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Food Insecurity and Its Association With Alcohol and Other Substance Use Among High School Students in the United States

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Abstract

BACKGROUND: Studies show that food insecurity is associated with adverse health behaviors for children and adults. However, published data among adolescents are limited. The objective of this study was to examine the association between food insecurity and substance use behaviors among US high school students.

METHODS: Data from the 2017 Youth Risk Behavior Survey in 10 states were combined to examine the association between household food insecurity and adolescent use of alcohol, marijuana, prescription opioid misuse, and illicit drugs using logistic regression.

RESULTS: Among surveyed respondents, 12.3% of high school students reported experiencing food insecurity. In unadjusted analyses, the prevalence of substance use was higher among students with food insecurity compared to food secure students: current binge drinking (16.2% vs 11.5%), current marijuana use (24.0% vs 16.2%), lifetime prescription opioid misuse (21.3% vs

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Human Subjects Approval Statement

The YRBS has been reviewed and approved by an Institutional Review Board at the US CDC.

Conflict of Interest

The authors declare no conflict of interest.

12.6%), and lifetime use of illicit drugs (12.3% vs 5.0%) (all $p < .05$). In adjusted models, food insecurity was associated with lifetime prescription opioid misuse and lifetime use of illicit drugs (aPR 1.38 and 1.70, respectively).

CONCLUSION: Students with food insecurity are a potential group at a higher rise of substance misuse and may benefit from prevention programs designed to address their needs.

Keywords

food insecurity; alcohol; substance use; adolescents

BACKGROUND

Households with food insecurity are characterized by uncertain or limited access to the adequate and nutritious food needed to maintain a healthy lifestyle.[1] Recent estimates indicate that 11.8% of households in the United States are food insecure, with a higher prevalence in households with children (≤ 18 years of age, 15.8%).[2] Food insecurity is concentrated among children from low-income households and disadvantaged communities, thus widening the gap of inequality among these populations.[2,3] Children residing in households with food insecurity experience both undernutrition and micronutrient deficiencies, which may lead to underdevelopment of the brain.[4,5] Previous studies have noted that areas of the brain that are particularly sensitive to inadequate nutrition are involved with neurocognitive deficits.[5–7] For example, evidence suggests that compromised nutritional status in early childhood is linked to immediate adverse developmental behavioral outcomes, including poor academic performance, deficits in impulse control, and exacerbated symptoms of Attention-Deficit Hyperactivity Disorder.[6–10] Additionally, a growing body of literature has found household food insecurity to be an emotional stressor that contributes to long-term mental health. Research has shown that food insecurity during childhood and associated adverse behaviors, such as impulsivity, may be a predictor for depression, interpersonal violence, suicidal ideation, and substance use disorders in adulthood.[6,11–13]

Adolescence is a pivotal period when choices about health-related behaviors are formed and continued into adulthood.[14] While an emerging body of research has examined the associations between food insecurity and adverse behavioral health outcomes in children and adults, there is a paucity of published data examining the relationship between food insecurity and substance use behaviors among adolescents. Low food security status, which has been linked to impulse control, could increase adolescents willingness to engage in risk taking behaviors such as substance misuse.[13] The US Department of Agriculture's (USDA) food insecurity surveillance statistics do not stratify food insecurity prevalence by age groups for children, therefore, less is known about the experience of food insecurity among adolescents.[2] Additionally, most studies collect data from the reports of parents and guardians. Research has suggested that parents' perceptions of their children's level of food insecurity may differ from the self-reports of adolescents.[15] This age group may also reduce their food intake for the benefit of other family members when the household experiences periods of low food security.[15,16] In order to develop and implement evidence-based strategies to prevent substance misuse among youth and mitigate future behavioral

problems in adulthood, it is important to identify factors associated with adolescent use of alcohol and other substances. In this article, we address the gap in the literature by examining data from US high school students in 10 states to determine the association between food insecurity and alcohol and substance use.

