated with increased sugar sweetened beverage (SSB) intake,[17]

which can lead to increased risk of obesity, cardiovascular diseases,[18] diabetes,[19] and some cancers.[20, 21]

Though multiple studies have established the health consequences of food insecurity in the adult population, [22–25] fewer studies have focused on U.S. college students. Students in four-year, public institutions in California who are food-insecure have reported that insufficient financial resources, time, transportation, and kitchen facilities contribute to food insecurity and poor diet intake.[26] Additionally, among college students at a large, four-year Midwestern university, Leung et al. found that food insecurity was associated with poor dietary intake and higher body mass index.[27] In another study conducted by Martinez et al. at the University of California's 10-campus system, food insecurity was associated with decreased fruit and vegetable intake, higher body mass index, fewer days of adequate sleep, and fewer days of moderate to vigorous physical activity.[28] While these studies establish the basics of the relationship between food insecurity and overall dietary intake in college populations, a major limitation is that they do not account for the potential role of dining plans.

College campuses are a unique food environment, especially for undergraduate students, many of whom live in residence halls and access meals through pre-paid dining plans they redeem at dining halls. Meal plan participation is an important factor to consider because students with unlimited access to food resources would be expected to have marginal or high food security. The prevalence of food insecurity in college populations would presumably decrease if students had unrestricted, and identical, access to the same food environment. El Zein et al. reported a 19% food insecurity rate among first-year college students across eight U.S. universities, with those not participating in a meal plan more likely to be food-insecure, and subsequently, had higher odds of disordered eating behaviors.[29] When meal plan participation is accounted for, food insecurity prevalence is expected to be substantially lower. Moreover, having access to the same food environment would anticipate more similar dietary intake among food-secure and food-insecure individuals, compared to students without dining hall access. The current study adds critical information to evidence regarding the associations between food insecurity and dietary intake among college students by assessing the outcomes of dietary intake among students who all have unlimited meal plans, and therefore made food choices in identical food environments.

In this study, the association between food security status and dietary intake was examined using data from 1,033 undergraduate students with unlimited meal plans in a large, public Midwestern university. To the authors' knowledge, this study is the first to examine food insecurity and dietary intake among college students with identical access to and resources for food within campus dining halls. Compared to what has been observed in previous studies that did not account for meal plans, the food insecurity prevalence in the present study was expected to be lower, and dietary intake was expected to be similar among food-secure and food-insecure students, given that the students in the sample all had the same unrestricted access to the same food environment.

METHODS

Study population

Participants for the study were recruited from three large dining halls of a large, public Midwestern University as part of a broader SSB quasi-experimental intervention study (NCT04435145).[30] Briefly, warning labels were affixed to SSB dispensers at one of the dining halls, which served as the intervention site. The other two dining halls served as control sites and no changes were made to any food or beverage dispensers. The data for the present study comes from the baseline survey, which was administered prior to the implementation of SSB warning labels.

Michigan Dining, the campus unit that manages all on-campus dining halls and eateries, provided the study investigators with a list of 3,032 students frequenting the three dining halls during the Fall 2018 term. To be included in the study, the participant had to be a student of the university who visited the same dining hall at least 100 times within the first two months of the semester, which translated into eating at the same dining hall at least once per day or more. The dining halls are open to the entire university community, though primarily serve students with meal plans. All students in the sample were assumed to have unlimited meal plans, because the university requires students living in residence halls to purchase unlimited meal plans. However, this information was not verified in the survey. Unlimited meal plans provide unrestricted access to all campus dining halls during the academic year, each of which provides food through an “all-you-care-to-eat” style buffet, i.e. students swipe their cards upon entry and can consume as much or as little food as they desire without being charged for individual items.

In November 2018, all 3,032 eligible students were contacted through their university e-mail to complete a survey, anticipating a sample size of 1,000 respondents. The survey was sent to their university e-mail address via a personalized link (Qualtrics, Provo, UT).[31] Within the first two days, 1,084 responses were received and the survey was closed to new responses. The sample size was determined based on the statistical power needed for an expected effect size for the broader SSB intervention study. The survey took approximately 10–15 minutes to complete and informed consent was obtained at the beginning of the survey. Students received a $10 Amazon.com gift card upon completion. For the current study, the analytic sample was comprised of all individuals with complete information on all variables of interest (n=1,033). The study was approved by the University of Michigan Institutional Review Board.

Measures

Food insecurity—Food security status over the past 30 days was assessed using the 6-item Short Form Food Security Survey Module.[32] Questions were adapted to capture the individual’s food security status, rather than that of their household over the past 30 days. According to the United States Department of Agriculture guidelines, food security status was assigned based on the number of affirmative responses to questions such as “In the last 30 days, did you ever cut the size of your meals or skip meals because there wasn’t enough money for food?”. Responses of “yes”, “often”, and “sometimes” were coded as affirmative.

