

Title: No food for thought: Food insecurity is related to poor mental health and lower academic performance among students in California's public university system

Abstract

This study examined the relationships between food insecurity, mental health, and academic performance among college students in a California public university system (N=8705).

Structural equation modeling was performed to examine a direct path from food insecurity to student grade point average (GPA) and an indirect path through mental health, controlling for demographic characteristics. Food insecurity was related to lower student GPA directly and indirectly through poor mental health. These findings support the need for future interventions and policy on the importance of providing students with the basic needs to succeed both academically and in the future.

KEYWORDS

Food insecurity, college students, mental health, academic performance, basic needs

INTRODUCTION

In 2016, 15.6 million U.S. households (12.3%) experienced food insecurity—characterized by limited or uncertain access to nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways due to limited financial resources (U.S. Department of Agriculture Economic Research Service, 2014; Coleman-Jensen et al., 2017). College students experience food insecurity at a higher rate than in the general U.S. population—a prevalence as high as 57% has been reported on U.S. college campuses (Bahrapour, 2014; Schallhorn, 2014; Eltman, 2014; Gaines et al., 2014; Chaparro et al., 2009; Hughes et al., 2011; Gallegos et al., 2014; Maroto, 2013; Micevski et al., 2014; Patton-Lopez et al., 2014; Morris et al., 2016; Freudenberg et al., 2011; Goldrick-Rab et al., 2017). About 40% of students in the University of California system have been found to experience food insecurity—a proportion that is three times higher than for U.S. households on average (Martinez et al., 2018; Martinez et al., 2016).

College students today face higher-than-ever cost of attendance (tuition and fees, room and board, books) (Ma et al., 2017). Declining state support is a main contributor to increasing cost of attendance in California. In 1990, 78% of the total cost of education per student was state-funded compared with 39% in 2011-2012 (University of California, 2011). California has unaffordable housing prices, which is also increasing the cost of living. On a federal level, Pell grants—which up to the 1990s covered the majority of the cost of attendance for students receiving them—now only covers about one-third of tuition, fees and room and board. (Baum et al., 2017; U.S. Department of Education) Several risk factors for food insecurity among college students have been identified. For example, Hispanic and black students are at increased risk compared to white students (Bruening et al., 2016; Freudenberg et al., 2011; Patton-Lopez et al., 2014; Maroto, 2013). Students from low-income backgrounds and with childhood history of food

insecurity are at increased risk for food insecurity in college (Morris et al., 2016; Martinez et al., 2018). Students experiencing food insecurity are likely to live in off-campus housing and to receive financial aid (Freudenberg et al., 2011; Morris et al., 2016; Patton-Lopez et al., 2014). Students who experience food insecurity often lack the skills to manage limited resources, and the impact of food insecurity may not only include physical hunger, but feelings of shame and isolation (Watson et al., 2017; Martinez et al., 2016).

Despite the high prevalence of food insecurity among college students, only a few studies have examined how food insecurity relates to student outcomes, including mental health and academic performance (Patton-Lopez et al., 2014; Bruening et al., 2016; MacDonald, 2016; Payne-Sturges et al.). In the 2015 National College Health Assessment sponsored by the American College Health Association, 14% of students had been treated or diagnosed with depression. Similarly, 14% of students reported that depression in the last 12 months impacted their academic performance such as receiving a lower grade on an exam, course grade, and course completion. One in five students also reported feeling very lonely, hopeless, and overwhelmed by all there was to do, and one in four students reported feeling very sad with respect to the last 12 months. Some risk factors for poor mental health among college students include being from a low-income background and having low social support (Hefner and Eisenberg, 2009; Eisenberg et al., 2007; Hunt and Eisenberg, 2010). It is also possible that being in a competitive academic environment coupled with a full academic workload contributes to poor mental health (Hunt and Eisenberg, 2010). The relationship between food insecurity and poor mental health has been shown in other populations (Althoff et al., 2016; Jones, 2017). Whether food insecurity exacerbates poor mental health and its relation to academic outcomes among college students

has not been adequately studied; freshman students from a large university who experienced food insecurity had higher odds of experiencing depression compared to students experiencing food security (Bruening et al., 2016). Also unclear are the interconnections between food insecurity and mental health and academic performance among college students. Given that attending higher education can be competitive and stressful in itself, it is worth examining these relationships among college students who have emerged as a group vulnerable to food insecurity. Findings have the potential to inform strategies and statewide policies to address food insecurity in higher education to improve the student experience and ultimately academic success.

