Food Insecurity and Substance Use Among Young Adult College Students in the United States

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Background: Food insecurity is prevalent among college students in the United States and has been associated with substance use. We sought to provide updated prevalence estimates and associations between food insecurity and a broad range of substances during the SARS-CoV-2 pandemic.
Methods: Using cross-sectional data from the Health Minds Study (N = 94,722; September 2020–June 2021), we used multivariable logistic regression to examine associations between food insecurity and several substances, adjusting for age, gender, race/ethnicity, hours worked, and residence. We then added a block of adjustments consisting of mental health factors (depression, anxiety, loneliness, financial stress).
Results: Food insecurity was associated with significantly greater odds of having used most individual substances, including greater odds of binge drinking (adjusted odds ratio [aOR], 1.21; 95% confidence interval [CI], 1.13–1.30), cigarette use (aOR, 1.91; 95% CI, 1.73–2.10), vaping (aOR, 1.74; 95% CI, 1.62–1.87), and a range of illicit or prescription drugs (using any illicit/prescription drug; aOR, 1.43; 95% CI, 1.32–1.55) These associations attenuated and many lost significance after adjusting for mental health factors.
Conclusions: This study found evidence to suggest that food insecurity is related to substance use in a large sample of young adult college students in the United States, calling for targeted interventions.

Key Words: food insecurity, drug use, substance use, illicit, prescription, college, young adult

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Food insecurity is defined as having limited access to nutritionally adequate foods or uncertainty of whether one can consistently acquire nutritious foods in a socially acceptable manner.[1] According to the National Health Interview Survey, between 2011 and 2017, young adults in the United States were more vulnerable to food insecurity when compared with older adults.[2] While a study that analyzed the Current Population Survey suggests that students in higher education in this age range tend to be more food secure than their nonstudent counterparts,[3] food insecurity remains an enduring concern on college campuses. A systematic review found that average prevalence of food insecurity was between 35% and 42% among students in higher education,[4] which was corroborated in another systematic review of 8 studies (n = 52,085) that found a similar prevalence (41.4%).[5] These estimates suggest a higher prevalence of food insecurity than US national households more broadly (13%),[5] although there is reason to suspect that prevalence of food insecurity may be inflated among college students because of nonprobability sampling and low response rates.[3] Still, roughly 1 in 10 students in higher education is food insecure according to the Current Population Survey,[3] which may be explained by the high cost of tuition, the financial burden of attending college (eg, rent, tuition, utilities), the lack of stable income, the lack of knowledge to manage finances, and the lack of food literacy.[6]

Studies have shown that food insecurity has previously been connected to substance use.[7] For example, in one study, food insecurity was associated with approximately 3 times greater odds of cigarette smoking, one and a half times greater odds of heavy alcohol use, and more than 5 times greater odds of dual use among adults in Wisconsin (n = 1616).[8] In a study using the National Longitudinal Study of Adolescent to Adult Health (n = 14,786 young adults aged 24–32 years), food insecurity was associated with greater odds of using marijuana, methamphetamines, cocaine, opioids, sedatives, and stimulants, adjusting for age, sex, race/ethnicity, education, income, household size, smoking, and alcohol use.[9] However, there are fewer studies that examine food insecurity and substance use among college populations. One study from Minneapolis, St Paul, Minnesota, analyzed the Eating and Activity over Time study (2017–2018) and found that the prevalence of cigarette, marijuana, heavy alcohol, and other drug use was significantly higher among college students who were food insecure than among those students who were food secure.[10] College can be a challenging time WHEN students deal with the pressures of excelling in their courses, WHILE adapting to new social environments, discovering their identities, experimenting, and seeking new experiences.[11–15] While the causal pathways are still unclear, one possibility is that food

insecurity may be stressful,[16] resulting in substance use.[17,18] At the same time, it is also possible that substance use can drain financial resources leading to food insecurity.[19] These are not mutually exclusive possibilities.

More research is needed to determine the extent to which food insecurity is related to use of a broad range of substances, especially the less commonly used substances, beyond alcohol, tobacco, and cannabis. Furthermore, research is needed to ascertain these associations net the effects of mental health factors. Thus, in this study, we explored these associations by analyzing data from a large sample of college students attending institutions of higher learning across the United States during the first year of the SARS-CoV-2 pandemic.