The total raw score, ranging from 0–6, determined food security status: high or marginal food security (0–1), low food security (2–4), and very low food security (5–6). For the analyses, full and marginal food security were combined to form a "food-secure" category, and low and very low food security were combined to form a "food-insecure" category.

Dietary intake—Dietary intake over the past month was assessed using the National Cancer Institute 26-item Dietary Screener Questionnaire (DSQ).[33] The DSQ has been previously validated.[34] Dietary outcomes from the DSQ included fruits (cup equivalents), vegetables including legumes (cup equivalents), whole grains (ounce equivalents), dairy (cup equivalents), added sugars from sugar-sweetened beverages (tsp equivalents), total added sugars (tsp equivalents), calcium (mg), and fiber (g).[33] Daily intakes for each dietary component were estimated using publicly available SAS macros.[35]

Beverage intake over the past month was assessed using a modified Beverage Intake Questionnaire-15 (BEV-Q).[36] The BEV-Q has been previously validated.[36] The instrument was modified by separating out flavored milk from plain/unflavored milk due to the broader intervention focused on SSB intake. Outcomes assessed with the BEV-Q included intake of regular/sweetened soda, fruit-flavored drinks, energy or sports drinks, sweetened teas, sweetened coffees, flavored milk, plain/unflavored milk, 100% fruit juice, diet soda, artificially sweetened or unsweetened tea/coffee, and water.[36] Total SSB intake was calculated by summing intakes of regular soda, fruit-flavored drinks, energy or sports drinks, sweetened tea, sweetened coffee, and flavored milk. Usual amount for each beverage was assessed using the following categories: less than 6 fluid ounces, 8 fluid ounces, 12 fluid ounces, 16 fluid ounces, or more than 20 fluid ounces. Daily intake (in ounces) for each beverage was then estimated by multiplying the frequency of intake and the usual amount for each beverage consumed.

Other covariates—In the same survey, students reported their demographic characteristics, including age, sex, race/ethnicity, and parental educational attainment. Students were also asked if they were Pell grant recipients. Pell grant is a type of federal financial aid typically awarded to undergraduate students who have not earned a degree yet and demonstrate serious financial need. Recipient status of this grant was used as an indicator of family socioeconomic status, which in the context of this study, is important as a potential correlate of a student's food security status.

Statistical analysis—First, differences in sociodemographic characteristics were compared by food security category using simple linear regression and chi-squared tests. Next, the association between food insecurity status and dietary variables was assessed through comparing unadjusted means of dietary variables between food-insecure and food-secure students. Finally, generalized linear models with a gamma distribution and log-link function were used to examine differences in dietary intake by food insecurity status.[37] The models were adjusted for all sociodemographic variables. All statistical tests were two-sided and significance was considered at the $P \leq 0.05$ level. Statistical analyses were performed in the statistical software SAS Version 9.4 (SAS Institute, Cary, NC).[38]

RESULTS

In the analytic sample of 1,033 students, the mean age was 18.5 years and 48% were female (Table 1). Approximately 55% of students identified as non-Hispanic White, 4% as non-Hispanic Black, 5% as Hispanic, 28% as Asian, and 8% as another race/ethnicity. The distributions of sex and race/ethnicity in the analytic sample closely resembled that of the broader undergraduate student population. Additionally, 76% were first-year students, 18% were second-year students, and 6% were students in their third, fourth, or fifth year. Approximately 14% experienced food insecurity within the past 30 days. Table 1 describes the sociodemographic characteristics of the sample by food security status. Students experiencing food insecurity were more likely to identify as non-Hispanic Black, Hispanic, or another race or ethnicity; as first-generation students; and as Pell grant recipients ($P<0.01$). Although there were significant differences in racial/ethnic composition, the majority of food-secure and food-insecure students alike were non-Hispanic White.

Table 2 displays the unadjusted mean daily intake results from both the DSQ and the BEV-Q for all students and stratified by food security status. On average, food-insecure students reported lower mean intakes of fruits and vegetables than food-secure students. There were also significant differences with respect to dietary fiber intake and added sugar from SSBs. There were no other significant unadjusted differences in dietary intake by students' food security status.

