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Food Insecurity and Substance Use in People with HIV Infection and Substance Use Disorder

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Abstract

Background: Food insecurity and substance use are common among people living with HIV (PLWH). Substance use may help people cope with hunger and thus be associated with food insecurity, but the association is uncertain. This study assessed whether, in PLWH and substance dependence, if there was an association between food insecurity and substance use.

Methods: We studied adults with HIV and current substance dependence or ever injection drug use interviewed at 12 and 24 months after enrollment in a prospective cohort study. The presence of food insecurity (insufficient food quantity or quality, or anxiety about its availability) was assessed using the Household Food Insecurity Assessment Scale questionnaire (HFIAS). Unhealthy alcohol use was assessed with the Alcohol Use Disorder Identification Test – Consumption (AUDIT-C) and past 30-day other drug use with the Addiction Severity Index. Associations using repeat cross-sectional data from each of two time-points, 12 months apart, from the same participants were tested using generalized estimating equations logistic regressions.

Results: The 233 participants had a mean age of 50 years and 65% were male. At the first interview, 44% reported food insecurity, 40% unhealthy alcohol use, 25% past 30-day cocaine

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Contributors: AR and RS developed the study question with the assistance of AYW. Data collection was done by research staff. Statistical analyses and interpretation were conducted by MRW and TCH; all other co-authors also interpreted analytic results. RS served as the Principal Investigator of the Boston ARCH Cohort Study. AR produced the first draft of the manuscript, which was subsequently edited, revised, and reviewed by all of the authors. All authors have read and approved the final draft of this manuscript.

use, and 17% past 30-day illicit opioid use. In analyses adjusted for demographics, social factors, physical and mental health function, and substance use related variables, there was no significant association between food insecurity and unhealthy alcohol use (adjusted odds ratio (aOR)=1.06 (95% CI: 0.59, 1.87)). Those with food insecurity had higher odds of illicit opioid use (aOR = 2.5 (95% CI: 1.12, 5.58)) and cocaine use (aOR = 1.95 (CI 95%: 1.00, 3.81)).

Conclusion: Food insecurity was not associated with unhealthy alcohol use but was associated with cocaine and illicit opioid use. Given the prevalence and impact substance use has on PLWH, food insecurity should be identified and addressed.

INTRODUCTION

Over 1 million people are living with Human Immunodeficiency Virus (HIV) (PLWH) in the United States[1]. With the advent and success of highly active antiretroviral therapy (HAART), PLWH are able to live longer and healthier lives[2]; however, health-risk behaviors can impact disease progression and comorbidities, even with HAART adherence[3]. Social factors such as unemployment, limited access to healthcare, homelessness, and food insecurity may also increase the likelihood of risky behavior and disease progression[4].

Food insecurity, a “household-level economic and social condition of limited or uncertain access to adequate food”,[5] is common in the United States (13% of households)[6]. In addition to malnutrition and nutrient deficiencies, food insecurity is associated with unsafe sex[7], depression[8], cognitive decline[9], and medication non-adherence[10]. Food insecurity may also be related to other health risk behaviors including substance use[11], though this has not been extensively studied.

Even in some resource-rich areas, approximately 25% to 50% of PLWH are food insecure[12,13], in part because of the high prevalence of unemployment and poverty. Clinical outcomes for PLWH who report food insecurity are worse than they are in those who are food secure[13], namely as a result of deficiencies in key nutrients that can affect immune function adversely[14]. Malnutrition is also a strong indicator of patient survival, independent of CD4 cell count[15]. Furthermore, HAART medications that require food at the time of administration for better absorption may be less effective when there is food insecurity[10].

Food insecurity has been associated with drug and alcohol use prior to sex and with exchanging sex (i.e. HIV risk behaviors) for money[16]. Food insecure individuals with and without HIV infection are more likely to report alcohol use and/or illicit drug use[11,17]. In addition, food insecurity and substance use often co-occur in PLWH[18]. In Canada, among PLWH, methadone treatment appears to lower food insecurity, again suggesting an association between it and illicit substance use[19]. Food insecurity may also be associated with depression, which can lead to maladaptive coping (e.g. heavy alcohol use, substance use)[20], and worse mental and general health[21]. However, little is known about the associations between food insecurity and substance use in the United States among PLWH.

