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Longitudinal associations between food insecurity and substance use in a cohort of women with or at risk for HIV in the United States

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Declaration of interests

None.

Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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Abstract

Background and Aims—Few longitudinal studies have examined the relationship between food insecurity and substance use. We aimed to investigate this relationship using longitudinal data among women with or at risk for HIV in the United States.

Design—Women's Interagency HIV Study (WIHS), a prospective cohort study.

Setting—Nine sites across the United States.

Participants—A total of 2553 women with or at risk for HIV.

Measurements—Semi-annual structured interviews were conducted during April 2013-March 2016. Food security (FS) was the primary predictor, measured using the Household Food Security Survey Module. Outcomes were: any illicit substance use except cannabis; licit or illicit cannabis use; stimulant use (crack, cocaine, or methamphetamine); opioid use (heroin or methadone in a non-prescribed way); and prescription drug misuse (prescription narcotics, amphetamines, or tranquilizers in a non-prescribed way) since the last visit. We used multivariable logistic regression with random effects to examine longitudinal associations of current and previous FS with the outcomes simultaneously, adjusting for socio-demographic factors, HIV serostatus, physical health and health insurance.

Findings—Average number of visits was 4.6. At baseline, 71% of participants were HIV-seropositive, 44% reported marginal, low, or very low FS, and 13% were using illicit substances. In adjusted analyses, current low and very low FS were significantly associated with 1.59 [95% confidence interval (CI) = 1.02, 2.46; $P = 0.039$] and 2.48 (95% CI = 1.52, 4.04; $P < 0.001$) higher odds of any illicit substance use, compared to high FS, and also with higher odds of cannabis, stimulant and opioid use, exhibiting a consistent dose-response relationship. Marginal, low, and very low FS at the previous visit were associated with 1.66 (95% CI = 1.08, 2.54; $P = 0.020$), 1.77 (95% CI = 1.14, 2.74; $P = 0.011$), and 2.28 (95% CI = 1.43, 3.64; $P < 0.001$) higher odds of current illicit substance use.

Conclusions—Food insecurity appears to be longitudinally associated with substance use among US women with or at risk for HIV.

Keywords

Drug use; food insecurity; HIV; mental health; substance use; women

INTRODUCTION

Substance use remains a major challenge in the United States. In 2015, nearly 25 million people reported using illicit substances other than marijuana in the past year [1]. More than

6.5 million had used stimulant drugs, and close to a million had used heroin. Marijuana use was reported among 36 million individuals [1]. Furthermore, the nation is facing an epidemic of prescription drug misuse. Nearly 12.5 million people in 2015 had misused prescription narcotics in the previous year [1]. Prescription narcotic use has risen steadily over the past two decades, with a concurrent rise observed in hospitalizations for heroin overdose [2]. In the wake of the criminalization and law enforcement strategies known as the 'War on Drugs', which are regarded both to have failed in their objectives and exacerbated public health and social problems associated with substance use, current research emphasizes taking evidence-based approaches to treatment and prevention [3,4]. Understanding and addressing the structural drivers, social context and health consequences of substance use forms a major part of this endeavor.

One structural factor known to interact with substance use is food insecurity (FI). FI is the limited or uncertain availability of nutritionally adequate, safe foods or the inability to acquire personally acceptable foods in socially acceptable ways [5]. Experienced by 42 million people in the United States in 2015 (13.4% of the population) [6], FI includes (a) insufficient quantity, quality or diversity of available foods; (b) feelings of deprivation, anxiety or restricted choice about the amount or type of available foods; and (c) the inability to procure foods in a socially acceptable manner [5]. Numerous population-based studies in the United States and Canada have demonstrated cross-sectional associations between FI and the use of crack [7], methamphetamine [8] and other illicit substances [9–14]. Consistently high rates of FI and/or malnutrition have also been reported in studies of people who use illicit substances [15–18], injected drugs [19–24] and crack [25].

Most of these studies have assumed that substance use contributes to FI, either by draining material resources [7,9,14,19,20,22,24,26] or by imposing a chaotic, marginalized life-style upon users [7,16,18,22,26,27]. Few studies, however, have considered that FI may also act as a structural driver of substance use. This is an important possibility to consider—first because of the high prevalence of FI in the United States, and secondly because substance use has been hypothesized to lie on the causal pathway between FI and poor outcomes in several chronic conditions [5]. These include HIV infection, where FI and substance use are salient issues. Studies show consistently high rates of FI and substance use among low-income people living with HIV (PLHIV) [7,10,16,17,19,21,23,25–27]. Both FI and substance use are also associated with increased HIV transmission risk behaviors, poor adherence to antiretroviral therapy and higher morbidity and mortality among PLHIV [5].