The purpose of this study was to examine potential paths by which food insecurity may relate to student GPA among college students in a statewide public university system. We hypothesized that food insecurity would be related to student GPA directly and also indirectly through mental health.

METHODS

Study context

The University of California (UC) is a statewide public university system, and in 2015 had a student enrollment of 242,326 (34% graduate, 66% undergraduate, 29% White, 3% Black, 25% Hispanic). Almost half of students are from low-income families and receive Pell Grants (federal financial aid for students from low-income families) and almost half are the first in their families to attend a 4-year university (University of California and Institutional Research and Academic Planning, 2015). This study was part of the UC Global Food Initiative, launched in 2014 to document the extent of student food insecurity on UC campuses and strategize solutions

to address the issue in California campuses, nationally and worldwide (University of California Global Food Initiative).

Recruitment and data collection

Using a cross-sectional study design, data were collected from all 10 campuses in the UC system in spring 2015. Students were randomly sampled from each campus. A total of 67,645 randomly sample students were invited to participate in an online survey in one of two ways: 1) through the National College Health Assessment II (NCHA), administered by the ACHA and scheduled to occur at four UC campuses in spring 2015,²² or 2) by an independent survey, administered by the UC Institutional Research and Program Planning at the six other UC campuses (where the NCHA was not scheduled for spring 2015). The actual 2014–2015 UC student population was compared with the 2015 study sample (weighted and unweighted) confirming that the samples were similar (Martinez et al., 2018). More details regarding the study design, response rates, and data collection are described in Martinez et al. (2018). Briefly, students consented electronically before being asked questions about mental health, GPA, and food insecurity. Participating students were entered into a lottery to be awarded prizes (i.e., gift cards worth \$25-125, computer monitors, tablets), an incentive structure found to be effective in increasing college survey participation (Laguilles et al., 2011). This study was approved by the Institutional Research Board at the University of California, Davis.

Of the 8,932 total student participants, 8,705 had complete data on food insecurity and 7,999 had complete data on GPA. Participants excluded from the analysis due to incomplete food security data did not differ from those included in the analysis in terms of sex and academic year (data

not shown), but a greater proportion of students with missing data on food insecurity were mixed raced/other (37%), enrolled part-time (2%), or international students (14%) as compared with students with complete data on food security (11%, 0.6%, 9%, respectively; $P < 0.05$).

Independent variable: Food security

Food security in the past 12 months was assessed using the validated USDA 6-item short form (U.S. Department of Agriculture Economic Research Service, 2014). Food security scores were computed from the number of affirmative answers to the six questions, using the USDA coding scheme: food secure [0-1 affirmative responses], low food secure [2-4 affirmative responses] and very low food secure [5-6 affirmative responses]. Low and very low food insecure scores were combined and coded as *food insecure* [1] vs. *food secure* [0].

Dependent variable: Student grade point average (GPA)

Cumulative GPA was self-reported by students. Response options ranged from A to D/F. Numeric values were assigned to the response categories D/F [1], C [2], B [3], and A [4].

Mediator: Poor mental health

Nine items from the National College Health Assessment II survey were used to assess student mental health (American College Health Association). Students reported if they had ever felt any of the following feelings in the past 12 months: 1) *hopelessness*, 2) *overwhelmed by all to do*, 3) *exhausted (not from physical activity)*, 4) *very lonely*, 5) *very sad*, 6) *overwhelming anxiety*, 7) *overwhelming anger*, and 8) *so depressed it was difficult to function*. Students responded either *no* [0] or *yes* [1] to each item. Lastly, students were asked to rate their overall level of stress in

the past 12 months. Response options ranged from *no stress* [0] to *tremendous stress* [5]. These nine items were used to estimate a latent construct representing poor mental health.

Covariates

We included covariates collected from student surveys that could in part be contributing to any associations found between food insecurity, mental health, and GPA. The covariates used were race/ethnicity, sex, being a financial aid recipient, employment status, being an undergraduate student (or graduate), and campus affiliation.

Analysis

Descriptive statistics were used to obtain student characteristics. Differences by food security status (food secure vs. food insecure) were computed using chi-square tests for categorical variables, and independent t-tests for continuous variables, with significance at $P < 0.05$. Chi-square post hoc tests were performed to compare food-secure and food-insecure groups.

Confirmatory factor analysis (CFA) was performed to estimate a latent variable using the nine mental health indicators. A measurement model was estimated and evaluated to confirm the factor structure for the latent construct, and included items with factor loadings greater than 0.30.

