

Residential eviction predicts initiation of or relapse into crystal methamphetamine use among people who inject drugs: a prospective cohort study

William Damon¹, Ryan McNeil^{1,2}, M.-J. Milloy^{1,2}, Ekaterina Nosova¹, Thomas Kerr^{1,2}, Kanna Hayashi^{1,3}

¹British Columbia Centre for Excellence in HIV/AIDS, St. Paul's Hospital, 608-1081 Burrard Street, Vancouver, British Columbia, Canada V6Z 1Y6

²Faculty of Medicine, University of British Columbia, St. Paul's Hospital, 608-1081 Burrard Street, Vancouver, British Columbia, Canada V6Z 1Y6

³Faculty of Health Sciences, Simon Fraser University, 8888 University Drive, Burnaby, British Columbia, Canada V5A 1S6

Address correspondence to Kanna Hayashi, E-mail: uhri-kh@cfeenet.ubc.ca

ABSTRACT

Reports of increasing methamphetamine use among vulnerable populations may be attributed in part to the adaptive use of stimulants in response to the loss of stable housing through residential eviction. We employed multivariable recurrent event extended Cox regression to examine the independent association between recent evictions and initiation of or relapse into crystal methamphetamine use among people who inject drugs in Vancouver, Canada enrolled in two prospective cohort studies. In a multivariable analysis, eviction remained independently associated with methamphetamine initiation or relapse (adjusted hazard ratio = 1.90; 95% confidence interval: 1.31–2.75). Findings demonstrate the need to secure tenancies for drug-using populations to reduce harms.

Keywords Cox regression, drug use, eviction, housing, initiation, methamphetamine

Background

While overall trends in methamphetamine use may be stabilizing in the general North American population,¹ widespread and increasing methamphetamine use has been reported among members of vulnerable and marginalized populations, including those who are homeless and unstably housed^{2–4} and people who inject drugs.^{4–6} Longitudinal cohort studies of people who inject drugs have reported high levels of methamphetamine use that appear to be increasing in some urban settings in Australia, the United States and Canada.^{5,7,8} Furthermore, methamphetamine use among people who inject drugs has been shown to be associated with a number of severe harms, including hepatitis C infection,⁹ psychosis¹⁰ and cerebrovascular complications, including stroke.¹¹ Therefore, identifying factors associated with relapse or initiation into methamphetamine use among people who inject drugs should inform policy and programmatic efforts to reduce harms associated with drug use.

A possible contributing cause to increasing methamphetamine use among people who inject drugs is its adaptive use in response to changes in housing status. The social

adaptation model of the etiology of substance use among homeless and unstably housed populations characterizes substance use as a means of coping with the trauma, stress, and uncertainty of homelessness.¹² For example, methamphetamine use has a long history of functional use as a means to stay awake and alert.^{13,14} Indeed, homelessness has been independently associated with the initiation of methamphetamine use among people who inject drugs,^{4,5} in part because of its perceived benefits in improving concentration and productivity.¹⁵ For people who inject drugs, homelessness and unstable housing have been found to significantly increase the risk of early mortality,¹⁶ exposure to violence,¹⁷ drug-related risk behavior¹⁸ and difficulty in accessing treatment for drug or alcohol use.¹⁹

William Damon, Research Coordinator, BCCSU

Ryan McNeil, Research Scientist, BCCSU

M.-J. Milloy, Research Scientist, BCCSU

Ekaterina Nosova, Senior Statistician, BCCSU

Thomas Kerr, Director, BCCSU

Kanna Hayashi, Research Scientist, BCCSU

Concurrent with reported increases in methamphetamine use among people who inject drugs,⁵ a growing epidemic of residential evictions has been documented in the wake of a widespread housing affordability crisis in cities around the world.^{20,21} Evictions have been found to be an increasingly common^{22–25} and distinctively harmful pathway into homelessness.^{21,26,27} Studies have shown that evictions have become commonplace among people living in poverty, particularly those living in high crime communities and those connected to disadvantaged social networks.²⁰ While little research is available on pathways into eviction among people who inject drugs, the ongoing criminalization of illicit drug use, poverty and social stigma faced by people who inject drugs likely elevates the risk of eviction within this group.^{19,28}