Substance use can also worsen outcomes in PLWH[22] via disinhibited or impulsive behavior[23], memory loss[24], and participation in related risk behaviors[25] resulting in medication non-adherence[3] and recurrent infectious exposures[26]. Unhealthy alcohol use,

defined as use that risks consequences or meeting criteria for alcohol use disorder, is prevalent among PLWH (up to 42%)[27]. HAART adherence in those who consume alcohol is lower than it is in those who do not drink (60% compared to 74%, respectively)[28]. High-dose and long-term opioid therapy are common among PLWH[29], and although findings are mixed, some studies suggest associations between opioid use and HIV disease progression.[30,31]. This association may be a direct pharmacological effect or due to substance use-related medication non-adherence and risky behavior[32].

In addition to increased risky behavior and medication nonadherence, heavy alcohol and cocaine use can directly impact the immune system[33,34]. Baum *et al.* noted a decline in CD4 cell count in PLWH who report heavy drinking. These individuals were almost three times more likely to have a decline in CD4 cell count[35]. Crack-cocaine use among PLWH not on ART, has also been associated with a decline in CD4 cell count[36].

In sum, food insecurity and substance use are common in PLWH, and food insecurity may be associated with substance use as a way to alleviate hunger or via complex relations between mental health symptoms, poverty, and consequences of both food insecurity and substance use. These associations are not well-understood among PLWH who have substance use disorder (SUD), especially in resource rich settings. Understanding these associations could inform clinicians regarding how to best address these circumstances and behaviors. This study aims to investigate whether food insecurity, compared to food security, is associated with substance use in PLWH and SUD in a resource rich, urban setting, as most of the current literature focuses on food insecurity and substance use in PLWH within third-world or developing countries. The primary aim of this study was to evaluate the association between food insecurity and unhealthy alcohol use based on prior literature. The secondary aim of this study examined associations with cocaine and opioid use secondarily given their prevalence and possible associations with food insecurity.

METHODS

The Uganda Russia Boston Alcohol Network for Alcohol Research Collaboration on HIV/AIDS (URBAN ARCH) Consortium conducts studies investigating the impact of alcohol on PLWH. The current study is a secondary analysis of data gathered annually from the Boston ARCH cohort (Boston Alcohol Research Collaboration on HIV/AIDS), a cohort which has previously been reported in Ventura et. al 2017 and Saitz et al. 2018[37,38]. The analytic sample includes participants who completed the Household Food Insecurity Assessment Scale (HFIAS), Addiction Severity Index (ASI) consumption items, and the Alcohol Use Disorder Identification Test – Consumption (AUDIT–C) questionnaires[39–41]. The Institutional Review Board of Boston University Medical Campus approved this study and a Certificate of Confidentiality was obtained from the National Institute on Alcohol Abuse and Alcoholism. All participants provided written informed consent and were compensated for completing research assessments.

Participants

ARCH cohort participants were enrolled from December 2012 to November 2014 from HIV primary care sites: The Center for Infectious Diseases at Boston Medical Center and the

Boston Healthcare for the Homeless Program. The following were assessed at study entry by interview by trained research staff: unhealthy alcohol use, food insecurity, age, sex, race/ethnicity, HIV viral load, CD4 cell count, physical health, mental health, how many people you spend time with who are heavy or problem drinkers, homelessness, people you can turn to, drug and alcohol dependence, past 30 day cocaine and illicit opioid use, obsessive drinking, and depressive symptoms. Participants were eligible if they met the following criteria: (1) confirmation of HIV infection in medical records or through testing within 3 months of enrolling in the study, (2) current drug or alcohol dependence (past 12-months, Diagnostic and Statistical Manual of Mental Disorders IV (DSM IV) assessed using the Mini-International Psychiatric Interview (MINI))[42] or ever injection drug use, (3) ability to speak English, (4) age 18 years or older, and (5) provision of contact information for at least one person to assist with follow-up. Exclusion criteria were: (1) pregnancy (by urine test), (2) plans to leave the Boston area in the next year, and (3) cognitive impairment precluding consent or understanding of interview questions (determined by a trained research assistant). Participants were followed for 1 to 3.5 years with in-person assessments every 12 months. Main independent and dependent variables for the study were assessed at 12 and 24-month follow-up interviews (we used 12 and 24-month assessments because the HFIAS was not administered at study entry, and we added it to the study assessment while 12-month interviews were ongoing). Note that because people with HIV who report ever injection drug use very likely met criteria for substance dependence at some time in their lives, for efficiency in the text we refer to the cohort as one of PLWH and substance dependence even though some did not meet criteria for dependence in the past year.