Structural equation modeling was used to test the hypothesis that food insecurity was directly and indirectly related to student GPA, and mediated by poor mental health. Analyses were conducted using Mplus Version 7 (Muthen & Muthen, Los Angeles, CA). Overall model fit was determined using the following fit indices: confirmatory fit index ($CFI \geq .95$) and root mean

square error of approximation (RMSEA approximating .06) (Hu and Bentler, 1995; Hu and Bentler, 1999). All paths were statistically significant if the p-value was less than 0.05. The parameter estimates, standard errors, z-statistics, and squared multiple correlations were inspected for sign and magnitude. Mediation was tested using the INDIRECT command within MPlus, which estimates indirect effects with delta method standard errors (Muthen, 2011). The full information maximum likelihood function was used to account for missing data.

[TABLE 1 INSERT HERE]

RESULTS

Participant characteristics

On average, students were 23.2 (SD=5.8) years old; and 67% female, 34% white, 31% Asian, and 21% Hispanic (Table 1). Most students reported an A (42%) or B (44%) GPA. In the past 12 months, 15% reported experiencing tremendous stress; 28-55% of students reported having felt very sad, very lonely, hopeless, overwhelming anxiety, overwhelming anger, depression making it difficult to function; and 76-82% had felt overwhelmed by all they had to do or exhausted. A total of 40% of students reported experiencing food insecurity. Among students who experienced food security, a significantly higher proportion had a cumulative A average (51%) compared to students experiencing food insecurity (30%). A significantly higher proportion of students experiencing food insecurity had a C average (19%) compared to students experiencing food security (9%). Students experiencing food insecurity had significantly higher proportions of poor mental health indicators (22-83%) compared to students experiencing food security (11-80%; Table 2).

[TABLE 2 INSERT HERE]

Modeling results

We constructed a latent variable for poor mental health. All nine items on student mental health loaded onto the latent variable, meaning that all items contributed to the construct of *poor mental health*. Factor loadings ranged from 0.52-0.91, with feelings of stress having the lowest factor loading and feelings of being very sad having the highest factor loading. The *a priori* model fit the data well (CFI =0.96, RMSEA=0.04).

[FIGURE 1 INSERT HERE]

The structural equation model showed that food insecurity was directly and indirectly related to student GPA, controlling for all covariates (Figure 1). Specifically, food insecurity was directly related to lower GPA among students (B= -0.08, $p < 0.001$). Additionally, food insecurity was significantly related to poor mental health (B= 0.17, $p < 0.001$), and in turn, poor mental health was significantly associated with lower GPA among students (B= -0.09, $p < 0.001$; indirect: -0.015; $P < 0.001$).

DISCUSSION

This study examined the relationships between food insecurity, student mental health, and GPA among college students enrolled in a statewide public university system. Food insecurity among students was related to lower GPA both directly and indirectly through poor mental health. These findings highlight the importance of consistent access to nutritionally adequate foods for students in higher education systems.

Our finding that food insecurity was linked to lower academic performance among students is consistent with several studies in higher education settings. Patton-Lopez et al. (2014) conducted a study among 354 students attending university in rural Oregon and found that university students who experienced food insecurity were at increased risk for poor academic performance. MacDonald (2016) conducted a similar study in 467 students attending a university in Alabama and found that food insecurity was negatively related to GPA. In the current study, one in three college students experiencing food insecurity had an A average whereas one in two college students experiencing food security had an A average. Additionally, in the UC sample, about 30% more students who experienced food insecurity had difficulty studying because they had no money for food compared to students who were food secure (Martinez et al., 2016). Recent qualitative research of students in the UC system also describes the experience of food insecurity impacting a student's ability to focus on academics (Watson et al., 2017). These findings are also consistent with studies showing that food insecurity may result in hunger—a physiological state resulting in discomfort due to lack of food. Hunger resulting from food insecurity affects the ability to focus, which in turn can affect academic performance (Hadley and Crooks, 2012; Jyoti et al., 2005). In school-age children, studies have shown that hunger as a result of food insecurity impacts concentration and even academic performance (Hadley and Crooks, 2012; Jyoti et al., 2005).