Table 3 presents relative differences in reported dietary intake between food-insecure and food-secure students after adjusting for student's sociodemographic characteristics. Compared to food-secure students, food-insecure students had 9% lower intake of fruits (Relative Difference (RD)=0.91, 95% CI: 0.84, 0.99), 9% lower intake of vegetables, including legumes (RD=0.91, 95% CI 0.87, 0.96), 10% higher intake of dairy (RD=1.10, 95% CI 1.04, 1.17), 10% higher intake of added sugars from SSBs (RD=1.10, 95% CI 1.02, 1.18), 6% higher intake of total added sugars (RD=1.06, 95% CI 1.01, 1.12), 4% higher intake of calcium (RD=1.04, 95% CI 1.01, 1.08), and 4% lower intake of fiber (RD=0.96, 95% CI 0.93, 0.99). The difference for whole grain intake by food security status was not statistically significant.

There were also significant differences in reported beverage intake between the food-secure and food-insecure groups after multivariate-adjustment (Table 3). Food-insecure students had 185% higher intake of energy and sports drinks (RD=2.85, 95% CI 1.54, 5.28), 121% higher intake of sweetened teas (RD=2.21, 95% CI 1.37, 3.58), and 56% higher intake of total sugar-sweetened beverages (RD=1.56, 95% CI 1.18, 2.06) compared to food-secure students. There were no statistically significant differences for regular soda, fruit-flavored drinks, sweetened coffees, flavored milk, plain milk, 100% fruit juice, diet soda, plain tea/coffee, and water by food security status.

DISCUSSION

In the sample, 14% of undergraduate students with unlimited meal plans experienced food insecurity. Compared to food-secure students, food-insecure students reported lower intakes

of fruits, vegetables, and fiber, and higher intakes of dairy and calcium, after adjusting for sociodemographic characteristics. Food-insecure students also reported higher intakes of total added sugar and added sugars from SSBs, which were likely driven by higher intakes of energy and sports drinks and sweetened teas. These findings suggest that food insecurity was associated with aspects of poor dietary intake among college students, despite having identical access to and resources for food within campus dining halls

Previous research has found that food insecurity is associated with poor dietary intake among U.S college students.[28,39] In 2014–2015, Martinez et al. investigated food insecurity in 8,705 California college students from public, four-year universities and found that food-insecure students consumed fewer fruits and vegetables than food-secure students, with food-insecure students reporting, on average, 0.5 fewer servings than food-secure students.[28] Another study at a large, Midwestern, public university conducted in 2012–2013 by Mirabitur et al. found that students with mild or moderate food insecurity had lower intakes of fruits and vegetables than food-secure students; however, this association was attenuated among students in housing with food provision (e.g. residence hall, fraternity or sorority house, cooperative).[39] Bruening et al. found that food insecurity was inversely associated with healthy eating and physical activity behaviors as well as a higher risk of feeling stressed and depressed in a longitudinal study from 2015–2016 of university freshmen in a public, four-year institution in Arizona.[40] A study conducted at the University of Alberta in Canada, another public, four-year institution, recruited students through a university food bank and found that severely food-insecure students were less likely to consume vegetables, fruits, and legumes daily, and more likely to report fair or poor general and mental health than their food-secure counterparts.[41] In 2018, a study at a large, public, four-year Midwestern university found that across a representative sample of all university students, those with moderate food insecurity had lower intakes of fruits, and those with severe food insecurity had higher intakes of added sugar from SSBs and total added sugar.[27] The results of the present study extend the current literature to show that dietary differences are observed even among students with identical access to campus eateries and resources for food.

There are a few potential explanations for the observed association between food insecurity and dietary intake among students in the current analytic sample. First, although students all had identical meal plans and unlimited access to dining halls, food-insecure students may have different availability to access campus dining halls if they also had outside employment. Thus, potential differences in economic circumstances could explain not only differences in dietary intake but food security status differences as well, for students who otherwise share the same food environment. A prior report found a graded, positive relationship between higher food insecurity levels and the number of hours a student worked per week, likely due to students needing to earn income to pay for tuition and other academic expenses.[42] The same report also found that food-insecure students were more likely to work evening shifts, which may affect their ability to access campus dining halls during regular meal times. While campus dining halls are open all day, food offerings vary throughout the day with greatest availability at main meal times.

Another explanation could be the relationship between food insecurity, stress, and food intake. Food insecurity has been associated with higher stress levels,[43] and higher stress levels have been associated with higher processed food intake.[44] It is possible that even when presented with an array of healthy foods, food-insecure students may select unhealthy foods as a coping mechanism for the stress related to food insecurity and its correlates. In a similar vein, food insecurity has been associated with poorer sleep outcomes;[29] thus, students with food insecurity may opt to consume higher levels of SSBs (including caffeinated drinks and energy drinks) to stay awake and maintain focus in classes. Another potential explanation could be previous dietary habits and preferences. Although food insecurity is not a fixed condition, there is a possibility that food-insecure college students may have experienced food insecurity at an earlier stage in life and adopted similar eating habits in the dining hall setting, such as higher levels of processed foods.[45] However, this does not account for the dietary intake of food-insecure students who may be experiencing this condition for the first time in college. It is important to note that the prior food security status of the students was not obtained, so this explanation is only a hypothesis that is not empirically verified. Finally, even students with meal plans do not exclusively eat in dining halls. Food-insecure students could be accessing unhealthy foods outside of the dining hall food environment more frequently than food-secure students. A combination of these factors could potentially explain the differences in dietary intake between food-insecure and food-secure students noted in this study despite identical access to food resources and food environments.

