



Published in final edited form as:

J Soc Distress Homeless. 2020 March 06; 1(9): . doi:10.1080/10530789.2021.1892931.

HIV Injection Risk Behaviors among HIV-Negative People Who Inject Drugs Experiencing Homelessness, 23 U.S. Cities

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Abstract

Despite recent declines in numbers of people who inject drugs (PWID) diagnosed with HIV, clusters of HIV among PWID are ongoing, especially among PWID experiencing homelessness. Using data from the National HIV Behavioral Surveillance in 2018, we evaluated the association between homelessness and injection risk and prevention behaviors among HIV-negative PWID who were recruited by respondent-driven sampling in 23 U.S. cities. Interviewers assessed sociodemographic characteristics, history of overdose, and behavioral risk and prevention factors for HIV. Adjusted prevalence ratios (aPR) and 95% CI were obtained using Poisson regression models. Of 10,614 HIV-negative PWID participants, 7275 (68.5%) reported experiencing homelessness. Homeless PWID were more likely than those who were not to be younger age, white, unemployed, without health insurance, in poverty, experiencing psychological distress, and incarcerated in the past 12 months. PWID experiencing homelessness were significantly more likely to report injection risk behaviors [share syringes/equipment (aPR = 1.26; 95% CI = 1.20–1.33), non-fatal opioid overdose (aPR = 1.64; 95% CI = 1.49–1.79)] and prevention behaviors [testing for HIV in past 12 months (aPR = 1.18; 95% CI = 1.12–1.24) and using syringe services programs (aPR = 1.09; 95% CI = 1.03–1.16)] than PWID not experiencing homelessness. Homelessness among PWID is associated with injection risk behaviors and non-fatal overdose.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Keywords

People who inject drugs; respondent-driven sampling; homelessness; HIV; HIV prevention; syringe services programs

Introduction

Despite the recent decline in annual diagnoses of HIV attributed to injection drug use (Centers for Disease Control and Prevention, 2019; Wejnert et al., 2016), clusters of HIV among people who inject drugs (PWID) are occurring in the U.S. due to increased opioid use and injection equipment sharing (Broz et al., 2018; Cranston et al., 2019; Peters et al., 2016). Among the most concerning issues is the risk of infection among PWID who are experiencing homelessness (Cranston et al., 2019; Golden et al., 2019). National estimates of the number of people in the U.S. experiencing homelessness showed an 8.7% increase from 2018 to 2019; driven by the number of unsheltered people who are homeless (U.S. Department of Housing and Urban Development Office of Community Planning and Development, 2020). Housing instability is associated with increased HIV morbidity and mortality, and poor health outcomes (Aidala et al., 2016; Bowen & Mitchell, 2016; Milloy et al., 2012). Moreover, there is a bidirectional relationship between homelessness and substance use disorders with disputable evidence regarding causation (Linton et al., 2013). People experiencing homelessness who inject drugs may be at greater risk for HIV than people who inject drugs who are stably housed due to higher rates of syringe and injection equipment sharing (Adams et al., 2019; Des Jarlais et al., 2007; Linton et al., 2013).

In 2015, HIV prevalence was 7% and homelessness in the past 12 months was 64% among PWID (Centers for Disease Control and Prevention, 2018). Moreover, 34% of PWID reporting receptive syringe sharing (i.e. injecting with a syringe or needle that had already been used by someone else) and 42% of PWID reporting distributive syringe sharing (i.e. passing a used syringe to another person) (Adams et al., 2019; Centers for Disease Control and Prevention, 2018). People who are unstably housed are twice as likely to report sharing injection equipment (Des Jarlais et al., 2007). Likewise, this can be seen in National HIV Behavioral Surveillance (NHBS) data in 2015 that showed distributive sharing was more frequent among people reporting homelessness in the past 12 months than among those who were not homeless (Adams et al., 2019). However, data are lacking on the association between homelessness and receptive syringe sharing among PWID at risk for HIV. These behavioral risks are also associated with non-fatal overdose, a growing concern among people with substance use disorders, particularly opioid use (Jenkins et al., 2011), yet the association between homelessness, injecting drug use, and non-fatal overdose among a large sample of HIV-negative PWID has not been explored.