METHODS

Sample

We analyzed data from the Fall and Spring cohort of the 2020–2021 Healthy Minds Study (HMS), a non-probability web-based survey examining health and wellness among students enrolled in higher education in the United States.[20] The HMS survey is administered annually as a repeated cross-section of schools, with a different set of schools every year, including community colleges, 4-year colleges, and professional schools. The HMS survey uses several validated measures to provide information about the prevalence of mental health outcomes, knowledge and attitudes about mental health, and service utilization. The survey was administered at 37 institutions of higher learning (n = 34,168) between September and December 2020 and then administered again at 103 institutions (n = 103,748) between January and June 2021. Students who completed the survey were entered into raffles to receive prizes. The response rate was 14%, which is comparable with other response rates from online surveys using convenience samples and panels. We restricted the sample by age[18–29] to isolate young adults and further excluded individuals who were missing data on any of the variables of interest; we used complete-case analysis, resulting in a final analytic sample of 94,722. The HMS was approved by the institutional review board of Advarra and the institutional review boards at all participating campuses. A list of all participating schools as well as the HMS data is available upon request at: https://healthymindsnetwork.org/hms/.

Measures

Food Insecurity (Predictor)

Food insecurity was measured using 2 items[1]: within the past 12 months, I was worried whether our food would run out before we got money to buy more[2]; within the past 12 months, the food I bought just did not last and I did not have money to get more. Respondents could answer: never true, sometimes true, and often true. Individuals were identified as food insecure with an affirmative answer (sometimes true or often true) to either question, following prior studies.[21,22]

Substance Use (Outcomes)

Binge drinking was measured using the item: "Over the past 2 weeks, about how many times did you have 4 [female]/

5 [male] or more alcoholic drinks in a row?" One drink was a can of beer, a glass of wine, a wine cooler, a shot of liquor, or a mixed drink.[23] This item was dichotomized to reflect binge drinking at least once over the past 2 weeks. Cigarette use was assessed using the item: "Over the past 30 days, about how many cigarettes did you smoke per day?" This item was coded to reflect at least one cigarette over the past month, consistent with prior studies.[24,25] Vaping was assessed using the single dichotomous (yes/no) item: over the past 30 days, have you used an electronic cigarette or vape pen? Respondents were then asked to complete a checklist of 14 illicit and prescription drugs to which they responded (yes/no) if they had used each drug over the past 30 days. We created a dichotomous variable "any drug" to capture the endorsement of any one of these 14 drugs (Table 2).

Mental Health (Covariates)

Given that the SARS-CoV-2 pandemic likely impacted the mental health of students, we adjusted for a set of mental health covariates. Loneliness was measured using the 3-item University of California, Los Angeles loneliness scale.[26] Depression was measured using the Patient Health Questionnaire 9.[27] Anxiety was measured using the General Anxiety Disorder 7.[28] Current financial distress was assessed using the single Likert item (never stressful to always stressful): "How would you describe your financial situation right now?"

Sociodemographic Characteristics (Covariates)

We restricted the sample to focus on young adults further controlled for age as a continuous variable. We adjusted for gender (man, woman, transgender/nonbinary/other), because food insecurity is more prevalent among women and transgender/nonbinary/other genders[29,30]; there are also gender differences in substance use.[31] We adjusted for race/ethnicity (White, Black, Latinx/Hispanic, Asian American/Pacific Islander, multiracial, and other) because Latinx and Black Americans tend to be more food insecure when compared with Whites,[32] and substance use profiles vary by race/ethnicity.[33] Given that the pandemic may have impacted students differently depending on whether they were living on campus or whether they were living at home, we adjusted for residence using a categorical variable reflecting: on-campus (residence hall, apartment), off-campus (nonuniversity housing, with parents/relative), and other housing (fraternity/sorority house, cooperative housing). Examining students in higher education represents a particular sociodemographic group, which in some ways controls for socioeconomic status (ie, education level is often used as a crude proxy for socioeconomic status). However, we acknowledge that there is gradation even within a single stratum. Thus, we adjusted for number of hours worked as a proxy for socioeconomic status, where students who work while in enrolled in school may be in a more precarious financial situation than students who do not have to work.