Qualitative research has characterized evictions as precipitating a period of intense stress, uncertainty and intensifying material hardship.^{26,29} Evictions have been shown to significantly increase the risk of suicide,^{21,30} exposure to violence,³¹ depression³² and psychological distress.³³ In a study of HIV-positive people who inject drugs in a setting with no-cost antiretroviral therapy, evictions were associated with detectable HIV viral load, mediated through poor adherence to antiretroviral therapy.³⁴ These findings suggest that evictions are more than just a pathway into homelessness—they are a distinctively consequential life event associated with intense adverse health outcomes. While, to the best of our knowledge, no research has explored the effect of evictions on drug use related risk, we hypothesized that residential evictions would increase the likelihood that people who inject drugs initiated or relapsed into methamphetamine use. To test this hypothesis, we longitudinally examined the relationship between evictions and initiation of or relapse into methamphetamine use among people who inject drugs in Vancouver, Canada.

Methods

Study sample

The Vancouver Injection Drug Users Study (VIDUS) and the AIDS Care Cohort to evaluate Exposure to Survival Services (ACCESS) are two open prospective cohort studies of people who use drugs operating in Vancouver, Canada. Participants have been recruited through self-referral, snowball sampling, and street outreach in the Greater Vancouver region since May 1996. These cohorts have been described in detail previously.^{35,36} In brief, VIDUS enrolls HIV-negative adults (≥ 18 years of age) who injected illicit drugs at least once in the previous month at enrollment. ACCESS enrolls HIV-positive adults who used illicit drugs other than

or in addition to cannabis in the previous month. VIDUS participants who seroconverted to HIV following recruitment have been transferred into the ACCESS study. All eligible participants provided written informed consent. The studies have been approved by the University of British Columbia/Providence Health Care Research Ethics Board.

The follow-up procedures for each study have been harmonized to allow for combined analyses. At baseline and semi-annually, all study participants completed a harmonized interviewer-administered questionnaire that elicited socio-demographic information, drug use and other behavioral patterns, and social and structural exposures. In addition, participants also provided blood samples for HIV and hepatitis C testing, and HIV disease monitoring as appropriate. At the conclusion of each visit, study participants received a \$30 CDN honorarium. Questions regarding experiences of eviction were added to the study instrument in June 2007; therefore, we restricted our analyses to individuals who completed at least two study visits between June 2007 and May 2015, reported a history of injection drug use at baseline, and did not report crystal methamphetamine use in the past 6 months at their first visit during the study period. Ultimately, our sample consisted of 1257 participants.

Measures

The primary outcome for this analysis was self-reported initiation of or relapse into crystal methamphetamine use by injection or non-injection in the past 6 months (yes versus no). We defined initiation or relapse to mean having used crystal methamphetamine at least once in the past 6 months during follow-up. Because we did not ask about a history of crystal methamphetamine use by non-injection at baseline, the first report of crystal methamphetamine use during follow-up could have been the initiation of or relapse into crystal methamphetamine use. The primary explanatory variable of interest was a residential eviction in the past 6 months, defined as answering yes to the question, ‘Have you been evicted in the last 6 months?’

In order to examine the extent to which evictions contribute to methamphetamine initiation or relapse we examined a set of potential confounding variables that were previously found to increase the risk of methamphetamine use.^{37–39} The potential confounders considered in this analysis were sex (male versus female), age (per 10 years older), ethnicity/ancestry (white versus other), education (high school or higher versus less than high school), sexual orientation (non-heterosexual versus heterosexual), childhood emotional abuse, history of sexual abuse, being in a stable relationship, homelessness, HIV status (positive versus negative), employment

(regular or temporary job, or self-employed), police or court imposed warrant or area restriction, any drug or alcohol treatment, drug dealing, incarceration, sex work involvement, heavy alcohol use and benzodiazepine use. Area restrictions referred to police or court imposed conditions of release, typically attached to judicial interim release orders, colloquially called ‘bail orders’, as an optional condition aimed at reducing the likelihood of recidivism. Other drug use behaviors considered included: daily non-injection crack use, daily heroin injection, and daily cocaine injection. Unless otherwise indicated, all behavioral variables referred to the 6-month period preceding the date of the interview and were treated as time-varying variables.