Furthermore, people experiencing homelessness may lack access to essential medical care, mental health services (Kertesz et al., 2014), and substance use treatment (Palepu et al., 2013) but less is known about factors associated with homelessness among HIV-negative PWID who are at risk for HIV and who may lack access to services for HIV prevention. We used 2018 NHBS data to evaluate HIV injection risk and prevention behaviors among HIV-

negative PWID participants who reported experiencing homelessness compared to those who did not. Findings may be used to identify factors that could improve recommendations for HIV prevention.

Methods

We used data from NHBS, which conducts standardized interviews and optional HIV testing to monitor prevalence of HIV infection, risk and prevention behaviors, and use of prevention services among populations at increased risk for HIV infection. In 2018, NHBS used respondent-driven sampling (RDS) (Heckathorn, 1997) to recruit a sample of PWID in 23 metropolitan statistical areas (MSAs) with high HIV prevalence (Centers for Disease Control and Prevention, 2020). Participants were eligible to participate if they reported injection drug use in the past 12 months, demonstrated physical evidence (e.g. track marks) or knowledge of injection, resided in the MSA, were aged 18, could provide informed consent, and could complete the interview in English or Spanish.

Trained interviewers at each site conducted standardized interviews on sexual and injection risk and prevention behaviors for HIV infection, sociodemographic characteristics, and access to care using computer-assisted personal interviews (CAPI). Interviews were conducted one-on-one in-person. Participants who consented were offered rapid HIV testing at the field site. Participants whose tests were reactive had either a second rapid test performed or an additional blood sample collected for supplemental laboratory-based testing to confirm the first rapid test result. Incentives in the form of cash or gift cards were given to participants (Centers for Disease Control and Prevention, 2020). Eligible PWID were offered up to five coupons to recruit PWID in their social network. All procedures, including HIV tests, were anonymous. Project activities were approved by the Centers for Disease Control and Prevention and by applicable institutional review boards in participating MSAs. Detailed methods are described elsewhere (Centers for Disease Control and Prevention, 2020).

Definitions/Measures

Homelessness, the exposure of interest, was measured in response to the question: “in the past 12 months, have you been homeless at any time? By homeless, I mean you were living on the street, in a shelter, in a Single Room Occupancy hotel (SRO) or in a car.” Demographic characteristics included: gender (male, female, and transgender), age group (18–29, 30–39, 40–49, and 50), race/ethnicity (Black, Hispanic/Latino, White, and Other), education (<high school, high school diploma/GED, and >high school), employment status (unemployed, employed full or part-time, and not in labor force/other), disability status (no disability and has a disability), and health insurance (no insurance, private plan, public plan, public and private plans, and other health insurance). Social factors assessed included: marital status (married/living together, single [i.e. separated/divorced/widowed], and never married), poverty status (household income at or below the federal poverty level, above the federal poverty level) according to the U.S. Department of Health and Human Services guidelines in 2018 (U.S. Department of Health and Human Services, 2018), and incarceration history (never incarcerated, incarcerated but not in the past 12

months, incarcerated in the past 12 months). Psychological distress was measured by the Kessler-6 screening scale (range 0–24) categorized as having psychological distress (score of 13–24) or no psychological distress (score of 0–12)(Kessler et al., 2003). The Kessler-6 is a screening measure used in epidemiological studies to assess the prevalence of “serious mental illness,” defined as at least one disorder meeting criteria for the Diagnostic and Statistical Manual (DSM) (Kessler et al., 2003). The Kessler-6 has been shown to identify persons likely to have a psychiatric disorder with accuracy and reliability comparable to other psychological screening instruments (Choi et al., 2015; Kessler et al., 2003; Swartz & Lurigio, 2006). Age at first injection was dichotomized as less than 30 years of age versus 30 years and older with calculations for median and interquartile ranges (IQR).