Analysis

Multivariable logistic regression analyses were used to test for associations between food security (predictor) and each type of substance (outcomes). We adjusted models using hierarchical blocks of covariates. First, we adjusted for age, gender, race/ethnicity, residence, and hours worked (BLOCK A). Then,

we added a block of adjustments consisting of mental health factors, including loneliness, depression, anxiety, and financial stress (BLOCK B). We present results as odds ratios with 95% confidence intervals (CI). We used sample probability weights to adjust for nonresponse based on administrative data on full student populations at each institution. Using multivariable logistic regression, response propensity was estimated based on gender, race/ethnicity, academic level, and grade point average. We then assigned response propensity weights to each student who completed the survey. Students who were less likely to have completed the survey were assigned a larger weight in the analysis. Sample weights gave equal aggregate weight to each school in the national estimates rather than assigning weights in proportion to school size, so that overall national estimates were not dominated by schools in our sample with large enrollment. Standard errors were clustered by university. We performed all statistical analyses using R.

RESULTS

In this sample of young adult college students aged 18 to 29 years, an estimated 30.54% of the sample reported food insecurity. Supplemental Table S1, http://links.lww.com/JAM/A372, contains sociodemographic information on the sample. Food insecurity was more common among women (31.7%, n = 17,217) and transgender/nonbinary/other (42.1%, n = 1337) when compared with men (27.8%, n = 10,371). Furthermore, food insecurity was more common among Black (50.5%, n = 5117) and Latinx/Hispanic (42.8%, n = 3178) students compared with White students (25%, n = 14,460). Food insecurity was higher among students who lived off-campus (31.5%, n = 20,227) or in other housing situations (38.2%, n = 1546) when compared with on-campus (27%, n = 7152). Those who were food insecure worked more hours per week on average (16.8 h/wk) than those who were food secure (12.8 h/wk). Table 1 provides descriptive statistics for all mental health variables, which are more prevalent among food insecure than among food secure.

Across the board, all substance use outcomes were more common among those who were food insecure than those who were food secure, although not necessarily at a conventional level of statistical significance (Table 2). Multivariable logistic regression models showed that food insecurity was associated with significantly greater odds of binge drinking (adjusted odds ratio [aOR], 1.21; 95% CI, 1.13–1.30), cigarette use (aOR, 1.91; 95% CI, 1.73–2.10), and vaping (aOR, 1.74; 95% CI, 1.62–1.87).

Furthermore, food insecurity was associated with a range of illicit or prescription drugs, except for heroin, methamphetamines, and athletic performance enhancers. Food insecure students were 1.43 times as likely to use any illicit or prescription drugs (aOR, 1.43; 95% CI, 1.32–1.55). These associations attenuated, and many fell beneath the conventional threshold for statistical significance after adjusting for mental health variables (Table 2).

DISCUSSION

Summary of Findings

To date, this is the largest study on food insecurity and substance use in the young adult college population of the United States. We found that food insecurity was associated with greater odds of common substance use (ie, binge drinking, cigarettes, vaping) and a range of illicit and prescription drugs (although not significantly for heroin, methamphetamines, or athletic performance enhancing drugs). Associations attenuated, and many became statistically insignificant (at least at a conventional level) after adjusting for mental health factors; however, this may be attributable to the fact that illicit and prescription drug use was relatively uncommon among college students, resulting in imprecise estimates. Even with the adjustments, the associations suggested greater odds of substance use across the board. Our findings support prior studies that have shown food insecurity is related to substance use[8,18,34] but also add to the literature by showing the association among young adults in colleges across the United States using a wide range of substances during the SARS-CoV-2 pandemic.

Explanation of Findings

The associations found in this cross-sectional study may be explained in a few ways. Although we cannot make any causal inferences, it is possible that food insecurity may drive substance use; namely, students may resort to substance use as a form of self-medication[35] to deal with the stress of not having enough money to buy adequate amounts of nutritious food. Prior studies have shown that food insecurity has indeed been associated with stress,[16] which is also linked to substance use.[17,18] It is also possible that the causal direction can flow in the opposite direction, such that substance use can contribute to food insecurity by draining material resources,[19] especially among college students who tend to have minimal income. Substances (eg, cigarettes)

TABLE 1. Mental Health Variables Stratified by Food Insecurity (Healthy Minds Study, 2020–2021)