The higher intake of SSBs by the food-insecure students compared to the food-secure students is a particularly important finding. SSBs are generally more economically accessible on the national level compared to healthier food options,[46] and food insecurity has been associated with higher SSB consumption in lower-income U.S. adults.[47] Because SSB intake has been associated with increased chronic disease risk[48] while providing little to no nutrition or satiety, interventions in campus dining halls to promote unsweetened and lightly sweetened drinks in place of SSBs might differentially benefit food-insecure students and narrow the health gap between food-insecure and food-secure students without significantly compromising hunger or energy levels. In the intervention study from which the baseline data was used for the present analysis, the warning labels on SSBs in the dining hall were found to significantly reduce consumption of SSBs among students at the intervention site compared to students at the control sites.[30] Further research is necessary to understand whether food-insecure students may respond differently to environmental interventions to promote healthier beverages when compared to food-secure students.

The primary limitation of this study is the cross-sectional design which does not allow for determining a causal relationship between food insecurity and dietary intake in college students. Other limitations were 1) the fact that the study sample was composed of primarily first-year students living in dormitories with access to dining halls, such that this information could not be generalizable to older students living off-campus, 2) students living in university residence halls are required to have unlimited meal plans, but the presence of a meal plan was not explicitly confirmed in the survey, and 3) information about outside employment, other basic needs, or students' intended major, all of which could modify the relationship between food insecurity and dietary intake, was not asked. Additionally, the

dietary instruments that were utilized were designed to capture snapshots of dietary intake rather than total dietary intake. Although the students in the sample had unlimited access to the campus dining halls, information on if certain foods were consumed in the dining hall setting or in a different setting was not obtained. In similar regard, the study did not have data available on the number of dining hall visits, thus, the results could not be compared for those who may have visited the dining hall more or less frequently. Finally, the data collected was self-reported, which may be subject to social desirability bias.[49] That being said, validated tools, including the DSQ[34] and the BEV-Q,[36] were used to reduce reporting errors and bias.[50]

A major strength of this study is the fact that the association between food insecurity and dietary intake was examined independent of the effects of food environment. Typically, in addition to the financial constraints that lead to food insecurity, food-insecure individuals may experience difficulty consuming healthy foods due to lower access to healthy foods in their food environment.[51] In this study, students were observed at similar stages of their academic career, with identical meal plans and unrestricted dining hall access. Still, the observed associations might still be explained by differential access to food resources outside of campus dining halls. Other factors, such as limited time availability, stress, or individual dietary preferences, may also be mediating these associations.

CONCLUSION

This study found that food insecurity was associated with aspects of poor dietary intake among college students with identical meal plans and access to campus dining halls. Due to the high prevalence of food insecurity observed on college campuses,[4] the known adverse associations between food insecurity, health,[29] and academic outcomes,[52,53] and the disproportionate number of low-income, first-generation, and racial/ethnic minority students affected by food insecurity, [29] food insecurity on college campuses is an important health disparity that needs to be addressed. Future research should include qualitative approaches to better understand the experiences of food-insecure students in diverse college settings, as well as longitudinal studies to see how food insecurity affects long-term health and academic outcomes. Together, these studies can help to inform the development of programs and policies to alleviate food insecurity on college campuses.

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References

1. Rose D Economic determinants and dietary consequences of food insecurity in the United States. J Nutr. 1999;129:517S–520S. [PubMed: 10064321]

2. Alaimo K, Briefel RR, Frongillo EA Jr., Olson CM. Food insufficiency exists in the United States: results from the third National Health and Nutrition Examination Survey (NHANES III). Am J Public Health. 1998;88:419–426. [PubMed: 9518974]

3. United States Department of Agriculture Economic Research Service. Key Statistics & Graphics. Vol 2020: United States Department of Agriculture; 2020.

4. Bruening M, Argo K, Payne-Sturges D, Laska MN. The Struggle Is Real: A Systematic Review of Food Insecurity on Postsecondary Education Campuses. J Acad Nutr Diet. 2017;117:1767–1791. [PubMed: 28754200]

5. 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. International Journal of Consumer Studies. 2014;38:374–384.