METHODS

Study Design

The US Centers for Disease Control and Prevention (CDC) has administered the Youth Risk Behavior Surveillance System (YRBSS) biennially since 1991. The YRBSS is a system of surveys conducted at national, state, large urban school district, territorial, and tribal levels. Each jurisdiction conducts its own Youth Risk Behavior Survey (YRBS). State-level YRBSs use a two-stage cluster sampling methodology to produce representative samples of mostly public high school students in 9th to 12th grades in each jurisdiction. Survey participation was anonymous, voluntary, and conducted in compliance with local parental permission requirements. Students completed the self-administered questionnaire during a regular class period, with responses recorded on a standard answer sheet or using a computer-scannable booklet. The data were weighted to adjust for school and student nonresponse and the oversampling of black and Hispanic students. For this analysis, the authors used the 2017 state-level YRBSs to examine the association between food insecurity and substance use behaviors among US high school students. The sample was restricted to adolescents residing in the 10 states which had opted to include questions assessing both food insecurity and sexual identity: Delaware, Hawaii, Nebraska, Nevada, North Carolina, North Dakota, Pennsylvania, Rhode Island, Texas, and Vermont. This study included sexual identity because previous research has found increased rates of substance misuse among high school students identifying themselves as sexual minorities.[17] Data from 43,857 students were available for the analysis. A student response rate of at least 60% is required to weight the data to reflect the student population. In the 10 states included in this analysis, the student response rate ranged from 63% to 88%. More detailed information on the methodology of the YRBSS has been previously reported.[18] The national YRBS has been reviewed and approved by an institutional review board at the CDC. The data used in this study were approved by CDC as research not involving identifiable human subjects.

Measures

Food Insecurity.—Participants' self-reported food security status was measured using the following question: ''During the past 30 days, how often did you go hungry because there was not enough food in your house?'' Response options were ''never,'' ''rarely,'' ''sometimes,'' ''most of the time,'' and ''always.'' Respondents who answered ''sometimes,'' ''most of the time,'' or ''always'' were categorized as food insecure, and those who answered ''never'' or ''rarely'' were categorized as food secure.[19]

Alcohol and Other Substance Use

This analysis examined four substance use behaviors to determine the strength of their association with food insecurity: current binge drinking, current marijuana use, lifetime prescription opioid misuse, and lifetime use of illicit drugs. To measure binge drinking,

students were asked, ‘‘During the past 30 days, on how many days did you have 4 or more drinks of alcohol in a row (if you are female) or 5 or more drinks of alcohol in a row (if you are male)?’’ Response options were ‘‘0 days,’’ ‘‘1 day,’’ ‘‘2 days,’’ ‘‘3 to 5 days,’’ ‘‘6 to 9 days,’’ ‘‘10 to 19 days,’’ and ‘‘20 or more days.’’ Responses were categorized into two groups: no current binge drinking (<1 days) and current binge drinking (≥1 days). Response options for marijuana and prescription opioid misuse questions and the questions used to create the composite variable for illicit drug use utilized the same response options: ‘‘0 times,’’ ‘‘1 or 2 times,’’ ‘‘3 to 9 times,’’ ‘‘10 to 19 times,’’ ‘‘20 to 39 times,’’ or ‘‘40 or more times.’’ Students were asked, ‘‘During the past 30 days, how many times did you use marijuana?’’ Responses were collapsed into two groups: no current marijuana use (0 times) and current marijuana use (≥ 1 times). Lifetime prescription opioid misuse was examined using the question, ‘‘During your life, have you ever taken prescription pain medicine without a doctor’s prescription or differently than how a doctor told you to use it? (Count drugs such as codeine, Vicodin, OxyContin, Hydrocodone, and Percocet).’’ Response options were combined to form two groups: never use (0 times) and ever use (≥1 times). Ever use of illicit drugs was determined by combining responses to three questions on use of heroin, methamphetamines, and cocaine. Heroin use was assessed by asking, ‘‘During your life, how many times have you used heroin (also called smack, junk, or China White)?’’ Students were also asked, ‘‘During your life, how many times have you used any form of cocaine, including powder, crack, or freebase?’’ Use of methamphetamines was measured using the question, ‘‘During your life, how many times have you used methamphetamines (also called speed, crystal, crank, or ice)?’’ For each variable, response options were categorized into either never use (0 times) or ever use (≥1 times). If the student had used any of these three substances, they were coded as having ever used an illicit drug. Throughout this manuscript, ‘‘ever use’’ responses are described as lifetime use.

Covariates

Additional variables used in the analysis include sex (female, male), race/ethnicity (non-Hispanic white [white], non-Hispanic black or African American [black], Hispanic or Latino [Hispanic], and other), grade in school (9th, 10th, 11th, or 12th), and sexual identity (heterosexual, lesbian/gay/bisexual [LGB], and not sure). Students were categorized as other race/ethnicity in the recoding if they selected Asian, American Indian or Alaska Native, and/or Native Hawaiian or Other Pacific Islander or multiple response options.