Analysis

First, we calculated the incidence density of crystal methamphetamine initiation or relapse using person-time methods. We estimated the time to the first report of crystal methamphetamine use by taking the midpoint between the date of the first interview during which crystal methamphetamine use was reported and the preceding interview in which the participant did not report crystal methamphetamine use. Then, we compared the baseline sample characteristics between those who reported initiation of or relapse into methamphetamine use at least once during follow-up with those who did not, using Pearson’s χ^2 test for categorical variables and Wilcoxon rank sum test for continuous variables.

Next we used Kaplan–Meier methods⁴⁰ to determine the cumulative incidence of crystal methamphetamine initiation or relapse during follow-up, stratifying the sample by those who did and did not report eviction at baseline. We used the log-rank test to compare the survival distributions of those two groups.

Because some participants reported initiating or relapsing into methamphetamine use more than once during follow-up, we constructed a recurrent event survival model to examine the relationship between evictions and the outcome of interest. We used a proportional rates-means model described by Lin *et al.*⁴¹ to account for correlation among the length of individuals’ repeated time at risk for crystal methamphetamine initiation or relapse. In this model, we specified a counting process framework to define time to repeated events, such that individuals were considered to be at risk from time zero to the first event, from the subsequent study visit when no crystal methamphetamine use was reported in the previous 6 months to the second event, and so forth. As in the case of the Cox proportional hazards regression, the model assumed proportional means.⁴¹ We

assessed this assumption for each variable of interest by visual inspection of the Schoenfeld residuals plots⁴² and by examining time-by-covariate interactions.⁴³

We first computed hazard ratios representing the bivariable associations between eviction and potential confounders with repeated crystal methamphetamine initiation or relapse. We then examined the independent effect of evictions by fitting a multivariable model that included all variables that were significantly associated with crystal methamphetamine initiation or relapse at the $P < 0.05$ level in bivariable analyses.

We also inspected a potential interaction between homelessness and eviction. At baseline, the phi coefficient (mean square contingency coefficient)⁴⁴ between these two variables was 0.26, and the P -value of the baseline association using logistic regression was <0.01 . In order to examine the effect of the interaction between homelessness and eviction, we re-ran our multivariable models including main effects and the interaction term. The interaction resulted in $P = 0.95$, showing that this interaction did not have any effect on the result. Then, we re-ran our model excluding the homelessness variable, and the eviction variable remained significantly associated with the outcome ($P < 0.01$). Therefore, we concluded that the association has not been driven by the possible interaction between homelessness and eviction. We conducted all statistical analyses with R software version 3.2.4,⁴⁵ and all P values were two-sided.

Results

In total, 1257 people who inject drugs were eligible for the present study. These individuals completed a median of 9 (interquartile range [IQR]: 5–13) study visits and contributed 11 069 observations and 31 539 person-years. The median age at baseline was 45 years (IQR = 38–50), and 806 (64.1%) were male. During the study period, 280 (22.3%) participants reported one or more reports of recent evictions. Of those who had been evicted, 52 (16.6%) had been evicted more than once, with 12 (4.3%) participants reporting three or more evictions. In total, 339 (27.0%) participants initiated or relapsed into crystal methamphetamine use during follow-up, with an incidence density of 1.13 (95% confidence interval [CI]: 1.02–1.26) per 100 person-years. Among those who initiated or relapsed 234 (69.0%) did so on one occasion during follow-up, 79 (23.3%) on two occasions, and 26 (7.7%) on three or more occasions. Self-reported crystal methamphetamine use at the time of re-initiation tended towards more infrequent patterns of use. A considerable proportion of events (50%) involved using crystal methamphetamine less than once a month, while