6. Patton-Lopez MM, Lopez-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;46:209–214. [PubMed: 24406268]

7. Payne-Sturges DC, Tjaden A, Caldeira KM, Vincent KB, Arria AM. Student Hunger on Campus: Food Insecurity Among College Students and Implications for Academic Institutions. Am J Health Promot. 2018;32:349–354. [PubMed: 28699401]

8. Mendy VL, Vargas R, Cannon-Smith G, Payton M, Enkhmaa B, Zhang L. Food Insecurity and Cardiovascular Disease Risk Factors Among Mississippi Adults. Int J Environ Res Public Health. 2018;15.

9. Saiz AM Jr., Aul AM, Malecki KM, et al. Food insecurity and cardiovascular health: Findings from a statewide population health survey in Wisconsin. Prev Med. 2016;93:1–6. [PubMed: 27612573]

10. Martin KS, Ferris AM. Food insecurity and gender are risk factors for obesity. J Nutr Educ Behav. 2007;39:31–36. [PubMed: 17276325]

11. Arenas DJ, Thomas A, Wang J, DeLisser HM. A Systematic Review and Meta-analysis of Depression, Anxiety, and Sleep Disorders in US Adults with Food Insecurity. J Gen Intern Med. 2019;34:2874–2882. [PubMed: 31385212]

12. Robaina KA, Martin KS. Food insecurity, poor diet quality, and obesity among food pantry participants in Hartford, CT. J Nutr Educ Behav. 2013;45:159–164. [PubMed: 23219294]

13. Laraia BA. Food insecurity and chronic disease. Adv Nutr. 2013;4:203–212. [PubMed: 23493536]

14. Hanson KL, Connor LM. Food insecurity and dietary quality in US adults and children: a systematic review. Am J Clin Nutr. 2014;100:684–692. [PubMed: 24944059]

15. Leung CW, Epel ES, Ritchie LD, Crawford PB, Laraia BA. Food insecurity is inversely associated with diet quality of lower-income adults. Journal of the Academy of Nutrition and Dietetics. 2014;114:1943–1953.e1942. [PubMed: 25091796]

16. Johnson CM, Sharkey JR, Lackey MJ, et al. Relationship of food insecurity to women's dietary outcomes: a systematic review. Nutr Rev. 2018;76:910–928. [PubMed: 30184168]

17. Fernandez CR, Chen L, Cheng ER, et al. Food Insecurity and Sugar-Sweetened Beverage Consumption Among WIC-Enrolled Families in the First 1,000 Days. J Nutr Educ Behav. 2020;52:796–800. [PubMed: 32444189]

18. Johnson RK, Appel LJ, Brands M, et al. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. Circulation. 2009;120:1011–1020. [PubMed: 19704096]

19. Singh GM, Micha R, Khatibzadeh S, et al. Estimated Global, Regional, and National Disease Burdens Related to Sugar-Sweetened Beverage Consumption in 2010. Circulation. 2015;132:639–666. [PubMed: 26124185]

20. Larsson SC, Bergkvist L, Wolk A. Consumption of sugar and sugar-sweetened foods and the risk of pancreatic cancer in a prospective study. The American Journal of Clinical Nutrition. 2006;84:1171–1176. [PubMed: 17093171]

21. Fuchs MA, Sato K, Niedzwiecki D, et al. Sugar-sweetened beverage intake and cancer recurrence and survival in CALGB 89803 (Alliance). PLoS One. 2014;9:e99816. [PubMed: 24937507]

22. Lee JS, Frongillo EA Jr. Nutritional and Health Consequences Are Associated with Food Insecurity among U.S. Elderly Persons. The Journal of Nutrition. 2001;131:1503–1509. [PubMed: 11340107]