Statistical Analysis

The prevalence of both food insecurity and substance use behaviors by demographic characteristics is described using weighted percentages and 95% confidence intervals (CIs). Bivariate analyses were performed using chi-square tests to determine differences in prevalence by characteristics (significant if $p < .05$). Logistic regression was used to examine the association between food insecurity (reference: food secure) and each substance use behavior. These models calculated the adjusted prevalence ratio (aPR), controlling for sex, race/ethnicity, grade, sexual identity, current binge drinking, current marijuana use, and lifetime prescription opioid misuse, among a weighted sample of 43,857 US high school students. Illicit drug use was examined as an outcome only and not controlled for in analyses because states did not consistently include illicit substance use measures on

their questionnaires. The sample size fluctuated across models because observations were dropped if missing covariate data, and the composite indicator of illicit drug use was only calculated for the seven states that asked all three questions (eg, heroin, cocaine, or methamphetamine). States that asked all three questions for the illicit drug variable were Delaware, Hawaii, Nebraska, Nevada, Pennsylvania, Texas, and Vermont. All analyses were performed using SUDAAN (version 11.0.1, RTI International, Research Triangle Park, North Carolina) to account for the survey's complex sampling design and sampling weights. Each model was conducted only on respondents with complete information; missing data were not imputed.

RESULTS

Survey respondents were evenly distributed by sex and grade in school (Table 1). By race/ethnicity, respondents were white (45.6%), Hispanic (32.1%), black (14.2%), and other (8.1%). The majority of respondents were heterosexual (86.1%), with fewer indicating that they identified as LGB (10.3%) or ''not sure'' (3.6%). Overall, 87.7% of students reported being food secure, while 12.3% were food insecure. Food security status significantly differed by race/ethnicity and sexual identity. Approximately 16.8% of black and 14.8% of Hispanic students were food insecure, compared to 8.3% of white students ($p < .01$). The prevalence of food insecurity in LGB and unsure students was 18.8% and 21.1%, respectively, versus a prevalence of 11.1% among heterosexual students ($p < .01$).

Among all respondents, the prevalence estimates for the substance use behaviors were: 12.0% (current binge drinking), 17.1% (current marijuana use), 13.6% (lifetime prescription opioid misuse), and 6.0% (lifetime use of illicit drugs). These prevalence figures significantly differed by demographic characteristics (Table 2). For example, the prevalence of current binge drinking in white and Hispanic students was 14.3% and 11.9%, respectively, versus a prevalence of 6.9% among black youth. Additionally, LGB students had the highest prevalence of all substance use behaviors.

In all unadjusted analyses (Table 3), the prevalence of substance use was significantly higher among students with food insecurity compared to food secure students: current binge drinking (16.2% [95% CI: 12.7, 20.6] vs 11.5% [95% CI: 10.4, 12.7]), current marijuana use (24.0% [95% CI: 19.6, 29.0] vs 16.2% [95% CI: 15.0, 17.4]), lifetime prescription opioid misuse (21.3% [95% CI: 17.6, 25.4] vs 12.6% [95% CI: 11.7, 13.5]), and lifetime use of illicit drugs (12.3% [95% CI: 9.4, 15.9] vs 5.0% [95% CI: 4.3, 5.9]) (all $p < .05$). In the adjusted models, students with food insecurity had a higher prevalence of some substance use behaviors compared to food secure students. Among the respondents, we found significant associations between food insecurity and lifetime prescription opioid misuse (aPR 1.38 [95% CI: 1.12, 1.71]), as well as lifetime illicit drug use (aPR 1.70 [95% CI: 1.22, 2.37]) (both $p < .05$). However, upon controlling for substance use and sociodemographics, current marijuana use and current binge drinking were no longer statistically significant.

DISCUSSION

Access to healthy foods is a critical social determinant of health.[20] These data indicate that food insecurity is prevalent among high school students and varies across racial and ethnic minority groups and by sexual identity. Results of this study suggest a significantly higher risk for some substance use behaviors among students with food insecurity compared to food secure students. The associations between food insecurity and lifetime prescription opioid misuse and illicit drug use were not attenuated even when controlling for other substance use and sociodemographics. In contrast, the models that examined the association between food insecurity, binge drinking, and marijuana use assessed ‘‘current use’’ instead of ‘‘lifetime use’’ and did not find a significant relationship.