Table 1 Baseline characteristics of people who inject drugs who did and did not report crystal methamphetamine initiation or relapse at least once during follow-up in Vancouver, Canada ($n = 1257$)

Characteristic	Total (%) $n = 1257$	Meth use ^a		P value
		No (%) $n = 918$	Yes (%) $n = 339$	
Eviction ^b				
Yes	82 (6.5)	51 (5.6)	31 (9.1)	0.022
No	1175 (93.5)	867 (94.4)	308 (90.9)	
Sex				
Male	806 (64.1)	589 (64.2)	217 (64.0)	0.961
Female	451 (35.9)	329 (35.8)	122 (36.0)	
Age				
Median (IQR)	44.5 (38.2–50.3)	45.6 (39.4–51.3)	41.3 (36.0–46.8)	<0.001 ^c
Ethnicity/ancestry				
Other	545 (43.4)	406 (44.2)	139 (41.0)	0.306
White	712 (56.6)	512 (55.8)	200 (59.0)	
Education				
High school or higher	617 (49.1)	472 (51.4)	145 (42.8)	0.012
Less than high school	617 (49.1)	433 (47.2)	184 (54.3)	
Sexual orientation				
Non-heterosexual	133 (10.6)	85 (9.3)	48 (14.2)	0.013
Heterosexual	1114 (88.6)	825 (89.9)	289 (85.3)	
Childhood emotional abuse				
Yes	501 (39.9)	361 (39.3)	140 (41.3)	0.172
No	660 (52.5)	499 (54.4)	161 (47.5)	
Sexual abuse in lifetime				
Yes	596 (47.4)	426 (46.4)	170 (50.1)	0.238
No	661 (52.6)	492 (53.6)	169 (49.9)	
In a stable relationship				
Yes	366 (29.1)	272 (29.6)	94 (27.7)	0.574
No	874 (69.5)	636 (69.3)	238 (70.2)	
Homeless ^b				
Yes	379 (30.2)	230 (25.1)	149 (44.0)	<0.001
No	875 (69.6)	687 (74.8)	188 (55.5)	
Employment ^b				
Yes	301 (23.9)	226 (24.6)	75 (22.1)	0.358
No	956 (76.1)	692 (75.4)	264 (77.9)	
HIV seropositive ^b				
Yes	516 (41.1)	355 (38.7)	161 (47.5)	0.005
No	741 (58.9)	563 (61.3)	178 (52.5)	
≥Daily crack cocaine use ^b				
Yes	457 (36.4)	292 (31.8)	165 (48.7)	<0.001
No	800 (63.6)	626 (68.2)	174 (51.3)	
≥Daily heroin injection ^b				
Yes	221 (17.6)	148 (16.1)	73 (21.5)	0.025
No	1036 (82.4)	770 (83.9)	266 (78.5)	
≥Daily cocaine injection ^b				
Yes	91 (7.2)	57 (6.2)	34 (10.0)	0.020
No	1166 (92.8)	861 (93.8)	305 (90.0)	

Continued

Table 1 Continued

Characteristic	Total (%) n = 1257	Meth use ^a		P value
		No (%) n = 918	Yes (%) n = 339	
Heavy alcohol use ^b				
Yes	170 (13.5)	129 (14.1)	41 (12.1)	0.368
No	1087 (86.5)	789 (85.9)	298 (87.9)	
Benzodiazepine use ^b				
Yes	16 (1.3)	13 (1.4)	3 (0.9)	0.579 ^d
No	1241 (98.7)	905 (98.6)	336 (99.1)	
Area restriction ^b				
Yes	112 (8.9)	70 (7.6)	42 (12.4)	0.007
No	1100 (87.5)	817 (89.0)	283 (83.5)	
Any drug or alcohol treatment ^b				
Yes	705 (56.1)	510 (55.6)	195 (57.5)	0.511
No	550 (43.8)	407 (44.3)	143 (42.2)	
Sex work involvement ^b				
Yes	146 (11.6)	95 (10.3)	51 (15.0)	0.020
No	1109 (88.2)	822 (89.5)	287 (84.7)	
Drug dealing ^b				
Yes	323 (25.7)	207 (22.5)	116 (34.2)	<0.001
No	934 (74.3)	711 (77.5)	223 (65.8)	
Incarceration ^b				
Yes	173 (13.8)	117 (12.7)	56 (16.5)	0.085
No	1084 (86.2)	801 (87.3)	283 (83.5)	