Women in particular face unique challenges associated with FI, substance use and HIV. Women are disproportionately vulnerable to FI [28,29]. In the United States, both single women with children and single women living alone exhibit higher rates of FI than the national average [6]. Low-income women—and particularly women of color—are also threatened by well-recognized synergistic epidemics of substance use, violence and HIV in the United States [30]. Substance use plays a key role by heightening the risk of unprotected sex, transactional sex and gender-based violence, while also undermining health-care decision-making processes [30–35]. Gender-based violence [36,37] and high-risk sexual activity [38–41] are also more common among food-insecure women.

These inter-related issues of FI, substance use, HIV and gender inequity indicate that further examination of the relationship between FI and substance use is critical, especially in the context of HIV and among women. Few longitudinal studies, however, have examined FI and substance use, particularly by substance class. Disaggregated examination is important because substance classes differ greatly in their socio-political, legal and pharmacological characteristics. Substances that reduce the sensation of hunger, for example, may provide a relative advantage to individuals experiencing food insecurity. Furthermore, no longitudinal studies have been conducted exclusively among women. We sought to address these research gaps by analyzing longitudinal data on FI and substance use among a cohort of women with or at risk for HIV in the United States. We hypothesized that: (a) FI would be associated with substance use, such that increasing severity of FI would strengthen the association; and (b) FI would be associated most strongly with stimulants and opioids, which are known appetite suppressants.

METHODS

Study design and population

This longitudinal analysis used data from the Women's Interagency HIV Study (WIHS). The WIHS is a large, ongoing, multi-center prospective cohort study of women with or at risk for HIV in the United States, established in 1993. Cohort recruitment, demographics and retention have previously been described in detail [42–45]. The study has undergone four waves of recruitment: 1994–95 (2054 HIV-seropositive and 569 HIV-seronegative women, demographically representative of the US epidemic at the time); 2001–02 (737 HIV-seropositive, 406 HIV-seronegative; added to meet new analytical requirements in the era of highly active antiretroviral therapy), 2011–12 (2 76 HIV-seropositive, 95 HIV-seronegative; replacing some from the original cohort who had died); and 2013–15 (610 HIV-seropositive, 235 HIV-seronegative; recruited from four newly added study sites in the Southern United States) [44,45]. As of October 2016, 1268 participants had died since the beginning of the WIHS (mostly from the first recruitment wave), 130 had withdrawn, 806 had been discontinued for administrative reasons (e.g. loss of funding), 415 had been lost to follow-up and 2363 were being actively followed [45].

WIHS participants undergo structured interviews and physical examinations, and have blood and other biological samples taken at semi-annual visits. The data for our study were collected as part of a WIHS Food Insecurity substudy spanning visits 38–43 during April 2013-March 2016. The substudy newly introduced comprehensive measures of food security, nutrition and other key socio-economic variables into the WIHS interviews among all nine study sites: Birmingham, AL/Jackson, MS; Atlanta, GA; Miami, FL; Chapel Hill, NC; San Francisco, CA; Chicago, IL; Washington, DC; Bronx, NY; and Brooklyn, NY. During the substudy period, there were 12 464 person-visits in total in the WIHS among 2613 unique women. Of these person-visits, 608 were abbreviated visits at which the women only contributed laboratory specimens, meaning that our substudy measures could not be offered. Further, 164 person-visits were missing data on our primary predictor. The data presented were therefore from 11 692 person-visits among 2553 unique women. Of these women, 1708 had been recruited prior to visit 38 and could contribute up to six visits in total

during the substudy period. The remaining 845 women were recruited during visits 39–42 as part of the Southern recruitment wave occurring contemporaneously with our substudy. These women could contribute between two and five visits.