Independent Variable: Food insecurity

Food insecurity was the main independent variable of interest. It was assessed using the HFIAS, a validated, continuous scale (score: 0 to 27) with 9 questions. Each item of the HFIAS has 4 self-reported response options (never, rarely, sometimes, and always), scored from 0 to 3. The HFIAS was used to measure food insecurity in the past 4 weeks[43,44]. HFIAS questions are grouped into three domains assessing the following: anxiety and uncertainty about the household food supply, insufficient quality of food, and insufficient food intake and its physical consequences. We scored the HFIAS questions into four categories (food secure, mildly food insecure, moderately food insecure, severely food insecure) according to the scoring algorithm in the HFIAS Indicator Guide[39]. For analysis purposes, we dichotomized the four-category food insecurity as any (mildly, moderately, or severely food insecure) and none (food secure), as it has been done in other similar studies[13,45].

Dependent Variables

Unhealthy alcohol use—Unhealthy alcohol use was the main dependent variable of interest; secondarily we were interested in cocaine use and illicit opioid use. Unhealthy alcohol use was assessed using the validated AUDIT-C questionnaire[46]. The AUDIT-C consists of 3 questions assessing alcohol consumption over the past year. It yields a score between 0 and 12 and a score greater than 3 in males and 2 in females is consistent with unhealthy use[47].

Cocaine and illicit opioid use—Cocaine and illicit opioid use were assessed using the Addiction Severity Index – 5 (ASI-5)[40] 'number of days in the past 30' consumption items, dichotomized at greater than zero.

Covariates (demographics, physical health, social circumstances, substance use disorder, alcohol craving, and mental health)

Covariates included demographics (age, sex, race ethnicity), physical health (HIV viral load, CD4 cell count, physical health—the Veterans Rand-12, see below), social circumstances (number of people the participant spends time with who are heavy or problem drinkers, homelessness (spending 1 or more night on the street or in a homeless shelter), social support (the participant had someone to turn to if they were feeling bad and needed someone to talk to), DSM IV alcohol and drug dependence (both assessed by the MINI[48]), alcohol craving, and mental health (mental health, depression). The Obsessive – Compulsive Drinking Scale (OCDS) was included to assess alcohol craving and is a 14-item self-reported on a Likert Scale[49]. The OCDS provides a total score, as well as sub-scores measuring thoughts about alcohol and craving behaviors[49,50]. The obsessive subscale consists of 6 questions and the score is calculated by summing the maximum of the first 2 items, then each of the remaining 4 questions, so the subscale can range from 0 to 20. A higher score is indicative of higher obsessiveness[49]. The 12-item Veterans Rand-12 (VR-12) was used to assess physical and mental health (physical component summary (PCS) and mental component summary (MCS) scales); it yields scores ranging from 0 to 100 (100 is self-reported perceived better health)[51,52]. The Patient Health Questionnaire (PHQ) is a self-report scale assessing somatic complaints[53]. The PHQ-2 was used to measure depression among our sample and consists of 2 items, each scored from 0 to 3 (maximum score of 6). The score was dichotomized as below three or three and higher[54]. This dichotomization has been used in many other studies with PLWH[55,56].

Covariates were selected based on their likely associations with both independent and dependent variables (and also for descriptive purposes). For example, mental and physical health are known to be associated with both substance use and food insecurity[21,57]. CD4 count shows a similar association[58,59(p4)], as well as a lack of social support and homelessness[7,60].

Statistical analysis

All statistical analysis was completed with SAS version 9.3 (SAS Institute Inc, 2011). Each participant could contribute up to two observations to the analysis, from data collected at the 12-month and 24-month assessments. Descriptive statistics were generated for all of the variables. We fit unadjusted and adjusted logistic regression generalized estimating equation (GEE) models to assess associations between the independent (food insecurity) and dependent (alcohol and substance use) variables measured at the same assessment, adjusted for covariates. We used GEE to account for correlation within multiple observations from each participant (each participant could contribute data from up to two time points). Analyses controlled for the covariates listed above with the following exceptions. MCS and PCS (mental component summary and physical component summary, respectively) were not included as covariates in the models as we suspected that they could be in the causal

pathway of the associations of interest, rather they are presented only to describe the sample. Depressive symptoms and craving were also not included in main models but post hoc we explored interactions with food insecurity.