^aRefers to reporting crystal methamphetamine use in the previous 6 months at least once during follow-up.

^bRefers to 6 months prior to an interview.

^cWilcoxon Rank-Sum test.

^dFisher's exact test.

only 11% reported using everyday. Stratified by the number of re-initiation events these patterns remain stable, except for the two participants who reported five re-initiation events during the study period and described more frequent crystal methamphetamine use. The baseline sample characteristics stratified by crystal methamphetamine initiation or relapse during follow-up are shown in Table 1.

As shown in Fig 1, 80 months after recruitment into the study the Kaplan–Meier cumulative incidence of the first self-reported methamphetamine initiation or relapse was 71.8% among those who reported being evicted at baseline, compared to 32.7% among those who did not (log-rank $P < 0.001$). Kaplan–Meier curves for other significant covariates are also shown in Appendix 1.

Table 2 depicts the unadjusted and adjusted hazard ratios of eviction and other covariates with repeated methamphetamine initiation or relapse. In the multivariable model, after adjusting for various potential confounders, eviction (adjusted hazard ratio [AHR] = 1.90; 95% CI = 1.31, 2.75) was

independently and positively associated with higher hazard of methamphetamine initiation or relapse, as were age (per 10 years older; HR = 0.72; 95% CI = 0.62, 0.83), homelessness (AHR = 1.46; 95% CI = 1.12, 1.89), HIV seropositivity (AHR = 1.78; 95% CI = 1.40, 2.25), daily injection heroin use (AHR = 1.57; 95% CI = 1.16, 2.13), daily injection cocaine use (AHR = 1.79; 95% CI = 1.32, 2.41), sex work (AHR = 1.73; 95% CI = 1.26, 2.38) and drug dealing (AHR = 1.71; 95% CI = 1.32, 2.20).

Discussion

Main finding of this study

In this community-recruited cohort of 1257 people who inject drugs, more than one in five participants reported one or more evictions over the course of the 8-year study period. After adjusting for a range of potential confounders including homelessness, evictions maintained an independent positive association with an increased hazard of crystal methamphetamine

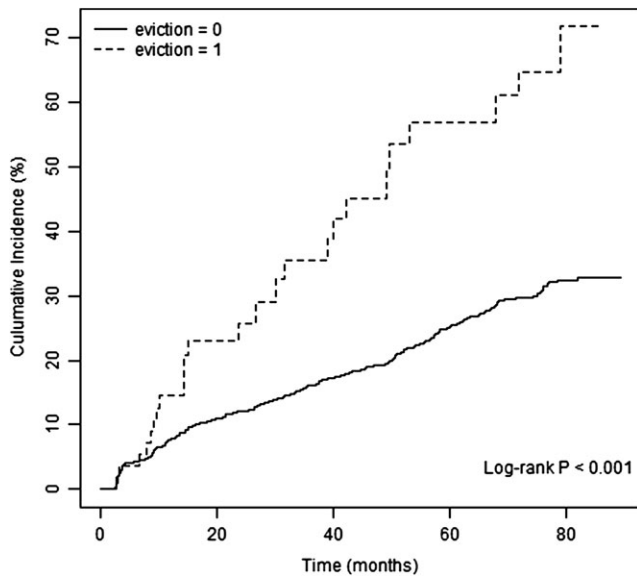


Fig. 1 Cumulative incidence of first self-reported crystal methamphetamine initiation or relapse, stratified by recent eviction at baseline among 1257 PWID in Vancouver, Canada (2007–15).

initiation or relapse. In our sample HIV status was also associated with increased likelihood of re-initiation of crystal methamphetamine alongside a set of other risk factors. While this interaction has been noted in past research,⁴ its persistence is disconcerting as methamphetamine use may enhance viral replication and accelerate HIV disease progression.⁴⁵ This finding suggests that evictions represent a uniquely consequential moment with regard to initiating methamphetamine use among people who inject drugs. Significantly, this persisted after controlling for the effects of homelessness on initiation, suggesting that evictions play a uniquely consequential role in drug use related risk behavior.