	Food Secure (n = 65,797)	Food Insecure (n = 28,925)	Total (94,722)	*P*
Depression, yes, n (%)	11,284 (17.15%)	10,486 (36.25%)	21,770 (22.98%)	<0.001
Anxiety, yes, n (%)	19,726 (29.98%)	14,530 (50.23%)	34,256 (36.16%)	<0.001
Loneliness, yes, n (%)	34,583 (52.56%)	19,213 (66.42%)	53,796 (56.79%)	<0.001
Financial stress				<0.001
Never stressful	6565 (9.98%)	151 (0.52%)	6716 (7.09%)	
Rarely stressful	17,615 (26.77%)	849 (2.94%)	18,464 (19.49%)	
Sometimes stressful	26,438 (40.18%)	6232 (21.55%)	32,670 (34.49%)	
Often stressful	11,594 (17.62%)	11,066 (38.26%)	22,660 (23.92%)	
Always stressful	3585 (5.45%)	10,627 (36.74%)	14,212 (15.00%)	

Patient Health Questionnaire 9 (scores >14); General Anxiety Disorder 7 (scores >9); UCLA Loneliness Scale (scores >5).
P values reflect χ^2 tests.

TABLE 2. Examining Associations Between Food Insecurity and Substance Use Among Young Students in Higher Education (<30 Years), Healthy Minds Study, 2020–2021

	Descriptive Statistics: Prevalence of Substance Use Stratified by Food Insecurity				Multivariable Logistic Regression Models	
					aOR (95% CI)	aOR (95% CI)
	Food Secure (n = 65,797)	Food Insecure (n = 28,925)	Total (N = 94,722)	*P*	A	A + B
Binge drinking	19,018 (28.90%)	9198 (31.80%)	28,216 (29.79%)	<0.001	**1.21 (1.13–1.30)**	**1.09 (1.02–1.16)**
Cigarettes	3320 (5.05%)	2467 (8.53%)	5787 (6.11%)	<0.001	**1.91 (1.73–2.10)**	**1.45 (1.31–1.61)**
Vaping	9572 (14.55%)	5831 (20.16%)	15,403 (16.26%)	<0.001	**1.74 (1.62–1.87)**	**1.23 (1.14–1.32)**
Illicit/prescription drugs						
Marijuana	12,440 (18.91%)	7129 (24.65%)	19,569 (20.66%)	<0.001	**1.43 (1.32–1.54)**	1.07 (0.98–1.16)
Cocaine	507 (0.77%)	311 (1.08%)	818 (0.86%)	0.014	**1.54 (1.22–1.93)**	**1.41 (1.05–1.90)**
Heroin	8 (0.01%)	4 (0.01%)	12 (0.01%)	0.957	1.11 (0.21–5.87)	1.18 (0.17–8.16)
Opioids	145 (0.22%)	186 (0.64%)	331 (0.35%)	<0.001	**3.18 (2.20–4.60)**	**1.89 (1.29–2.76)**
Benzodiazepines	255 (0.39%)	212 (0.73%)	467 (0.49%)	<0.001	**2.09 (1.54–2.82)**	1.19 (0.87–1.62)
Methamphetamines	32 (0.05%)	15 (0.05%)	47 (0.05%)	0.819	1.08 (0.45–2.57)	1.20 (0.47–3.05)
Stimulants	861 (1.31%)	520 (1.80%)	1381 (1.46%)	0.003	**1.56 (1.27–1.92)**	1.13 (0.88–1.46)
MDMA	159 (0.24%)	150 (0.52%)	309 (0.33%)	<0.001	**2.11 (1.53–2.91)**	**1.51 (1.11–2.04)**
Ketamine	86 (0.13%)	66 (0.23%)	152 (0.16%)	0.066	**1.86 (1.04–3.34)**	1.30 (0.61–2.77)
Lysergic acid diethylamide	384 (0.58%)	279 (0.96%)	663 (0.70%)	0.001	**1.96 (1.46–2.63)**	1.34 (0.96–1.89)
Psilocybin	734 (1.12%)	474 (1.64%)	1208 (1.28%)	<0.001	**1.55 (1.24–1.94)**	1.16 (0.94–1.43)
Kratom	186 (0.28%)	175 (0.61%)	361 (0.38%)	0.001	**2.56 (1.76–3.73)**	**1.49 (1.05–2.10)**
Athletic performance enhancers	45 (0.07%)	14 (0.05%)	59 (0.06%)	0.423	0.78 (0.32–1.87)	0.51 (0.17–1.48)
Other drugs	308 (0.47%)	168 (0.58%)	476 (0.50%)	0.177	1.29 (0.93–1.79)	1.06 (0.73–1.55)
Any drugs	14,235 (21.63%)	8073 (27.91%)	22,308 (23.55%)	<0.001	**1.43 (1.32–1.55)**	1.07 (0.98–1.15)