In the main models, we included drug dependence in the unhealthy alcohol use outcome models, and alcohol dependence in the other drug use outcome models. However, we did not include dependence on the substance modeled, as that would constitute alcohol disorder predicting unhealthy alcohol use and drug disorder predicting drug use. As we were also interested in the association of food insecurity on alcohol and other drug use without regard to the presence of dependence, we also fit models without dependence. Finally, we investigated if food insecurity has a different association with unhealthy alcohol use among those with depressive symptoms and higher craving by fitting separate models including interaction terms between these variables and food insecurity for the unhealthy alcohol use outcome. Odds ratios with 95% confidence intervals were calculated for all independent variables.

RESULTS

Of 1,460 individuals approached, 673 (46%) were assessed for eligibility, 299 (44%) did not meet eligibility criteria (most commonly (82%) due to never injecting drugs or no current alcohol or other drug dependence). Of 364 eligible individuals, 250 (67%) were enrolled and 233 (93%) completed assessments of the main independent and dependent variables at least once at 12 or 24-month interviews or at both timepoints.

Study participants

The 233 participants provided 299 data points (166 participant responses at 12 and 133 participant responses at 24 months); 100 participants had data at 12 months only, 67 participants had data at 24 months only, and 66 participants had data at both 12 and 24 months, largely determined by when we implemented the HFIAS questionnaire.

Descriptive Analysis

Descriptive statistics are presented for both time-points. Participants had a mean age in their 6^{th} decade (Table 1) with the majority of the sample identifying as male (65%), and Black/African American (51%). At both time-points, less than one fourth of the sample was homeless (defined as spending 1+ night on the street or in a homeless shelter), most had an HIV viral load under 200 copies/ml, and more than half had a CD4 cell count greater than or equal to 500.

At 12-months, 44% (N= 73) of the cohort was food insecure, approximately 40% (N= 67) had unhealthy alcohol use, 25% (N= 43) had alcohol dependence, 25% (N=42) reported cocaine use, 17% (N= 28) opioid use, 41% (N= 68) drug dependence, and 50% (N=94) spent time with heavy/problem drinkers. Values at 24-months were similar. Details can be seen in Table 1. Mean PCS and MCS scores were both below 50 each time they were measured.

Multivariable Analyses

Unadjusted and adjusted models indicated no significant association between food insecurity and unhealthy alcohol use (Tables 2 and 3). In an unadjusted regression model, the odds ratio (OR) for the association between food insecurity and unhealthy alcohol use was 1.58 (CI 95%: 0.95, 2.62, p = 0.08) (Table 2). In adjusted regression analysis, the odds ratio was 1.06 (CI 95%: 0.59, 1.87, p=0.85 (Table 3).

In adjusted analysis, food insecurity was significantly associated with cocaine use in the past 30 days [adjusted odds ratio (aOR): 1.95 (CI 95%: 1.00, 3.81), p=0.05] (Table 3) and this association remained significant in a model fit without alcohol dependence as a covariate (Table 4).

Food insecurity and illicit opioid use, in adjusted associations, in the past 30 days was also significant [aOR: 2.5 (CI 95%: 1.12, 5.58), p=0.03] (Table 3). This association was still significant in a model fit without alcohol dependence as a covariate (Table 4).

Covariates for depressive symptoms and alcohol craving were each added to the main models with AUDIT-C as the outcome (and without drug dependence) along with interaction terms for depressive symptoms or alcohol craving and food insecurity to assess whether they moderated the association between food insecurity and unhealthy alcohol use. Interaction terms were not significant (depressive symptoms p=0.39, craving p=0.98).

DISCUSSION

Substance use and food insecurity impact many individuals worldwide in resource-rich and resource-poor settings. Given the prevalence of these risks and their impact on health outcomes in PLWH, the goal of this study was to assess whether there was an association between food insecurity and substance use – specifically, unhealthy alcohol use, cocaine use, and illicit opioid use. There was no significant association between food insecurity and unhealthy alcohol use, and alcohol craving and depressive symptoms did not appear to play a moderating role. However, there were significant associations between food insecurity and both cocaine and illicit opioid use.