Although there is limited research examining the association between food insecurity and substance use among adolescents, the link between food insecurity and behavioral problems has been well established in school-aged children. For example, several studies have found that food insecurity increased the odds of hyperactivity, poor social skills, and academic cheating among school-aged children.[7–10,21] Episodes of compromised nutrition during childhood development have also been linked to adverse mental health outcomes, particularly behavioral vulnerabilities such as impulsivity and hyperactivity, in early adulthood.[10–13] Adolescence is a critical period for cognitive development and is associated with increased rates of impulsive behaviors due to significant hormonal and neurodevelopmental changes.[22] Food insecurity, a noted risk factor for deficits in impulse control, could increase vulnerable adolescents’ susceptibility for maladaptive behaviors, including substance misuse.[13]

The findings from this study are consistent with previous research. Prior research on adolescents (13–17 years) has demonstrated that food insecurity was significantly related to mental health disorders, including mood, anxiety, and substance use disorders.[23] However, these data are older; the National Comorbidity Survey Replication Adolescent Supplement was conducted from 2001 to 2004.[23] In a study of urban youth aged 15 to 25 years, researchers demonstrated that higher levels of food insecurity were associated with a higher total, or cumulative burden, of ‘‘health-related social problems’’, including health care access, housing, and substance use.[24]

Our findings highlight the association between racial/ethnic minority adolescents, food insecurity, and substance use behaviors. Additionally, this study provides evidence that food insecurity and substance use behaviors disproportionately impact sexual minority adolescents compared to their heterosexual peers. These findings are consistent with prior research that show certain subpopulations have an increased likelihood of experiencing food insecurity compared to other groups.[25] For example, households with an income below 185% of the federal poverty threshold are more likely to be food insecure, and families led by single mothers have a higher probability of food insecurity.[2] A recent analysis by the USDA found that food insecurity rates for households headed by black and Hispanic persons were at least twice that of white-headed households.[2] Evidence also suggests that sexual and gender minority adults are more likely to experience unique stressors compared

to their heterosexual or cisgender counterparts, potentially increasing their susceptibility to food insecurity.[26,27]

The minority stress theory may help to elucidate the link between food insecurity and substance misuse among minority groups. The minority stress theory proposes that social conditions, such as discrimination, experienced by marginalized populations may cause excess chronic stress, thus increasing the prevalence of adverse health and mental health outcomes in these populations.[28,29] Previous studies have found that both racial/ethnic minority youth and LGB adolescents experience disparities in overall health when compared to other youth. For example, a recent study examining the trajectories of risk behaviors found that black adolescents are more likely to be obese and/or develop substance use disorders in adulthood due to increased levels of stress.[30] Evidence suggests that Hispanic adolescents are disproportionately burdened with chronic stress, which may increase the risk of alcohol and substance use among these youth.[31] Recent assessments have found that sexual minority adolescents are at an increased risk of demonstrating symptoms of internalizing and externalizing disorders, including anxiety, depression, and suicidality compared to their heterosexual counterparts.[32,33] Research has also found that LGB adolescents have elevated rates of engaging in maladaptive behaviors, such as substance misuse, compared to their heterosexual peers .[17,34] Substance use prevention efforts could be strengthened by further research examining the complex relationships between minority groups, food insecurity, and risk-taking behaviors.

Limitations

This study is subject to several limitations. YRBS data are self-reported, and it is not possible to determine to what extent underreporting or overreporting occurred. However, a previous psychometric evaluation of the national YRBS questions indicated it had substantial reliability.[35] Associations are cross-sectional; therefore, causality and directionality cannot be determined. Because the data are observational, this study cannot provide certainty about the temporal relationship between food insecurity and substance use behaviors. The YRBS data are only collected on adolescents who attend school, and therefore, this study is not representative of all youth within this age group. However, nationally, roughly 96% of all youth attend school according to the National Center for Education Statistics (NCES) data.[36] Some students might not have understood the sexual identity question, might not have been fully aware of their sexual identity, or might have been unwilling to disclose it on the survey, thus we cannot discount the possibility of misclassification of the sexual identity of some of the respondents. The categorization of food insecurity was determined by a single-item question, which addressed hunger, a more moderate to severe dimension of food insecurity. These results may not reflect the experiences of high school students with low or marginal food security. Additionally, we are unable to differentiate between acute and chronic food insecurity, which may have different associations with substance misuse. The findings are only representative of the states that contributed data to analyses. Finally, YRBS does not capture more detailed information on students' household socioeconomic status, therefore, the current study is also limited in its ability to explore additional parental or household factors that may affect food insecurity and substance use. However, a strength of the YRBS is that it is a rich source of surveillance

data, and one of the only data sources on health and health behaviors among US high school students.