23. Gundersen C, Ziliak JP. Food Insecurity And Health Outcomes. Health Aff (Millwood). 2015;34:1830–1839. [PubMed: 26526240]
24. Pan L, Sherry B, Njai R, Blanck HM. Food insecurity is associated with obesity among US adults in 12 states. J Acad Nutr Diet. 2012;112:1403–1409. [PubMed: 22939441]
25. Seligman HK, Laraia BA, Kushel MB. Food insecurity is associated with chronic disease among low-income NHANES participants. J Nutr. 2010;140:304–310. [PubMed: 20032485]
26. Crutchfield R, Maguire J. Study of Student Basic Needs. Vol 2020: The California State University; 2018.
27. Leung CW, Wolfson JA, Lahne J, Barry MR, Kasper N, Cohen AJ. Associations between Food Security Status and Diet-Related Outcomes among Students at a Large, Public Midwestern University. J Acad Nutr Diet. 2019;119:1623–1631. [PubMed: 31561811]
28. Martinez SM, Grandner MA, Nazmi A, Canedo ER, Ritchie LD. Pathways from Food Insecurity to Health Outcomes among California University Students. Nutrients. 2019;11.
29. El Zein A, Shelnutt KP, Colby S, et al. Prevalence and correlates of food insecurity among U.S. college students: a multi-institutional study. BMC Public Health. 2019;19:660. [PubMed: 31142305]
30. Leung CW, Wolfson JA, Hsu R, Soster K, Mangan S, Falbe J Warning Labels Reduce Sugar-Sweetened Beverage Intake among College Students. J Nutr. 2020.
31. Qualtrics. Qualtrics. Provo, Utah, USA: https://www.qualtrics.com; 2020. Accessed January 30, 2020.
32. United States Department of Agriculture Economic Research Service. Survey Tools. Vol 2020: United States Department of Agriculture; 2019.
33. National Cancer Institute. View or Download Validated Short Dietary Assessment Instruments. Vol 2020. Division of Cancer Control & Population Sciences: National Cancer Institute; 2020.
34. Thompson FE, Midthune D, Kahle L, Dodd KW. Development and Evaluation of the National Cancer Institute's Dietary Screener Questionnaire Scoring Algorithms. J Nutr. 2017;147:1226–1233. [PubMed: 28490673]
35. Dietary Screener Questionnaires (DSQ) in the NHANES 2009–10: DSQ. Vol 2020: Division of Cancer Control & Population Sciences, National Cancer Institute; 2020.
36. Hedrick VE, Savla J, Comber DL, et al. Development of a brief questionnaire to assess habitual beverage intake (BEVQ-15): sugar-sweetened beverages and total beverage energy intake. J Acad Nutr Diet. 2012;112:840–849. [PubMed: 22709811]
37. McCullagh P, Nelder JA. Generalized linear models. 2nd ed. London; New York: Chapman and Hall; 1989.
38. SAS Institute Inc. SAS. Cary, NC, USA: https://www.sas.com/en_us/home.html; 2013. Accessed January 30, 2020.
39. Mirabitur E, Peterson KE, Rathz C, Matlen S, Kasper N. Predictors of college-student food security and fruit and vegetable intake differ by housing type. J Am Coll Health. 2016;64:555–564. [PubMed: 27414196]
40. Bruening M, van Woerden I, Todd M, Laska MN. Hungry to learn: the prevalence and effects of food insecurity on health behaviors and outcomes over time among a diverse sample of university freshmen. Int J Behav Nutr Phys Act. 2018;15:9. [PubMed: 29347963]
41. Farahbakhsh J, Hanbazaza M, Ball GDC, Farmer AP, Maximova K, Willows ND. Food insecure student clients of a university-based food bank have compromised health, dietary intake and academic quality. Nutr Diet. 2017;74:67–73. [PubMed: 28731560]
42. Goldrick-Rab S, Richardson J, Schneider J, Hernandez A, Cady C. Still Hungry and Homeless in College. Vol 2020: Wisconsin Hope Lab; 2018.
43. Meza A, Altman E, Martinez S, Leung CW. "It's a Feeling That One Is Not Worth Food": A Qualitative Study Exploring the Psychosocial Experience and Academic Consequences of Food Insecurity Among College Students. J Acad Nutr Diet. 2019;119:1713–1721 e1711. [PubMed: 30553586]
44. Adam TC, Epel ES. Stress, eating and the reward system. Physiol Behav. 2007;91:449–458. [PubMed: 17543357]

45. Nackers LM, Appelhans BM. Food insecurity is linked to a food environment promoting obesity in households with children. J Nutr Educ Behav. 2013;45:780–784. [PubMed: 24021456]

46. Bruce MA, Thorpe RJ Jr., Beech BM, Towns T, Odoms-Young A. Sex, Race, Food Security, and Sugar Consumption Change Efficacy Among Low-Income Parents in an Urban Primary Care Setting. Fam Community Health. 2018;41 Suppl 2 Suppl, Food Insecurity and Obesity:S25–S32. [PubMed: 29461313]

47. Leung CW, Epel ES, Ritchie LD, Crawford PB, Laraia BA. Food insecurity is inversely associated with diet quality of lower-income adults. J Acad Nutr Diet. 2014;114:1943–1953 e1942. [PubMed: 25091796]

48. Hu FB, Malik VS. Sugar-sweetened beverages and risk of obesity and type 2 diabetes: epidemiologic evidence. Physiol Behav. 2010;100:47–54. [PubMed: 20138901]

49. Hebert JR, Ma Y, Clemow L, et al. Gender differences in social desirability and social approval bias in dietary self-report. Am J Epidemiol. 1997;146:1046–1055. [PubMed: 9420529]

50. Althubaiti A Information bias in health research: definition, pitfalls, and adjustment methods. J Multidiscip Healthc. 2016;9:211–217. [PubMed: 27217764]

51. Larson NI, Story MT, Nelson MC. Neighborhood environments: disparities in access to healthy foods in the U.S. Am J Prev Med. 2009;36:74–81. [PubMed: 18977112]

52. Maroto ME, Snelling A, Linck H. Food Insecurity Among Community College Students: Prevalence and Association With Grade Point Average. Community College Journal of Research and Practice. 2015;39:515–526.