Our results, with respect to unhealthy alcohol use, are consistent with results found in very different PLWH populations, both are HAART-naïve persons in Mbara, Uganda and St. Petersburg, Russia. These cross-sectional studies[61] both used the HFIAS and the AUDIT-C and assessed and adjusted for sociodemographic covariates, substance dependence (Russia)[48], CD4 cell count, and a social support survey score[62]. The Uganda cohort additionally included religious affiliation, literacy, CD4 cell count, and an HIV symptom index[63]. In both of these cohorts, the prevalence of food insecurity was high (52% of the Russia cohort and 84% of the Uganda cohort) as was the prevalence of unhealthy alcohol use (71% of the Russia Cohort and 43% of the Uganda cohort). Neither study found an association between heavy alcohol use and food insecurity, though in a subgroup analyses there was an association among women in the Uganda cohort[61]. It is also noteworthy that both settings in this study are resource poor; however, our results are consistent despite being in a resource rich setting.

Current interventions for individuals who are food insecure include food banks, community kitchens, cash transfers, and food subsidies.[64] Community Servings is a program that provides home-delivered, medically tailored meals (MTM) to qualifying individuals within the state of Massachusetts[65]. To qualify for these services, individuals are evaluated by a clinician based upon the extent of their illness (i.e. renal disease, HIV, diabetes, etc.), lack of mobility, and access to food/ ability to cook. A JAMA study found a 16% net reduction in healthcare utilization costs in the population using Community Servings[66]. This further highlights the importance of assessing food insecurity as a contributing factor to overall health outcomes.

The results of this study should be considered in the context of limitations. First, analyses were cross-sectional and cannot be construed as testing causality or even the directionality of the associations observed. Second, outcomes were based on self-report, though we did use validated tools in confidential interviews and participants were not aware of any hypotheses regarding food insecurity. Third, the sample size was modest though likely enough to detect associations between our dichotomous variables. With rare outcomes, the odds ratio approximates the relative risk or risk ratio when the outcome is rare. However, none of the main variables of interest were rare in this study, and thus we focused our findings on whether there was an association or not and not on the magnitude of association. Fourth, our study sample had many competing risks for substance use, with food insecurity being only one. As such, associations may have been obscured. The confluence of homelessness, impaired mental and physical health, current alcohol or other drug dependence, and other social and physiological ills may impact our ability to detect the effect of the single risk factor food insecurity on substance use. However, this sample is representative of many PLWH in the US in which the question of the impact of food insecurity arises. Fifth, 7% of the sample had no data on food insecurity and were thus excluded from analyses; 93%, however, were included. Lastly, while representative of some clinical samples, generalizability is limited to those PLWH with SUD receiving primary care for HIV in an urban medical setting.

The study has notable strengths. The main independent and dependent variables were assessed confidentially by trained research staff using validated tools. Data were collected prospectively from a diverse population of interest, and participants were unaware of hypotheses as the main purpose of the cohort study was to study alcohol consumption and bone density. We had detail on many covariates, most assessed using validated tools, to allow for adjusted analyses.

In conclusion, food insecurity appears to be associated with cocaine and illicit opioid use in cross sectional analyses. Food insecurity was not associated with unhealthy alcohol use in this study in which participants had many competing risks. Future research should further explore this relationship and prospectively consider food insecurity as a potential risk for return to substance use in PLWH and SUD. It would also be advantageous to study individuals who are not currently seeking treatment, have uncontrolled viral loads, and/or low CD4 cell counts in resource rich settings such as the United States. Such studies should consider the potential mediating and moderating roles that medical and mental health symptoms, socioeconomic status and social service access may play. Food insecurity

may also have different effects on substance use in rural settings. By gaining a better understanding of the relationship between food insecurity and substance use in PLWH and SUD, clinicians will be better equipped to provide their patients with appropriate resources and treatment options.

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Table 1.