Primary predictor

The primary predictor was food security (FS), measured using the 18-item US Department of Agriculture Household Food Security Survey Module (HFSSM) [46]. The HFSSM has been validated across diverse settings and in multiple countries [47], including the United States [48]. Based on in-depth qualitative and survey data among women and low-income families in the United States [49,50], it was developed to capture the experience of anxiety regarding household food supplies, inadequate food quality and/or reduced food intake among adults and their children during the previous 12 months [47]. Respondents completed the HFSSM at each visit and reported FS during the previous 6 months. Respondents were classified as having high, marginal, low or very low FS per guidelines [46]. The internal consistency of the HFSSM in this sample was high: Cronbach's alpha = 0.91.

Primary outcomes

The primary outcomes were categories of substance use since the last visit. Participants were asked if they had used marijuana (licitly or illicitly), hashish, crack, cocaine, methamphetamine, heroin, speedball (cocaine and heroin together), methadone in a non-prescribed way (i.e. without prescription, more than was prescribed or recreationally to get high), prescription narcotics in a non-prescribed way, prescription amphetamines (e.g. Adderall) in a non-prescribed way, prescription tranquilizers in a non-prescribed way, hallucinogens, club drugs or any other illicit or recreational drugs since the last visit. We pooled their responses into the following non-mutually exclusive outcomes: any illicit substance use except cannabis (i.e. except marijuana or hashish); cannabis use (marijuana or hashish); stimulant use (crack, cocaine, speedball or methamphetamine); opioid use (heroin, speedball or methadone in a non-prescribed way); and prescription drug misuse (prescription narcotics, amphetamines or tranquilizers in a non-prescribed way) since the last visit.

Covariates

Based on previous literature [1,6,51], we selected multiple socio-demographic and health-related covariates that may confound the relationship between FI and substance use. Socio-demographic factors included age at visit, race/ethnicity (non-Hispanic white, Hispanic, African American/black or other), annual income (≤ $12 000, $12001–24000 or ≥ $24001), education (less than high school education versus at least high school education), having child dependents (yes versus no) and housing status (homeless/marginally housed versus not homeless/marginally housed). Health-related factors included HIV status (HIV-infected versus - uninfected), baseline physical health status (measured using the validated MOS-HIV physical health summary score [52] at first visit in the substudy) and having health insurance (yes versus no).

Ethics statement

All participants provided written informed consent for participation in the WIHS and were compensated for their participation at each visit. This study was approved by the Institutional Review Board at each study site's institution and by the WIHS Executive Committee.

Statistical analysis

Baseline summary characteristics were obtained for the primary predictor, outcome variables and covariates by using the data from the first visit per WIHS participant for the substudy period. Bivariate and adjusted associations between FS, covariates and the outcome categories were examined using multivariable two-level logistic regression with individuals as random effects (i.e. random intercepts) and time-varying and time-invariant predictors and covariates as fixed effects. We performed a complete-cases analysis. Covariates were missing from 770 person-visits (6.5% of total person-visits), mostly income. These person-visits were therefore excluded from multivariable analyses. Compared to women without missing data, women with missing data were more likely to be non-Hispanic white and of the highest income category. There were no other statistically significant differences between women with and without a missing covariate.

We examined both current FS (as measured at the current visit) and previous FS (as measured at the previous visit, 6 months earlier) simultaneously in the same models, which required two successive time-points. Any person-visit at which the participant had not been present or was missing data from the previous visit was dropped from the analysis. This analysis allowed us to compare the independent associations of previous versus current FS with current substance use, and also to investigate the potential effect of persistent FI (i.e. current and previous FI combined, encompassing 1 year of FS status). The effect of persistent FI was calculated by summing the natural logarithm of the odds of any given outcome category for current and previous FS status, then exponentiating.

To test for effect modification between FS and HIV status we also ran an adjusted model, including an interaction term between the two variables. Further, we conducted a sensitivity analysis in which we introduced previous use of the same substance (as measured at the previous visit) into the model as an additional covariate for each outcome, given that past substance use is a strong predictor of current substance use. Finally, we conducted a further sensitivity analysis adding prescription narcotic misuse to opioid use and prescription amphetamine misuse to stimulant use to examine how these drugs with similar pharmacological properties but different socio-cultural and legal profiles would affect the associations. All analyses were completed using Stata version 14 (StataCorp LP, College Station, TX, USA).