53. Martinez SM, Frongillo EA, Leung C, Ritchie L. No food for thought: Food insecurity is related to poor mental health and lower academic performance among students in California's public university system. J Health Psychol. 2018:1359105318783028.

RESEARCH SNAPSHOT

Research Question:

Is food insecurity associated with dietary intake in college students with unlimited meal plans?

Key Findings:

In a cross-sectional sample of 1,033 college students with unlimited meal plans, food insecurity was significantly associated with lower intake of fruits, vegetables, and fiber as well as higher intake of dairy, calcium, total added sugars, added sugars from sugar-sweetened beverages, energy drinks, sweetened teas, and total sugar-sweetened beverages.

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Table 1:

Demographic characteristics of 1,033 college students with meal plans at a large, public Midwestern university by food security status: survey data from November 2018

	Total (n=1,033)		**Food secure (n=891)**		**Food insecure (n=142)**		***P-value***
	N	**%**	***N***	**%**	**N**	**%**	
Age[a], mean (SE)[b]	18.5	(0.03)	18.5	(0.03)	18.4	(0.06)	*0.33*
Class year[c]							*0.45*
First-year student	786	76.1	678	76.1	108	76.1	
Second-year student	182	17.6	159	17.9	23	16.2	
Third, fourth, or fifth-year student	65	6.3	54	6.1	11	7.8	
Sex[c]							*0.11*
Male	537	52.0	472	53.0	65	45.8	
Female	496	48.0	419	47.0	77	54.2	
Race/ethnicity[c]							*0.003*
Non-Hispanic White	570	55.2	495	55.6	75	52.8	
Non-Hispanic Black	44	4.3	34	3.8	10	7.0	
Hispanic	56	5.4	41	4.6	15	10.6	
Asian	284	27.5	257	28.8	27	19.0	
Other race/ethnicity[d]	79	7.7	64	7.2	15	10.6	
First generation student[c]							*<.0001*
No	873	84.5	773	86.8	100	70.4	
Yes	160	15.5	118	13.2	42	29.6	
Pell grant recipient[c]							*<.0001*
No	794	76.9	706	79.2	88	62.0	
Yes	239	23.1	185	20.8	54	38.0	

[a]Differences in age between food-secure and food-insecure groups assessed using simple linear regression.

[b]SE = standard error

[c]Differences in categorical variables between food-secure and food-insecure groups assessed using Chi-squared tests.

[d] Includes students identifying as Middle Eastern/ North African, Pacific Islander, individuals identifying as multi-racial or multiethnic, and individuals not identifying as any of the listed racial/ethnic categories

Table 2.

Unadjusted mean daily intakes of foods and beverages overall and by food security status for 1,033 college students with meal plans at a large, public Midwestern university: survey data from November 2018