P values reflect χ^2 tests.
Blocks of covariates:
MDMA, 3,4-Methyl enedioxy methamphetamine.
In the multivariable logistic regression models, $P < 0.05$ is indicated in bold.
A. Adjusted for age, gender, race/ethnicity, residence, and hours worked.
B. Adjusted for depression, anxiety, financial stress, and loneliness.

can be costly as a direct expenditure but also indirectly by causing health problems that strain one's budget. It is important to note that the relation between food insecurity and substance use can be bidirectional. With that being said, the associations found in the current study may also reflect socioeconomic and socioenvironmental factors. Students in higher education represent a particular social stratum of people with high levels of education (vs people with less than a high school education). Examining a single stratum in some ways controls for several socioeconomic confounders. At the same time, we acknowledge the heterogeneity throughout student populations, where students come from varying socioeconomic backgrounds that correspond with varying levels of financial distress. Certainly, the durable effects of poverty and other neighborhood-level deprivations can impact security and behavioral health into young adulthood.

Limitations

Our study should be interpreted bearing in mind several limitations. First, the data were cross-sectional and could not be used to establish a causal direction. Specifically, we could not ascertain whether food insecurity preceded substance use or vice versa. Prior studies have conceptualized food insecurity as a driver of substance use, though it is entirely possible that the association is the other way around.[34] Future longitudinal studies may help establish temporal precedence. Second, the survey was administered to students enrolled in higher education, and findings cannot be generalized beyond this population. Future

research can examine the associations between food insecurity and substance use among noncollege students, or older populations. Third, the data were collected during the SARS-CoV-2 pandemic, which introduced several potential confounding factors. Starting in March 2020, college campuses (including campus housing) were abruptly closed in response to mandates that aimed to contain the spread of SARS-CoV-2 virus. Students experienced significant disruption in their schoolwork (eg, struggling to adapt to virtual classes), social lives (eg, not being able to socialize), employment (eg, losing their service sector jobs), housing/living arrangements (eg, moving back home versus being isolated), and access to services (eg, not being able to readily use mental health and substance use treatment).[36] Moreover, the pandemic impacted different groups of people according to social and geographic locations. We recognize the potential for omitted variable bias during this precarious time. Along these lines, we ran a set of models adjusting for an extensive set of mental health factors, including depression, anxiety, loneliness, and financial stress (which associate with both food insecurity and substance use but may have been elevated because of the pandemic); however, the temporal order of events and causal pathways are still unclear in this cross-sectional analysis. It is therefore possible that these covariates may be better framed as mediators, in which case these adjustments may actually be controlling away the effects of food insecurity on substance use.[37] Fourth, the response rate was approximately 14%, which is not outside of the expected range for online nonprobability

samples.[38] While we used survey weights to account for nonresponse, we note that nonprobability samples and low response rates may have resulted in inflated prevalence of food insecurity, which has been suggested in a prior study.[3] Finally, we used a 2-item measure of food insecurity, which has been used widely in previous research. However, future studies may aim to more comprehensively measure all the dimensions of food insecurity, including access, utilization, stability, and availability. Despite these limitations, this study is the largest to date to examine associations between food insecurity and substance use among young adult college students in the United States.

Implications

While no causal direction can be established in this study, findings may inspire future research to design and test the effectiveness of programs that address food insecurity as a means of reducing substance use, and vice versa. Colleges may consider intervening on food insecurity by creating affordable meal plans and dining options on campuses, offering financial counseling, and providing referrals to resources, such as food banks/pantries. It is unknown whether these measures would necessarily curb substance use; however, they may be broadly beneficial regardless. At the same time, substance use treatment programs can be more recovery oriented by addressing broader functioning across multiple domains, including education, employment, and food security. That is, perhaps a goal of treating substance use may be to enhance overall capability while decreasing insecurity. Regardless of causal direction, these measures can be coordinated to address specific needs of students,[6,39] which can potentially enhance academic performance, improve wellbeing more broadly. Preventive interventions for substance use and food insecurity during this life stage can have a strong impact on wellness throughout the life course.

Conclusions

Food insecurity remains a public health problem that affects students enrolled in higher education. Our study found that food insecurity was associated with use of a broad range of substances, accounting for key sociodemographic characteristics. These associations attenuated after adjusting for mental health factors.

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