What is already known on this topic?

Contemporary research has characterized a widespread ‘epidemic of evictions’ in cities cross North America.^{20,46} Evictions are associated with a range of severe health related harms.^{16–21,23,26} A small but growing literature has documented the unique effects of evictions on the health and well being of people who inject drugs.^{31,34} This growing body of research characterizes eviction as an important but heretofore under-studied risk factor in the lives of people who inject drugs.

In addition to the already documented harms associated with eviction, people who inject drugs are at elevated risk for a range of drug-use related harms. The association between the ‘binge’ use of methamphetamine type substances and severe physical and mental harms^{1,9–11} is a

prominent example of the unique drug-use related harms that people who inject drugs are vulnerable too. Studies have documented relatively high rates of methamphetamine use among vulnerable people who inject drugs.^{1–3} Qualitative research has characterized people who use methamphetamine as falling into social and functional sub-groups.⁴⁷ Functional users were described as initiating methamphetamine use in the context of stressful work environments, such as long haul truckers,⁴⁸ rural oil and gas workers,⁴⁹ and air force pilots.⁵⁰ Given the qualitative description of the material hardship associated with eviction,²⁹ the use of methamphetamine among people who inject drugs as a functional response to eviction seems possible, as individuals are forced to contend with the sequelae of eviction.

What does this study add?

The association documented in this article between residential evictions and initiation or relapse into methamphetamine use among people who inject drugs suggests that an eviction is a critical transition event associated with a range of methamphetamine-related harms.⁵¹ This association may well be explained by the functional or adaptive use of methamphetamine by the recently evicted as they attempt to manage the unique stresses and uncertainties that accompany an eviction.^{26,29} The widespread use of methamphetamine among people who inject drugs might be an extension of amphetamine-type substances’ long history of use as a tool to, in the words of Murakawa,¹³ ‘speed up to keep up’ (p. 224). In the context of homelessness, crystal methamphetamine’s stimulating effect may help people who inject drugs navigate the many challenges people facing homelessness face.¹⁵ Further, given the social and economic costs associated with eviction,^{26,29} and given that crystal methamphetamine is considerably less expensive than other commonly used drugs,⁸ it is possible that crystal methamphetamine use post eviction is related with fewer resources. Understanding the exact mechanisms at work in people who inject drugs’s transition into methamphetamine use is necessary in order to pin point micro and meso level environmental risk factors that can, in turn, be directly targeted with policy and programmatic interventions. While widespread concern about methamphetamine use has contributed to a predominately punitive drug law enforcement-based approach to preventing the sale and use of methamphetamine,¹³ these findings signal a need to incorporate housing-focused approaches to efforts aimed at reducing stimulant use and drug-related harms. Our findings support broader structural interventions aimed at ensuring the stability of tenancies of people who inject drugs.

Table 2 Unadjusted and adjusted hazard ratios for crystal methamphetamine initiation or relapse among people who inject drugs in Vancouver, Canada (2007–15)