	Total (n=1,033)	Food secure (n=891)	Food insecure (n=142)	*P-value* [a]
Dietary Screener Questionnaire [b]				
Fruits, cup equivalents, (SE)	1.07 (0.02)	1.09 (0.02)	0.97 (0.04)	*0.003*
Vegetables including legumes, cup equivalents, (SE)	1.54 (0.01)	1.56 (0.02)	1.37 (0.03)	*<.0001*
Whole grains, ounce equivalents, (SE)	0.78 (0.01)	0.78 (0.01)	0.78 (0.03)	*0.79*
Dairy, cup equivalents, (SE)	1.94 (0.03)	1.93 (0.03)	2.01 (0.07)	*0.25*
Added sugars from sugar-sweetened beverages, teaspoon equivalents, (SE)	5.95 (0.11)	5.87 (0.11)	6.46 (0.37)	*0.02*
Added sugars total, teaspoon equivalents, (SE)	16.77 (0.17)	16.66 (0.18)	17.48 (0.56)	*0.07*
Calcium, milligrams, (SE)	1104 (8.7)	1104 (9.4)	1110 (22.2)	*0.79*
Fiber, grams, (SE)	17.72 (0.12)	17.89 (0.13)	16.65 (0.25)	*<.0001*
Beverage Intake Questionnaire (BEV-Q) [c]				
Total sugar-sweetened beverages, ounces, (SE)	9.90 (0.50)	9.16 (0.46)	14.56 (2.27)	*0.05*
Regular (sweetened) soda, ounces, (SE)	2.04 (0.17)	1.95 (0.18)	2.61 (0.58)	*0.3*
Fruit drinks, ounces, (SE)	1.87 (0.17)	1.74 (0.17)	2.65 (0.58)	*0.29*
Energy and sports drinks, ounces, (SE)	0.66 (0.09)	0.55 (0.08)	1.31 (0.44)	*0.08*
Sweetened teas, ounces, (SE)	1.28 (0.14)	1.09 (0.10)	2.45 (0.76)	*0.31*
Sweetened coffees, ounces, (SE)	1.97 (0.22)	1.80 (0.20)	3.09 (0.95)	*0.14*
Flavored milk, ounces, (SE)	2.08 (0.21)	2.02 (0.23)	2.45 (0.55)	*0.15*
Plain milk, ounces, (SE)	4.59 (0.27)	4.67 (0.30)	4.11 (0.60)	*0.73*
100% fruit juice, ounces, (SE)	2.75 (0.19)	2.68 (0.20)	3.16 (0.52)	*0.05*
Diet soda, ounces, (SE)	1.20 (0.18)	1.07 (0.17)	1.99 (0.69)	*0.26*
Plain tea/ coffee, ounces, (SE)	3.14 (0.28)	3.04 (0.28)	3.76 (1.04)	*0.35*
Water, ounces, (SE)	55.77 (1.07)	56.10 (1.14)	53.69 (2.98)	*0.48*

[a] Differences in continuous food variables between food-secure and food-insecure groups assessed using simple linear regression with a gamma distribution and a log-link function. Differences in continuous beverage variables between food-secure and food-insecure groups assessed using the Wilcoxon rank-sum test.

[b] The Dietary Screener Questionnaire was used to assess dietary intake, including fruit, vegetable, dairy, whole grain, fiber, calcium, and sugar intake.

[c] The Beverage Intake Questionnaire (BEV-Q) was used to assess beverage intake, including juice, milk, coffee/tea, and sugar-sweetened beverages.

Table 3.

Multivariate-adjusted relative differences between food security status and dietary outcomes in college students with meal plans (n = 1,033) at a large, public Midwestern university: survey data from November 2018

	Relative difference[a]	95% CI[b] Lower	95% CI Upper	*P-value*
Dietary Screener Questionnaire [c]				
Fruits, cup equivalents	0.91	0.84	0.99	*0.02*
Vegetables including legumes, cup equivalents	0.91	0.87	0.96	*0.0003*
Whole grains, ounce equivalents	1.00	0.93	1.09	*0.90*
Dairy, cup equivalents	1.10	1.04	1.17	*0.002*
Added sugars from sugar-sweetened beverages, teaspoon equivalents	1.10	1.02	1.18	*0.01*
Added sugars total, teaspoon equivalents	1.06	1.01	1.12	*0.01*
Calcium, milligrams	1.04	1.01	1.08	*0.01*
Fiber, grams	0.96	0.93	0.99	*0.01*
Beverage Intake Questionnaire (BEV-Q) [d]				
Total sugar-sweetened beverages, ounces	1.56	1.18	2.06	*0.002*
Regular (sweetened) soda, ounces	1.28	0.73	2.24	*0.40*
Fruit drinks, ounces	1.54	0.91	2.61	*0.11*
Energy and sports drinks, ounces	2.85	1.54	5.28	*0.001*
Sweetened teas, ounces	2.21	1.37	3.58	*0.001*
Sweetened coffees, ounces	1.42	0.80	2.51	*0.23*
Flavored milk, ounces	1.66	0.99	2.77	*0.05*
Plain milk, ounces	1.14	0.82	1.58	*0.45*
100% fruit juice, ounces	1.18	0.81	1.73	*0.39*
Diet soda, ounces	2.15	0.91	5.04	*0.08*
Plain tea/ coffee, ounces	1.59	0.90	2.82	*0.11*
Water, ounces	0.95	0.85	1.07	*0.41*

[a]Relative difference is interpreted as the percentage difference between students with food insecurity compared to students with food security (reference group). All models were adjusted for age, sex, race/ethnicity, first-generation status, and Pell grant status.

[b]CI = confidence interval

[c]The Dietary Screener Questionnaire was used to assess dietary intake, including fruit, vegetable, dairy, whole grain, fiber, calcium, and sugar intake.

[d] The Beverage Intake Questionnaire (BEV-Q) was used to assess beverage intake, including juice, milk, coffee/tea, and sugar-sweetened beverages.