RESULTS

There were 2553 women in the sample, comprising 11 692 person-visits. The range of total visits among the women was one to six, with an average of 4.6. Among the women who could contribute six visits (i.e. excluding women from the new Southern sites entering the

study from visits 39–42), the average number of visits was 5.2. At substudy baseline, median age was 48, a majority were living with HIV (71%) and most identified as African American/black (72%; Table 1). Approximately half (52%) had an annual income < $12 000 and approximately one-third (33%) had less than a high school education. Just fewer than half the women (44%) were food-insecure (i.e. reported marginal, low or very low FS). Nearly a quarter (22%) reported using cannabis since the last visit, while 13% reported using illicit substances other than cannabis. Stimulants were the next most common class of substance used (11%).

In bivariate analyses, current marginal, low and very low FS were each associated significantly with all categories of substance use, compared to high FS (Supporting information, Table S1a,b). We observed a dose-response relationship for all outcomes. The magnitude of the association was highest for opioid use. There were also statistically significant, independent dose-response relationships between previous FS and all outcome categories.

In adjusted analyses, the dose-response relationship between FS status (both current and previous) and substance use remained across most outcome categories (Table 2). Current FS status again showed a dose-response relationship with any illicit substance use, although not significant for marginal FS. Compared to high FS, current low and very low FS were associated with 1.59 [95% confidence interval (CI) = 1.02, 2.48; $P = 0.039$] and 2.48 (95% CI = 1.52, 4.04; $P < 0.001$) higher odds of any illicit substance use, respectively. There were similar dose- response relationships with cannabis, stimulant and opioid use although, again, associations with marginal FS were not significant. Associations between current FS status and prescription drug misuse were not significant.

Previous FS status similarly had independent associations with many of the outcomes (Table 2). Compared to high FS, previous marginal, low and very low FS were associated with 1.66 (95% CI = 1.08, 2.54; $P = 0.020$), 1.77 (95% CI = 1.14, 2.74; $P = 0.011$) and 2.28 (95% CI = 1.43, 3.64; $P < 0.001$) higher odds of any illicit substance use, respectively, holding both current FS status and potential confounders constant. Among the individual categories of substance use, previous low and very low FS were associated significantly with increasingly higher odds of stimulant use. The associations of previous low and very low FS with cannabis and opioid use were in a positive direction, but only the association of previously low FS with cannabis reached statistical significance.

When we combined previous and current FS from the above model (in Table 2) to examine persistent FI we found that, holding all other variables constant, women with persistent very low FS had 5.64 (95% CI = 3.07, 10.3 7; $P < 0.001$) higher odds of any illicit substance use, 2.79 (95% CI = 1.50, 5.20; $P = 0.001$) higher odds of cannabis use, 6.04 (95% CI = 3.18, 11.44; $P < 0.001$) higher odds of stimulant use and 10.04 (95% CI = 3.00, 33.68; $P < 0.001$) higher odds of opioid use, compared to women who had high FS at both visits (Table 3).

HIV serostatus was not an effect modifier of the associations between FS and substance use. We therefore adjusted for HIV serostatus as a covariate in our models and found that HIV-seropositivity was associated with lower odds of substance use in most categories.

In the sensitivity analysis introducing previous substance use as an additional covariate, the significant concurrent associations shown in Table 2 remained significant (with the sole exception of the association between low FS and any illicit substance use), but were somewhat attenuated (Supporting information, Table S2a,b). Very low previous FS remained associated significantly with 1.64 (95% CI = 1.16, 2.30; $P < 0.001$) higher odds of any current illicit substance use. The lagged associations between previous FS and stimulant use, however, were no longer statistically significant. In the other sensitivity analysis, the addition of prescription amphetamines made no difference in the stimulant use model, while the addition of prescription narcotics attenuated the association between FI and opioid use. The association with low FS was no longer statistically significant, and very low FS was associated with 3.18 (95% CI = 1.44, 7.01; $P = 0.004$) higher odds of opioid use.

DISCUSSION

In this longitudinal study of FI and substance use among women with or at risk for HIV, current FI and persistent FI were associated with higher odds of using illicit substances, cannabis, stimulants and opioids. Previous FI was associated with higher odds of illicit substance use and stimulant use. These associations exhibited a consistent dose-response relationship, with the most severe form of FI (very low FS) almost always associated with the highest odds of substance use. HIV serostatus was not an effect modifier, and HIV-seropositive women had lower odds of substance use. This may reflect that PLHIV in many states have access to additional support services and social safety net components, and may also be more motivated to reduce risk behaviors and engage with clinical and social services [53]. Overall, the results demonstrate a significant burden of FI among these women, and provide further evidence for the relationship between FI and substance use.