If any drug other than prescribed drugs was injected in the past 12 months, the participant was asked about the drug injected most frequently (heroin by itself, speedball [heroin and cocaine together], powder or crack cocaine, methamphetamine [includes meth, crystal meth, speed, or crank], or prescription opioids [painkillers such as Oxycontin, Dilaudid, morphine, Percocet, or Demerol]). We also ascertained non-injection use of any of the following drugs during the 12 months before interview: marijuana, powder or crack cocaine, benzodiazepines, ecstasy, heroin, methamphetamine, or prescription opioids. Binge drinking in the past 30 days was defined as drinking in about two hours four or more alcoholic drinks for females, and five or more alcoholic drinks for males. Receptive syringe sharing (defined as using a needle or syringe that had been previously used by someone else in the past 12 months), shared injection equipment (including cookers, cotton, or water), and shared syringes to divide drugs, were combined to create an overall shared syringes or other equipment variable. Non-fatal opioid overdose in the past 12 months was assessed among participants who reported using opioids during that time frame. Prevention behaviors in the past 12 months included being tested for HIV, obtaining sterile syringes from a syringe services program (SSP), safe syringe disposal (only disposal methods were “put it in a medical sharps container” or “took it to a needle or syringe exchange program”), and, among PWID who used opioids in the past 12 months, use of medication-assisted treatment (MAT).

Data analysis

Analyses were limited to participants who were eligible for and completed the interview, had a negative NHBS HIV test result, self-reported as HIV-negative, and had non-missing response to the key exposure variable, homelessness in the past 12 months. We assessed correlates of homelessness in the past 12 months, and the association between homelessness and key outcomes of interest (i.e. injection risk and prevention behavior). Prevalence ratios (PRs) and 95% confidence intervals (CIs) were estimated from log-linked Poisson regression models with generalized estimation equations clustered on RDS recruitment chains and adjusted for participants’ personal network size and city. To account for confounding, models calculating adjusted prevalence ratios (aPR) additionally controlled for gender, race/ethnicity, poverty, disability status, and employment status based on the literature (Adams et al., 2019).

Results

Of the 11,437 eligible PWID who completed the interview, 10,615 agreed to an HIV test and self-reported HIV-negative status; homelessness was missing for one additional participant, resulting in an analysis sample of 10,614. Of 10,614 HIV-negative PWID who met the inclusion criteria in the 2018 NHBS, 7275 (68.5%) reported experiencing homelessness. A higher percentage of homeless PWID compared with PWID who were not homeless were 18–39 years old [18–29 years old (17.3% vs. 8.9%) and 30–39 years old (30.7% vs. 18.9%)], white (44.3% vs. 31.9%), unemployed (56.8% vs. 34.3%), without health insurance (28.9% vs. 21.0%), living in poverty (77.2% vs. 70.2%), experiencing psychological distress (44.8% vs. 26.7%), and incarcerated in the past 12 months (43.3% vs. 21.0%) (Table 1). PWID experiencing homelessness were also more likely to inject speedballs (56.3% vs. 45.6%), powder or crack cocaine (47.7% vs. 36.7%), prescription opioids (23.3% vs. 14.9%), binge drink (28.9% vs. 24.0%), and use non-injection drugs (81.8% vs. 72.4%) than PWID not reporting homelessness.

PWID experiencing homelessness were significantly more likely to report injection risk behaviors, including syringe and equipment sharing (aPR=1.26; 95% CI=1.20–1.33) and non-fatal overdose (aPR=1.64; 95% CI=1.49–1.79) than PWID who did not experience homelessness (Table 2). Homeless PWID were more likely to engage in HIV prevention behaviors, including testing for HIV in the past 12 months (aPR=1.18; 95% CI=1.12–1.24) and obtaining sterile syringes from an SSP (aPR=1.09; 95% CI=1.03–1.16) compared to PWID who did not experience homelessness. There was no notable difference in the proportion who reported safe syringe disposal or MAT use among opioid users experiencing homelessness compared to those who were not homeless.