Characteristics of 233 People Living with HIV infection and Substance Use Disorder

	12 Month Visit n=166	24 Month Visit n=133
Unhealthy alcohol use[1]		
No	99 (59.6%)	77 (57.9%)
Yes	67 (40.4%)	56 (42.1%)
Food Insecurity[2]		
Food secure	93 (56.0%)	75 (56.4%)
Food insecure	73 (44.0%)	58 (43.6%)
Age at interview		
N	166	133
Mean (SD)	50.2 (9.3)	51.7 (8.3)
Sex		
Male	108 (65.1%)	82 (61.7%)
Female	58 (34.9%)	51 (38.4%)
Race/ethnicity		
Black/African American	85 (51.2%)	71 (53.4%)
White	29 (17.5%)	25 (18.8%)
Hispanic	43 (25.9%)	31 (23.3%)
Other	9 (5.4%)	6 (4.5%)
HIV Viral Load		
<200 copies/mL	129 (80.1%)	110 (84.6%)
200+ copies/mL	32 (19.9%)	20 (15.4%)
CD4 Cell Count (cells/microliter)		
<200	16 (9.9%)	14 (10.8%)
200–<500	59 (36.7%)	33 (25.4%)
500+	86 (53.4%)	83 (63.8%)
Physical health[3]		
N	165	133
Mean (SD)	42.2 (10.1)	42.2 (10.3)
Mental health[4]		
N	165	133
Mean (SD)	43.6 (12.3)	45.7 (11.4)
How many of the people you spend time with are heavy or problem drinkers?		
None	72 (43.4%)	59 (44.4%)
A few	63 (37.9%)	57 (42.9%)
About half or more	31 (18.7%)	17 (12.8%)
Homelessness[5]		
No	126 (75.9%)	113 (85.0%)
Yes	40 (24.1%)	20 (15.0%)

	12 Month Visit n=166	24 Month Visit n=133
People you can turn to[6]		
No	7 (4.2%)	4 (3.0%)
Yes	159 (95.8%)	129 (97.0%)
Drug dependence[7]		
No	97 (58.8%)	87 (65.9%)
Yes	68 (41.2%)	45 (34.1%)
Alcohol dependence[7]		
No	122 (73.9%)	102 (76.7%)
Yes	43 (26.1%)	31 (23.3%)
Used cocaine past 30 days[8]		
No	124 (74.7%)	101 (75.9%)
Yes	42 (25.3%)	32 (24.1%)
Used illicit opioids past 30 days[8]		
No	138 (83.1%)	107 (80.5%)
Yes	28 (16.9%)	26 (19.5%)
PHQ-2 depressive symptoms[9]		
< 3	118 (71.5%)	105 (78.9%)
≥ 3	47 (28.5%)	28 (21.1%)
Obsessive-compulsive drinking scale at time-point 12 months prior to assessment		
N	166	132
Mean (SD)	3.2 (3.8)	2.9 (4.1)

[1] Alcohol Use Disorder Identification Test – Consumption score greater than 3 in males and 2 in females

[2] measured by the Household Food Insecurity Access Scale, score ≥2 is food insecure. Measured over 4-week timeframe

[3] measured using the Veterans Rand – 12 (scored 0 to 100), where a higher score means better health

[4] measured using the Veterans Rand – 12 (scored 0 to 100), where a higher score means better health

[5] 1+ nights on street or in shelter past 6 months

[6] Are there people that you feel you could turn to if you were feeling bad and needed someone to talk to about something that was important to you?

[7] Any drug dependence or alcohol dependence in a 12-month period measured on the Mini International Neuropsychiatric Interview

[8] measured on the 30-day Addiction Severity Index

[9] physical Healthy Questionnaire - 2

Table 2.

Unadjusted Associations between Food Insecurity and Unhealthy Alcohol Use, Cocaine Use, and Opioid Use