Poor mental health was a mediator that linked food insecurity to lower academic performance among college students. To our knowledge, this is the first study to suggest a connection between nutritional status, mental wellbeing and academic performance among college students. Moreover, this finding is consistent with recent studies of freshman students (Bruening et al.,

2016) and undergraduate students (Payne-Sturges et al.) showing that students experiencing food insecurity are more likely to report depression compared to students experiencing food security. Similarly, Patton-Lopez et al. (2014) found that students experiencing food insecurity were more likely to self-report their health as fair or poor. While our study echoes these findings, our findings also extend the knowledge of poor mental health as a mediator in the relationship between food insecurity and academic achievement among college students.

It is worth noting the economic context in which we observed the high prevalence of food insecurity in the UC student population (40%) compared to that in the general U.S. population (13%). In 2013-14, a large majority of first year UC students (82%) were from California (University of California, 2015c); a state that has high unemployment and food insecurity rates (Feeding America, 2015), has the highest poverty rate in the nation (Renwick and Fox, 2016), and spends more on its correctional system than on public higher education (University of California, 2015a). Nearly half of UC students (41%) received Pell Grants based on financial need and were among the first in their families to attend a 4-year college (44%)—the highest in the past decade (University of California, 2015b). A steadily rising proportion of undergraduate students (42%) were from low-income backgrounds (defined as a family income below \$50,000 per year) (University of California, 2015c), a prevalence which has increased almost 1% each year since 2008. According to an index of student economic diversity, six of the top seven colleges in the nation doing the most to help low-income students were UC campuses (New York Times, 2015). It is in this socioeconomic climate that we administered the 2015 Student Food Access and Security Study, which may partly explain the high prevalence of food insecurity among UC students. Furthermore, students are taking longer to graduate, yet graduation rates are higher among students with a parent who earned a bachelor's degree

(University of California, IRAP, 2017). Data from 2012 show that earning a degree in four years was 58% in first-time generation college students and 67% in college students whose parent earned a bachelor's degree.

Student basic needs is a new and evolving concept, the core aspects of which include access to nutritionally adequate and safe foods, and access to stable and safe housing. A state and institutional commitment to meeting students' basic needs seems like a promising strategy to ensure student wellness (nutritional and mental) and academic achievement to improve the academic experience and graduation rates. In turn, this investment, may have a long lasting impact on career success (Tan, 1991). The University of California system has made strides with the support of the UC Global Food Initiative. Across all 10 UC campuses, both short- and long-term strategies are being implemented. Short-term strategies include on-campus food pantries and meal vouchers, and long-term strategies include improving access to services such as Supplemental Nutrition Assistance Program (SNAP) enrollment, on-campus hubs for basic needs, and improving food systems practices. California's higher education systems (UC, state universities, and community colleges) have also partnered to develop statewide policy solutions. More recently housing insecurity has also become part of the agenda, but far less is known about the negative impacts of housing insecurity among college students. Nevertheless, more efforts are needed to improve student basic needs.

Study strengths include the large sample size and randomly selected participants in a statewide university system. We also controlled for student characteristics that may be associated with student mental health and GPA. Study limitations include the cross-sectional design, which

cannot determine cause and effect, or directionality. The assumed directions of association in the examined structural equation model were informed by previous research, and the resulting model fit indices suggest that the data fit the model well. Study participation included more females than males, and a low response rate (14%). Lastly, freshmen were asked to report on food insecurity in the last 12 months, so their food insecurity experience could have occurred prior to attending UC.

Conclusion

While college students may be viewed as a “privileged group”, high levels of food insecurity among some may negatively impact student mental wellbeing and academic success. Our findings suggest that mental health and academic performance may be improved if food insecurity is addressed. Longitudinal studies should examine impacts of student food insecurity—and intervention to address it—on educational attainment and health disparities. Lastly, these findings can be used to inform future policy on the importance of providing students with the basic needs to ensure academic and future success. Growing income inequality, low wages, and lack of housing affordability, coupled with increasing cost of higher education in the U.S., make it difficult for many young Americans to have the resources to meet basic needs, especially for food (Holmes and Berube, 2016; Ma et al., 2017). Institutions of higher education need to devise strategies and actions to identify students at risk of food insecurity, and assist students who will benefit from campus services and complementary federal, state, and local programs.