To our knowledge, only three other studies have produced longitudinal data on this relationship, all among predominantly male samples in the United States and Canada [26,27,54]. Our findings extend this body of research in four ways. First, our sample consisted exclusively of women, who have been under-researched on this topic. Secondly, we disaggregated FI into marginal low and very low FS, whereas all previous studies used a binary classification of food-secure versus food-insecure. This allowed us to demonstrate the dose-response relationship. Thirdly, our analysis by substance class found that FI was associated with cannabis, stimulant and opioid use individually. Only one of the above studies performed a similar analysis [54], reporting a significant association between FI and marijuana use only among US veterans. Fourthly, we utilized the longitudinal nature of the data to examine the relationship between FS at the previous visit and current substance use in the same model as current FS. This demonstrated significant independent lagged associations between FI and both illicit substance use overall and stimulant use individually, and also allowed us to calculate the associations of persistent FI (associated with five times higher odds of illicit substance use).

Directionality and mechanisms

While most previous studies have posited that substance use contributes to FI, the possibility that FI may equally act as a structural driver of substance use is relatively unexplored.

Although our findings cannot demonstrate causality in this direction, the lagged associations show that the temporality in our data is consistent with FI contributing to substance use—a key criterion that must be fulfilled for a causal relationship [55]. This possibility is strengthened by the sensitivity analysis that adjusted for previous illicit substance use, in which the lagged association between very low FS and current illicit substance use remained significant. Furthermore, another criterion is a dose-response relationship, which we found consistently between FI and all outcome categories except prescription drug misuse.

Plausible mechanisms that might explain an association in this direction (a third criterion) have been described previously. Studies in diverse resource-poor settings have shown that street youth use appetite-suppressing, psychoactive substances to curb hunger and anxiety around food supplies and, in the case of stimulants, provide energy for food procurement [56–58]. While these mechanisms have not been examined in resource-rich settings, food-insecure individuals in North America are known to engage in time- and energy-consuming food procurement strategies to stave off hunger that are often personally undesirable and/or socially unacceptable (including stealing and sex exchange) [59–61]. The appetite-suppressing properties of both opioids and stimulants, as well as the energizing effects of the latter, may therefore partly explain why the strongest associations in this study were with these substance classes.

Moreover, stress, depression and negative life experiences are all thought to play a role in the use of opioids, stimulants and cannabis [62–64]. Crack use, specifically, has been described in ethnographic data as a response to anxiety, sadness, depression and despair [65]. FI is well known to fuel such symptoms and experiences, and has been associated with stress, anxiety and depression across diverse settings [7,27,66–71]. The negative psychological and mental health sequelae of FI may therefore also play a role in our findings.

LIMITATIONS

We did not measure frequency of substance use, meaning that our data cannot differentiate between habitual and occasional users. The extent of substance use among food-insecure women in this population is therefore unclear. Moreover, overall reporting of substance use was relatively low, which may reflect self-report bias and/or the age of the cohort (median age 48, whereas individuals aged 18–25 report the highest proportion of substance use nation-wide [1]). Most WIHS participants also live in urban settings. It is unclear to what extent these findings are applicable to younger and more rural populations in the United States, who may exhibit different patterns of substance use (including higher prescription drug misuse rates [72]). Another limitation is that cannabis legislation varies greatly by jurisdiction in the United States. The substudy survey did not distinguish between legal medical, legal recreational and illegal recreational use, and did not account for legislative changes in several states during data collection.

CONCLUSION

The data presented raise the possibility that FI may act as a structural driver of substance use, in addition to being a product of substance use. Future studies should specifically investigate whether a bidirectional relationship does exist, and the mechanisms acting in either direction. Above all, our findings represent a warning against sidelining drug policies that seek to address structural vulnerabilities. Political focus is needed on the social, structural and public health dimensions of substance use in the United States, of which FI is a component. This is especially true in the context of mutually reinforcing HIV and substance use epidemics, with unique implications for women.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Socio-demographic characteristics of sample at first visit in the Food Insecurity substudy (n = 2553).