	ALCOHOL: Unadjusted		**COCAINE: Unadjusted**		**OPIOID: Unadjusted**	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Food Insecurity[1]						
Secure	Reference	0.0794	Reference	0.0048	Reference	0.0045
Insecure	1.58 (0.95, 2.62)		2.33 (1.29, 4.19)		2.59 (1.34, 5.00)	
Age, 1 yr increase	0.99 (0.97, 1.02)	0.7212	0.99 (0.96, 1.03)	0.7277	0.99 (0.96, 1.03)	0.6698
Sex						
Male	Reference	0.8033	Reference	0.2193	Reference	0.8425
Female	1.07 (0.62, 1.85)		0.67 (0.36, 1.27)		0.93 (0.48, 1.82)	
Race/ethnicity						
Black/African American	Reference	0.5011	Reference	0.0883	Reference	0.2908
White	0.85 (0.40, 1.76)		1.53 (0.71, 3.31)		1.93 (0.83, 4.47)	
Hispanic	0.72 (0.37, 1.40)		0.71 (0.32, 1.57)		1.82 (0.86, 3.85)	
Other	1.99 (0.52, 7.64)		3.81 (0.99, 14.61)		0.94 (0.21, 4.28)	
HIV Viral Load (copies/mL)						
<200	0.55 (0.30, 1.01)	0.0528	0.51 (0.26, 0.98)	0.0446	0.35 (0.18, 0.70)	0.0028
200+	Reference		Reference		Reference	
CD4 Count (cells/microliter)						
<200	Reference	0.2706	Reference	0.1094	Reference	0.0486
200–<500	0.88 (0.37, 2.11)		0.56 (0.23, 1.38)		0.36 (0.14, 0.89)	
500+	0.59 (0.25, 1.41)		0.41 (0.17, 0.96)		0.40 (0.18, 0.89)	
How many people spend time with are heavy/problem drinkers		<0.0001		<0.0001		0.0011
None	Reference		Reference		Reference	
A few	2.40 (1.37, 4.19)		5.15 (2.58, 10.27)		2.74 (1.31, 5.74)	
About half or more	5.48 (2.53, 11.87)		7.71 (3.33, 17.87)		4.96 (2.10, 11.69)	
Homeless[2]						
No	Reference	0.0032	Reference	0.0026	Reference	<0.0001
Yes	2.62 (1.38, 4.98)		2.77 (1.43, 5.38)		3.75 (1.94, 7.24)	
Drug dependence[3]						
No	Reference	<0.0001				
Yes	3.51 (2.03, 6.05)					
Alcohol dependence[3]						
No			Reference	0.0011	Reference	0.1489
Yes			2.79 (1.51, 5.15)		1.68 (0.83, 3.39)	

[1] measured by the Household Food Insecurity Access Scale, score ≥2 is food insecure. Measured over 4-week timeframe

[2] 1+ nights on street or in shelter past 6 months

[3] Any drug dependence or alcohol dependence in a 12-month period measured on the Mini International Neuropsychiatric Interview

Table 3.

Adjusted Associations between Food Insecurity and Alcohol, Cocaine, and Opioid Use in Regression Models

	ALCOHOL: Adjusted		**COCAINE: Adjusted**		**OPIOID: Adjusted**	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Food Insecurity[1]						
Secure	Reference	0.8518	Reference	0.0503	Reference	0.0258
Insecure	1.06 (0.59, 1.87)		1.95 (1.00, 3.81)		2.50 (1.12, 5.58)	
Age, 1 yr increase	1.00 (0.97, 1.04)	0.7808	1.00 (0.96, 1.04)	0.9889	1.03 (0.99, 1.07)	0.2130
Sex						
Male	Reference	0.4060	Reference	0.0448	Reference	0.4526
Female	1.30 (0.70, 2.42)		0.50 (0.25, 0.98)		0.75 (0.35, 1.59)	
Race/ethnicity						
Black/African American	Reference	0.7656	Reference	0.0295	Reference	0.0214
White	1.05 (0.46, 2.42)		2.32 (0.88, 6.09)		3.26 (1.29, 8.23)	
Hispanic	0.78 (0.37, 1.66)		0.73 (0.28, 1.86)		2.47 (1.06, 5.74)	
Other	1.68 (0.41, 6.96)		4.18 (1.08, 16.20)		0.49 (0.09, 2.67)	
HIV Viral Load (copies/mL)						
<200	1.02 (0.47, 2.23)	0.9550	0.92 (0.39, 2.15)	0.8467	0.49 (0.20, 1.21)	0.1193
200+	Reference		Reference		Reference	
CD4 Count (cells/microliter)						
<200	Reference	0.7348	Reference	0.3796	Reference	0.5396
200–<500	1.12 (0.36, 3.57)		0.53 (0.18, 1.58)		0.64 (0.25, 1.67)	
500+	0.88 (0.28, 2.76)		0.47 (0.16, 1.37)		1.00 (0.37, 2.70)	
How many people spend time with are heavy/problem drinkers		0.0128		0.0001		0.0330
None	Reference		Reference		Reference	
A few	1.85 (1.02, 3.36)		4.66 (2.25, 9.63)		2.69 (1.22, 5.95)	
About half or more	3.59 (1.49, 8.66)		4.31 (1.62, 11.41)		3.09 (1.18, 8.10)	
Homeless[2]						
No	Reference	0.6053	Reference	0.5205	Reference	0.0147
Yes	1.22 (0.57, 2.63)		1.33 (0.56, 3.16)		2.74 (1.22, 6.15)	
Drug dependence[3]						
No	Reference	0.0031				
Yes	2.65 (1.39, 5.06)					
Alcohol dependence[3]						
No			Reference	0.0395	Reference	0.8050
Yes			2.17 (1.04, 4.53)		0.89 (0.34, 2.30)	