<i>Characteristic</i>	<i>Unadjusted</i>		<i>Adjusted</i>	
	<i>Hazard Ratio (95% CI)</i>	<i>P-value</i>	<i>Hazard Ratio (95% CI)</i>	<i>P-value</i>
Eviction*				
(yes versus no)	2.79 (1.97–3.95)	<0.001	1.90 (1.31–2.76)	0.001
Age				
(per 10 years older)	0.60 (0.53–0.68)	<0.001	0.72 (0.62–0.83)	<0.001
Gender				
(male versus female)	0.91 (0.71–1.17)	0.468	–	–
Ethnicity/ancestry				
(White versus other)	1.02 (0.80–1.30)	0.873	–	–
Education				
(high school or higher versus less than high school)	0.81 (0.63–1.04)	0.099	–	–
Sexual orientation				
(non-heterosexual versus heterosexual)	1.77 (1.26–2.47)	0.001	1.36 (0.98–1.89)	0.069
Childhood emotional abuse				
(yes versus no)	1.17 (0.91–1.51)	0.222	–	–
Sexual abuse in lifetime				
(yes versus no)	1.19 (0.94–1.51)	0.154	–	–
In a stable relationship				
(yes versus no)	0.93 (0.73–1.20)	0.587	–	–
Homeless*				
(yes versus no)	2.27 (1.81–2.85)	<0.001	1.46 (1.13–1.90)	0.004
Employment*				
(yes versus no)	0.67 (0.52–0.87)	0.002	0.92 (0.70–1.20)	0.529
HIV seropositive*				
(yes versus no)	1.67 (1.31–2.12)	<0.001	1.79 (1.41–2.27)	<0.001
≥Daily non-injection crack use*				
(yes versus no)	1.54 (1.23–1.93)	<0.001	0.80 (0.61–1.04)	0.101
≥Daily injection heroin use*				
(yes versus no)	2.46 (1.91–3.19)	<0.001	1.59 (1.17–2.14)	0.003
≥Daily injection cocaine use*				
(yes versus no)	2.40 (1.78–3.23)	<0.001	1.79 (1.33–2.43)	<0.001
Heavy alcohol use*				
(yes versus no)	1.07 (0.79–1.44)	0.673	–	–
Benzodiazepine use*				
(yes versus no)	1.36 (0.74–2.50)	0.316	–	–
Area restriction*				
(yes versus no)	2.12 (1.57–2.87)	<0.001	1.39 (0.99–1.95)	0.057
Any drug or alcohol treatment*				
(yes versus no)	1.36 (1.08–1.72)	0.094	1.25 (0.99–1.58)	0.065
Sex work involvement*				
(yes versus no)	2.78 (2.05–3.78)	<0.001	1.73 (1.25–2.39)	0.001
Drug dealing*				
(yes versus no)	2.50 (1.99–3.14)	<0.001	1.71 (1.32–2.21)	<0.001
Incarceration*				
(yes versus no)	2.28 (1.71–3.04)	<0.001	1.27 (0.90–1.79)	0.178

*Refers to activities in the past 6 months

Limitations of this study

This study has several limitations. Both VIDUS and ACCESS cohorts consist of non-random samples of people who inject drugs, and therefore our findings may not be generalizable to people who inject drugs locally or in other settings. The data were also self-reported and may be subject to reporting bias. As with all observational research, unmeasured confounders may exist although we sought to reduce this bias through a multivariable model with an extensive covariate adjustment. For example, our data set did not include longitudinal measures of mental health disorders, which may have acted as an unmeasured confounder.

Further research should investigate how best to prevent evictions among drug-using populations, such as better access to legal advocates, housing subsidies and supportive housing programs, including those that provide support immediately following eviction and during housing transitions. In addition, future research should explore the contribution of eviction to the risk of experiencing other forms of drug-related harm. Interventional studies should also be considered, potentially modeled after public health focused eviction prevention strategies at work in other jurisdictions.⁵¹

In summary, more than one-fifth of our sample of 1257 people who inject drugs were evicted at least once during the study period, and more than one-fourth initiated or relapsed into crystal methamphetamine use during follow-up. Residential eviction independently predicted methamphetamine initiation/relapse after controlling for a number of potential confounders that might be associated with methamphetamine initiation, even including homelessness. These findings support the exploration of policy and programmatic interventions focused on housing as a means to reduce methamphetamine use.

Supplementary data

Supplementary data are available at the *Journal of Public Health* online.

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