IMPLICATIONS FOR SCHOOL HEALTH

Early intervention for food insecurity is critical for ameliorating adverse health outcomes in children and adolescents. This issue is particularly salient given the concerns that food insecurity may have worsened during the COVID-19 pandemic. Our results support the need for food insecurity screening among adolescents in order to identify students who may be at increased risk of substance misuse and implement early intervention.[37] Screening for food insecurity may also provide insight into concomitant health-related social problems in youth, such as housing insecurity, as well as help develop evidence-based modalities to mitigate the consequences of food insecurity. One tool to address adolescent food insecurity includes educating health care providers such as primary care physicians to screen for food insecurity and developing and implementing standardized protocols for referring patients to appropriate food resources.[38] However, some families may have limited or no access to health care, consequently, clinical screening may not capture all food insecurity among adolescents and complementary school-based screening may be necessary.

School nurses can be effective in providing direct care for acute and chronic health conditions, conducting health risk assessments, and assisting in case management services to improve the health and well-being of students.[39–41] Training school nurses to screen for food insecurity may also help to provide support for students with low food security through early identification and referrals to social support services, such as the National School Lunch Program. Utilization of the Hunger Vital Sign tool in clinical settings has demonstrated to be effective in identifying children and adolescents who may be at risk for compromised nutrition and linking families to resources that may alleviate household food insecurity.[24,42,43] School nurses can use the two-question food insecurity screening tool to identify and facilitate referrals promptly. In the absence of a school nurse, other school staff with experience discussing sensitive topics with students (eg, counselors, social workers, psychologists) could be trained to facilitate screenings and referrals.

Food insecurity may be a consequence or cause of alcohol and other substance misuse. If food insecurity is the consequence and not necessarily the cause of unsafe alcohol and other substance use, then interventions that are effective in reducing substance use may still need to be developed and applied among youth whose food supply is insecure. Schools that are interested in doing more to support prevention efforts can start by examining and becoming familiar with evidence-based strategies that aim to reduce risk factors among adolescents and enhancing existing policies. One school prevention program that has proven to be efficacious in mitigating maladaptive behaviors and producing long-term, positive behavioral outcomes is the *Life Skills Training* program.[44,45] *Life Skills Training* is a classroom-based intervention that addresses psychosocial factors and incorporates social resistance skills in order to prevent substance use. Schools can assist in attenuating health risk behaviors by implementing comprehensive health programs, such as the *Life Skills Training*.

These findings highlight the potential role of food insecurity in increasing the risk of adverse health behaviors among adolescents. Food insecurity is a multifaceted and complex public health issue, which increases the risk of poor academic and health outcomes. Additional research to better understand the association between food insecurity and alcohol and substance use is critical and may assist in preventing these behaviors in adolescents and young adults. Adolescents experiencing food insecurity may have additional needs that should be considered and addressed when developing and implementing health-promoting behavioral interventions for youth. Identifying and addressing social determinants that influence behavioral outcomes for adolescents may aid in designing effective interventions to improve health and well-being.

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Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Table 1.

Characteristics of Respondents and Their Associations with Food Security Status[a]

Characteristics	All (%)[b]	Food Security Status % (95% CI)	
		Food Secure (n = 5609)	Food Insecure (n = 38,248)
Total (n = 43,857)[c,d]	100	12.3 (11.2, 13.5)	87.7 (86.5, 88.8)
Sex (n = 43,318)			
Female	49.6	11.6 (10.3, 13.1)	88.4 (86.9, 89.7)
Male	50.4	12.9 (11.4, 14.5)	87.1 (85.5, 88.6)
Race/ethnicity (n = 42,571)			
White, non-Hispanic	45.6	**8.3 (7.2, 9.6)**	**91.7 (90.4, 92.8)**
Black, non-Hispanic	14.2	**16.8 (13.5, 20.7)**	**83.2 (79.3, 86.5)**
Hispanic	32.1	**14.8 (12.8, 17.0)**	**85.2 (83.0, 87.2)**
Other	8.1	**17.7 (13.9, 22.1)**	**82.4 (77.9, 86.1)**
Grade (n = 43,285)			
9th	28.1	12.2 (10.3, 14.4)	87.8 (85.6, 89.7)
10th	26.1	11.7 (10.2, 13.4)	88.3 (86.6, 89.8)
11th	23.4	12.4 (10.4, 14.8)	87.6 (85.2, 89.6)
12th	22.4	13.1 (10.7, 15.9)	86.9 (84.1, 89.3)
Sexual identity (n = 43,208)			
Heterosexual (straight)	86.1	**11.1 (9.8, 12.5)**	**88.9 (87.5, 90.2)**
Gay, lesbian, bisexual	10.3	**18.8 (15.7, 22.4)**	**81.2 (77.6, 84.3)**
Not sure	3.6	**21.1 (15.8, 27.7)**	**78.9 (72.3, 84.2)**