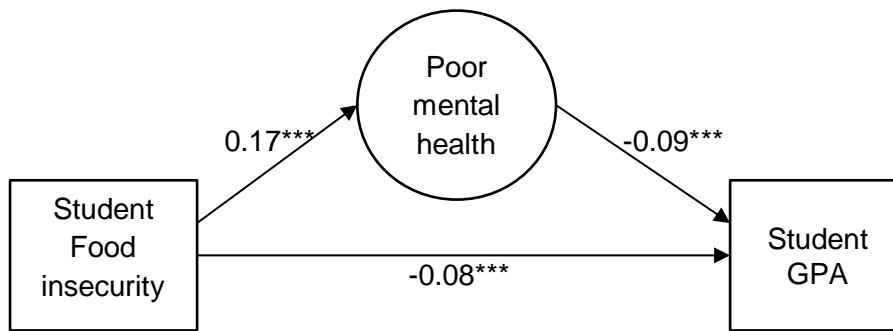


FIGURE 1

Structural equation model with standardized path coefficients showing relationships between student food insecurity, student mental health and student GPA (n = 8568). Controlling for race/ethnicity, sex, being a financial aid recipient, part-time and full-time employment, undergraduate level, and campus affiliation. Model fit: CFI =0.96, RMSEA=0.04; ***P < 0.001 for significant pathways.

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Table 1. Characteristics of 8705 students surveyed in spring 2015 about food insecurity at University of CA, and differences by food security status in the past 12 months; data represent % (No.) unless otherwise specified

Characteristics	Total Sample	Food Secure	Food Insecure
Total	100 (8705)	22 (1907)	18 (1531)
Age (years), mean±SD	23±6	24±5	23±5
Gender^a			
Female	67 (5818)	67 (3514)	67 (2304)
Male	33 (2817)	33 (1720)	32 (1097)
Race/ethnicity			
Non-Hispanic White	34 (2974)	41 (2147)	24 (827)
Non-Hispanic Black	2 (206)	2 (100)	3 (106)
Hispanic	21 (1844)	15 (797)	31 (1047)
Asian	31 (2691)	31 (1637)	31 (1054)
Mixed race or other	11 (990)	11 (586)	12 (404)
Academic level			
Undergraduate	66 (5720)	57 (3006)	79 (2714)
Graduate	34 (2994)	43 (2233)	22 (711)
Cumulative grade average			
A	42 (3358)	49 (2395)	29 (963)
B	44 (3481)	39 (1880)	49 (1601)
C	13 (1032)	9 (415)	19 (617)
D/F	1 (51)	<1 (21)	1 (30)
Living situation			
Off campus housing	58 (5053)	60 (3169)	55 (1885)
Campus residence hall	23 (2020)	22 (1176)	25 (844)
Other campus housing	10 (891)	10 (508)	11 (383)
Parent/guardian's home	5 (468)	5 (266)	6 (202)
Other housing ^b	2 (17)	2 (92)	2 (83)
Fraternity/sorority house	1 (51)	1 (51)	1 (32)
Hours worked for pay			
0 hours	48 (4121)	49 (2557)	46 (1564)
1-9 hours	12 (1060)	11 (596)	14 (464)
10-19 hours	19 (1602)	16 (883)	22 (769)
20-29 hours	10 (854)	10 (509)	10 (345)
30-39 hours	2 (177)	2 (90)	3 (87)
40+ hours	4 (372)	13 (658)	6 (199)
Received financial aid, need-based scholarship, grant, loan	65 (5628)	73 (1386)	82 (1247)

^aA total of 48 (<1%) students were transgender.

^bOther housing refers to living temporarily with a friend, homeless or other unknown.

Note: Not all students had complete data on demographic characteristics; therefore, percentages may not add up to 100%.

Table 2. Mental health indicators for 8705 students surveyed in spring 2015 about the past 12 months at University of CA; data represent % (No.) unless otherwise specified

Have you ever felt...	Total Sample	Food Secure	Food Insecure
Hopeless*	43 (3694)	36 (1912)	46 (882)
Overwhelmed by all you had to do*	82 (7080)	80 (4229)	81 (1534)
Exhaustion (not from physical activity)*	76 (6625)	74 (3891)	77 (1470)
Very lonely*	52 (4494)	47 (2489)	53 (1016)
Very sad*	55 (4792)	51 (2662)	58 (1112)
Overwhelming anxiety*	52 (4517)	47 (2447)	56 (1068)
Overwhelming anger*	28 (2459)	23 (1230)	32 (604)
Depression that made it difficult to function*	31 (2694)	24 (1284)	36 (680)
Tremendous stress*	15 (1324)	11 (563)	18 (337)

* Chi-square tests between food secure and food insecure groups significantly different at $P < 0.05$.

Note: Not all students had complete data on demographic characteristics; therefore, percentages may not add up to 100%.