	n	%
Food security (FS)		
High FS	1419	55.6
Marginal FS	405	15.9
Low FS	372	14.6
Very low FS	357	14.0
HIV-seropositive	1803	70.6
Age at visit (median, IQR)	47.7	40.4, 53.8
Race/ethnicity		
White	255	10.0
Hispanic	377	14.8
African American/black	1829	71.6
Other	92	3.6
Income		
< $12 000	1262	51.9
$12001–24 000	541	22.3
≥ $24 001	629	25.9
< High school education	832	32.6
Homeless/marginally housed	54	2.1
Child dependents	986	38.6
Baseline physical health score (median, IQR)	0.237	−0.713, 0.816
Insured	2235	87.5
Substance use		
Any illicit substance use (not including cannabis)[a]	331	13.0
Cannabis use[b]	566	22.2
Stimulant use[c]	288	11.3
Opioid use[d]	50	2.0
Prescription drug misuse[e]	52	2.0
Person-visits	11692	–
Unique WIHS women	2553	–

[a]Use of crack, cocaine, speedball, methamphetamine, heroin or methadone in a non-prescribed way, prescription narcotics in a non-prescribed way, prescription amphetamines in a non-prescribed way, prescription tranquilizers in a non-prescribed way hallucinogens, club drugs or any other illicit substances.

[b]Licit or illicit use of marijuana or hashish.

[c]Use of crack, cocaine, speedball or methamphetamine.

[d]Use of heroin, speedball, or methadone in a non-prescribed way.

[e]Use of prescription narcotics, prescription amphetamines or prescription tranquilizers in a non-prescribed way. IQR = interquartile range; WIHS = Women's Interagency HIV Study.

Table 2

Adjusted associations between food security and substance use outcome categories.

	Any illicit substance use[a]			Cannabis use[b]			Stimulant use[c]			Opioid use[d]			Prescription drug misuse[e]		
	aOR	**95% CI**	**P-value**	**aOR**	**95% CI**	**P-value**	**aOR**	**95% CI**	**P-value**	**aOR**	**95% CI**	**P-value**	**aOR**	**95% CI**	**P-value**
Current Food Security (high ref)															
Marginal FS	1.46	0.94, 2.25	0.089	1.61	1.12, 2.32	0.011	1.44	0.90, 2.30	0.133	1.45	0.59, 3.56	0.424	1.79	0.88, 3.65	0.110
Low FS	1.59	1.02, 2.46	0.039	1.66	1.14, 2.43	0.008	1.68	1.05, 2.69	0.030	2.70	1.17, 6.24	0.020	1.73	0.86, 3.49	0.124
Very Low FS	2.48	1.52, 4.04	<0.001	2.02	1.27, 3.21	0.003	3.31	1.98, 5.54	<0.001	5.33	2.15, 13.17	<0.001	2.13	0.92, 4.91	0.078
Previous Food Security (high ref)															
Marginal FS	1.66	1.08, 2.54	0.020	0.80	0.56, 1.16	0.2 50	1.39	0.88, 2.22	0.161	1.48	0.62, 3.53	0.372	1.23	0.61, 2.49	0.569
Low FS	1.77	1.14, 2.74	0.011	1.49	1.02, 2.18	0.037	1.68	1.05, 2.68	0.031	1.48	0.63, 3.51	0.370	1.39	0.69, 2.80	0.353
Very Low FS	2.28	1.43, 3.64	<0.001	1.38	0.88, 2.17	0.160	1.83	1.11, 3.00	0.018	1.89	0.77, 4.63	0.166	0.99	0.44, 2.27	0.990
HIV-seropositive	0.31	0.19, 0.50	<0.001	0.27	0.16, 0.45	<0.001	0.40	0.24, 0.67	0.001	0.55	0.19, 1.63	0.283	0.33	0.17, 0.66	0.002
Age at Visit	1.00	0.98, 1.03	0.180	0.93	0.90, 0.95	0.016	1.02	0.99, 1.05	0.248	0.99	0.94, 1.05	0.137	0.97	0.94, 1.01	0.151
Race/Ethnicity (White ref.)															
Hispanic	0.11	0.041, 0.29	<0.001	0.11	0.04, 0.32	<0.001	0.27	0.10, 0.77	0.014	0.16	0.019, 1.33	0.090	0.07	0.021, 0.25	<0.001
African American/ Black	0.30	0.15, 0.62	0.001	0.37	0.16, 0.87	0.023	0.71	0.32, 1.57	0.398	0.29	0.061, 1.41	0.126	0.08	0.032, 0.19	<0.001
Other	0.44	0.12, 1.64	0.220	0.41	0.09, 1.80	0.240	0.93	0.23, 3.71	0.916	1.11	0.080, 15.35	0.938	0.36	0.083, 1.60	0.181
Income (≤$12,000 ref)															
$12,001 -$24,000	0.33	0.21, 0.51	<0.001	0.63	0.44, 0.89	0.010	0.38	0.23, 0.61	<0.001	0.29	0.10, 0.84	0.022	0.36	0.16, 0.78	0.010
≥$24,001	0.32	0.19, 0.54	<0.001	0.40	0.26, 0.63	<0.001	0.33	0.19, 0.58	<0.001	0.48	0.15, 1.54	0.219	0.65	0.31, 1.35	0.245
<High School Education	0.72	0.45, 1.17	0.140	0.54	0.32, 0.89	0.670	0.74	0.45, 1.23	0.232	0.45	0.16, 1.29	0.922	1.71	0.82, 3.56	0.064
Homeless/Marginally housed	1.98	0.80, 4.92	0.730	1.24	0.45, 3.42	<0.001	1.79	0.69,4.65	0.224	1.09	0.19, 6.38	0.769	3.60	0.93 –13.94	0.108
Child Dependents	0.43	0.28, 0.66	<0.001	0.90	0.63, 1.30	0.580	0.42	0.27, 0.66	<0.001	0.34	0.13, 0.86	0.022	0.75	0.39, 1.45	0.395
Baseline Physical Health Score	0.59	0.47, 0.74	<0.001	0.46	0.36, 0.60	<0.001	0.61	0.48, 0.77	<0.001	0.54	0.33, 0.88	0.013	0.64	0.46, 0.89	0.008
Insurance Status	0.44	0.25, 0.77	0.005	0.97	0.55, 1.68	0.900	0.38	0.21, 0.69	0.001	1.16	0.32, 4.20	0.824	0.70	0.30, 1.65	0.420
Person-Visits	8,340			8,336			8, 336			8, 335			8, 338		
Unique WIHS Women	2,253			2,253			2, 253			2, 253			2, 253		