CI, Confidence interval.

Food security status was determined using the question: ‘‘During the past 30 days, how often did you go hungry because there was not enough food in your home?’’ Food secure was defined as answering ‘‘never’’ or ‘‘rarely.’’ Food insecure was defined as answering ‘‘sometimes,’’ ‘‘most of the time,’’ or ‘‘always.’’

Chi-square tests were used for each variable to examine differences within categories. Bold text indicates a significant difference in food security status across levels of the demographic characteristics. Differences were considered significant if the chi-square p value was $< .05$.

[a]Delaware, Hawaii, Nebraska, Nevada, North Carolina, North Dakota, Pennsylvania, Rhode Island, Texas, and Vermont.

[b]Weighted percentages; because of rounding, percentages may not add up to 100%.

[c]Unweighted sample size.

[d]Sample sizes for each characteristic are not equal to total sample due to missing data in the question.

Table 2.

Characteristics of Respondents and Their Associations with Alcohol and Other Substance Use[a,b,c,d]

Characteristics	Current Binge Drinking[e] (n = 41,626) % (95% CI)	Current Marijuana Use[f] (n = 43,177) % (95% CI)	Lifetime Prescription Opioid Misuse[g] (n = 43,574) % (95% CI)	Lifetime Illicit Drug Use[h] (n = 36,478) % (95% CI)
Total	12.0 (10.9, 13.3)	17.1 (15.7, 18.6)	13.6 (12.8, 14.5)	6.0 (5.1, 6.9)
Sex				
Female	12.1 (10.9, 13.3)	16.7 (15.0, 18.5)	13.6 (12.5, 14.9)	**3.8 (3.1, 4.6)**
Male	12.0 (10.3, 13.8)	17.4 (15.6, 19.3)	13.3 (11.9, 14.9)	**7.7 (6.6, 8.9)**
Race/ethnicity				
White, non-Hispanic	**14.3 (12.7, 16.0)**	**14.7 (13.3, 16.3)**	13.4 (12.3, 14.5)	**4.0 (3.1, 5.2)**
Black, non-Hispanic	**6.9 (4.7, 9.9)**	**21.2 (17.4, 25.7)**	13.9 (11.1, 17.3)	**6.3 (3.7, 10.5)**
Hispanic	**11.9 (10.2, 14.0)**	**19.1 (16.1, 22.4)**	14.2 (12.8, 15.7)	**8.1 (6.8, 9.5)**
Other	**8.3 (6.8, 10.1)**	**15.9 (12.8, 19.6)**	11.5 (9.2, 14.4)	**4.8 (3.6, 6.4)**
Grade				
9th	**6.4 (5.2, 7.8)**	**11.3 (10.2, 12.6)**	**10.9 (9.3, 12.7)**	4.9 (3.7, 6.5)
10th	**9.4 (7.7, 11.4)**	**15.6 (13.7, 17.6)**	**12.2 (10.6, 13.9)**	6.1 (4.8, 7.7)
11th	**13.7 (12.1, 15.5)**	**19.6 (17.4, 21.9)**	**16.2 (13.8, 18.9)**	5.8 (4.1, 8.0)
12th	**20.4 (17.5, 22.6)**	**22.9 (19.4, 26.9)**	**15.8 (13.7, 18.1)**	6.6 (5.1, 8.6)
Sexual Identity				
Heterosexual (straight)	11.9 (10.6, 13.3)	**15.9 (14.4, 17.6)**	**11.9 (11.0, 12.8)**	**4.8 (4.2, 5.6)**
Gay, lesbian, bisexual	14.1 (11.5, 17.2)	**28.4 (24.5, 32.7)**	**24.4 (20.2, 29.0)**	**12.4 (9.5, 15.9)**
Not sure	9.6 (6.3, 14.3)	**14.7 (9.6, 21.8)**	**22.0 (15.8, 29.9)**	**9.3 (5.0, 16.4)**

CI, Confidence Interval.