Note: adjusted for all covariates in the table

[1] measured by the Household Food Insecurity Access Scale, score ≥2 is food insecure. Measured over 4-week timeframe

[2] 1+ nights on street or in shelter past 6 months

[3] Any drug dependence or alcohol dependence in a 12-month period measured on the Mini International Neuropsychiatric Interview

Table 4.

Adjusted Associations, without Drug Dependence, between Food Insecurity and Alcohol Use and Adjusted Associations, without Alcohol Dependence, between Food Insecurity and Cocaine and Opioid Use.

	ALCOHOL: Adjusted, without Drug Dependence		**COCAINE: Adjusted, without Alcohol Dependence**		**OPIOID: Adjusted, without Alcohol Dependence**	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Food Insecurity[1]						
Secure	Reference	0.3972	Reference	0.0387	Reference	0.0292
Insecure	1.27 (0.73, 2.22)		1.97 (1.04, 3.76)		2.45 (1.09, 5.48)	
Age, 1 yr increase	1.00 (0.97, 1.03)	0.8719	1.00 (0.96, 1.04)	0.9725	1.03 (0.99, 1.07)	0.2047
Sex						
Male	Reference	0.6454	Reference	0.0752	Reference	0.4622
Female	1.15 (0.64, 2.07)		0.54 (0.27, 1.07)		0.75 (0.35, 1.61)	
Race/ethnicity						
Black/African American	Reference	0.7662	Reference	0.0566	Reference	0.0199
White	1.11 (0.50, 2.48)		2.24 (0.91, 5.51)		3.31 (1.31, 8.34)	
Hispanic	0.79 (0.38, 1.66)		0.72 (0.27, 1.88)		2.51 (1.08, 5.86)	
Other	1.55 (0.45, 5.33)		3.21 (0.85, 12.13)		0.51 (0.09, 2.76)	
HIV Viral Load (copies/mL)						
<200	0.89 (0.43, 1.85)	0.7489	0.91 (0.39, 2.09)	0.8213	0.49 (0.20, 1.20)	0.1177
200+	Reference		Reference		Reference	
CD4 Count (cells/ microliter)	Reference	0.7285	Reference	0.3658	Reference	0.5499
<200	1.05 (0.37, 2.96)		0.55 (0.20, 1.52)		0.65 (0.25, 1.69)	
200–<500	0.82 (0.29, 2.33)		0.49 (0.18, 1.33)		1.00 (0.37, 2.72)	
500+						
How many people spend time with are heavy/ problem drinkers		0.0025		<0.0001		0.0274
None	Reference		Reference		Reference	
A few	2.09 (1.17, 3.73)		4.89 (2.34, 10.19)		2.64 (1.22, 5.67)	
About half or more	4.13 (1.78, 9.54)		4.81 (1.88, 12.32)		3.01 (1.20, 7.54)	
Homeless[2]						
No	Reference	0.2797	Reference	0.2592	Reference	0.0150
Yes	1.51 (0.71, 3.20)		1.60 (0.71, 3.63)		2.69 (1.21, 5.97)	

Note: adjusted for all covariates in the table, as noted above

[1] measured by the Household Food Insecurity Access Scale, score ≥2 is food insecure. Measured over 4-week timeframe

[2] 1+ nights on street or in shelter past 6 months