[a]Use of crack, cocaine, speedball, methamphetamine, heroin, methadone in a non-prescribed way, prescription narcotics in a non-prescribed way, prescription amphetamines in a non-prescribed way, prescription tranquilizers in a non-prescribed way, hallucinogens, club drugs, or any other illicit substances.

[b] Licit or illicit use of marijuana or hashish.

[c] Use of crack, cocaine, speedball, or methamphetamine.

[d] Use of heroin, speedball, or methadone in a non-prescribed way.

[e] Use of prescription narcotics, prescription amphetamines, or prescription tranquilizers in a non-prescribed way.

Table 3

Association of food security over the previous year with substance use outcome categories.[a]

	Any illicit substance use			Cannabis use			Stimulant use			Opioid use			Prescription drug misuse		
	aOR	95% CI	P-value	aOR	95% CI	P-value	aOR	95% CI	P-value	aOR	95% CI	P-value	aOR	95% CI	P-value
Current + previous food security (high ref)															
Marginal	2.42	(1.31,4.46)	0.005	1.29	(0.75, 2.23)	0.350	2.00	(1.04, 3.87)	0.039	2.14	(0.60, 7.64)	0.240	2.19	(0.81, 5.96)	0.120
Low	2.80	(1.54, 5.11)	0.001	2.49	(1.44, 4.31)	0.001	2.81	(1.48 5.3 5)	0.002	4.01	(1.22, 13.13)	0.022	2.41	(0.97, 6.00)	0.058
Very low	5.64	(3.07, 10.37)	< 0.001	2.79	(1.50, 5.20)	0.001	6.04	(3.18, 11.44)	< 0.001	10.04	(3.00, 33.68)	< 0.001	2.11	(0.81, 5.53)	0.123

[a]Results are the exponentiated linear combinations of the natural log of the adjusted odds ratios (aOR) for current and prior food security within each level (i.e. marginal, low and very low) from Table 2, i.e. persistent FS = e^[ln $aOR_{current}$) + ln (aOR_{prior})]. Estimates, confidence intervals and *P*-values obtained through post-estimation commands for linear combinations in Stata. CI = confidence interval.