Chi-square tests were used for each variable to examine differences within categories. Bold text indicates a significant difference in substance use across levels of the demographic characteristics. Differences were considered significant if the chi-square p value was <.05.

[a]Delaware, Hawaii, Nebraska, Nevada, North Carolina, North Dakota, Pennsylvania, Rhode Island, Texas, and Vermont.

[b]Weighted percentages.

[c]Unweighted sample size.

[d]Sample sizes for each characteristic are not equal to total sample due to missing data in the question.

[e] Consumed four or more drinks of alcohol in a row for female students or five or more drinks of alcohol in a row for male students, within a couple of hours, on at least 1 day during the 30 days before the survey.

[f] Used marijuana one or more times during the 30 days before the survey.

[g] Ever used prescription pain medicine without a doctor's prescription or differently than how a doctor told them to use it (counting drugs such as codeine, Vicodin, OxyContin, Hydrocodone, and Percocet, one or more times during their life).

[h] Ever used heroin, cocaine, or methamphetamine one or more times during their life. Note: this composite indicator of illicit drug use was only calculated for the seven states that asked all three questions: Delaware, Hawaii, Nebraska, Nevada, Pennsylvania, Texas, and Vermont.

Table 3.

Unadjusted Prevalence (%) and Adjusted Prevalence Ratios (aPRs) of Alcohol and Other Substance Use Among Food Insecure and Food Secure High School Students[a]

	Bivariate Analysis[a] Food Security Status		Multivariable Logistic Regression aPR (95% CI) for Substance Use for Food Insecure Students (ref: Food Secure)	
Substance Use	**Food Insecure % (95% CI)**	**Food Secure % (95% CI)**	**aPR (95% CI)**	**p Value**
Current binge drinking[b]	**16.2 (12.7, 20.6)**	**11.5 (10.4, 12.7)**	1.21 (0.97, 1.51)	.090
Current marijuana use[c]	**24.0 (19.6, 29.0)**	**16.2 (15.0, 17.4)**	1.17 (0.91, 1.51)	.228
Lifetime prescription opioid misuse[d]	**21.3 (17.6, 25.4)**	**12.6 (11.7, 13.5)**	**1.38 (1.12, 1.71)**	**.005**
Lifetime illicit drug use[e]	**12.3 (9.4, 15.9)**	**5.0 (4.3, 5.9)**	**1.70 (1.22, 2.37)**	**.003**

CI, Confidence Interval.

Chi-square tests were used for each substance use variable to examine differences by food security status. Differences were considered significant if the chi-square p-value was <.05. Bivariate analysis sample sizes were: current binge drinking (n = 41,626), marijuana use (n = 43,177), opioids (n = 43,574), illicit drugs (n = 36,478). Illicit drug use was examined as an outcome only and not controlled for in analyses because states did not consistently include illicit substance use measures on their questionnaires.

Models controlled for sex, race/ethnicity, grade, sexual identity, current binge drinking, current marijuana use, and lifetime prescription opioid misuse. Regression model sample sizes were: binge drinking (n = 39,124), marijuana use (n = 39,124), prescription opioid misuse (n = 39,124), illicit drug use (n = 32,638).

[a]Delaware, Hawaii, Nebraska, Nevada, North Carolina, North Dakota, Pennsylvania, Rhode Island, Texas, and Vermont.

[b]Consumed four or more drinks of alcohol in a row for female students or five or more drinks of alcohol in a row for male students, within a couple of hours, on at least 1 day during the 30 days before the survey.

[c]Used marijuana one or more times during the 30 days before the survey.

[d]Ever used prescription pain medicine without a doctor's prescription or differently than how a doctor told them to use it (counting drugs such as codeine, Vicodin, OxyContin, Hydrocodone, and Percocet, one or more times during their life).

[e]Ever used heroin, cocaine, or methamphetamine one or more times during their life. Note: this composite indicator of illicit drug use was only calculated for the seven states that asked all three questions (e.g. heroin, cocaine, or methamphetamine): Delaware, Hawaii, Nebraska, Nevada, Pennsylvania, Texas, and Vermont.