Discussion

In this multi-site, cross-sectional study, we found that among HIV-negative PWID, homelessness is associated with injection risk behaviors which can increase the risk of HIV acquisition, including sharing injection equipment and non-fatal opioid overdose. These findings support previous studies (Corneil et al., 2006; Jenkins et al., 2011; Linton et al., 2013) that demonstrated an association between homelessness and injection risk behaviors. However, our sample provides more recent data from a large, geographically diverse population of PWID from the community who were actively injecting drugs, and the analysis explored receptive injection equipment sharing and the multifactorial relationship between homelessness, PWID, and non-fatal overdose. Additionally, previous studies have focused on injection risk behaviors among people with diagnosed HIV (Kidder et al., 2008) and not those at risk for infection. Overall, in 2018, almost 7 in 10 HIV-negative PWID from 23 geographically diverse U.S. cities experienced homelessness in the previous 12 months. Injection equipment sharing and non-fatal overdose were more common among homeless PWID possibly due to factors such as public injection (Hunter et al., 2018; Sutter et al., 2019; Trayner et al., 2020), which can increase risky injection practices, and fear of confiscation of injecting equipment by law enforcement or police harassment (Werb et al., 2008). Among PWID, 45% experience non-fatal overdose in their lifetime (Martins et al., 2015). The association between homelessness and non-fatal overdose was reported in

previous studies (Jenkins et al., 2011a; Lyons et al., 2019), in which the relationship was compounded by a history of incarceration and sharing of injection equipment. Furthermore, the introduction of fentanyl and fentanyl analogs into the drug supply has increased the number of reported overdoses (Hedegaard et al., 2018; O'Donnell et al., 2018; Park et al., 2018). We also found a higher percentage of PWID experiencing homelessness compared with PWID who were not homeless were injecting multiple types of substances and using non-injecting drugs. Polysubstance use has previously been identified among people experiencing homelessness (Bhalla et al., 2017) and is associated with overdose (Barocas et al., 2019; Schneider et al., 2019).

Our study also found an association between homelessness and certain sociodemographic factors and social determinants of health. These findings support earlier studies that show housing instability provides an increased risk environment for PWID (Padgett et al., 2015; Rhodes et al., 2005). We found demographic factors, such as younger age, were associated with PWID experiencing homelessness with almost half of homeless PWID in our analysis being aged 18–39 years compared with nearly 28% of those not experiencing homelessness. Furthermore, we identified psychosocial and structural factors associated with homelessness among PWID including psychological distress, poverty, lack of health insurance, and incarceration. These social factors have frequently been shown to influence housing stability among PWID (Degenhardt et al., 2017; Fryling et al., 2015; Padgett et al., 2011; Thompson et al., 2013).

Homelessness was associated with HIV prevention behaviors among HIV-negative PWID. Early diagnosis and prevention of HIV acquisition are two of four primary goals of the federal campaign designed to *End the HIV Epidemic* (Fauci et al., 2019) in the United States. Testing all vulnerable populations including PWID, is an essential component of this initiative. We found encouraging evidence that HIV-negative PWID experiencing homelessness are engaging in preventive behaviors against HIV acquisition, specifically, testing for HIV in the past 12 months and obtaining sterile syringes from an SSP. Reasons for higher rates of HIV testing among PWID experiencing homelessness may be due to the high rates of incarceration (Courtenay-Quirk et al., 2008) and use of emergency departments for medical care (Fazel et al., 2014), which can be venues for routine HIV testing. Routine HIV testing is also often available through harm reduction programs such as comprehensive SSPs that integrate syringe services and primary medical care (Rich et al., 2018), and SSPs can serve as a gateway into integrated medical care for HIV for people who test positive, and HCV testing, abscess and wound care, evaluation for endocarditis, and importantly, integration with behavioral health addressing co-occurring mental health needs and substance use referral and treatment (Rich et al., 2018). Unfortunately, SSPs are not available in all jurisdictions (Centers for Disease Control and Prevention, 2020; Des Jarlais et al., 2015) despite their proven benefits in: reducing risky injection behaviors (injection drug use, injection equipment sharing, and non-fatal overdose) (Dasgupta et al., 2019; Des Jarlais et al., 2015; Huo & Ouellet, 2007), improving access to drug treatment programs, including medication-assisted treatment (Kidorf et al., 2009), and safe syringe disposal (Dasgupta et al., 2019; Tookes et al., 2012), and providing naloxone for overdose prevention (Clark et al., 2014). Introduction of SSPs after the HIV outbreak in Scott County, Indiana (Peters et al., 2016) resulted in a reduction in syringe sharing from 75% before the

outbreak to 21% (Dasgupta et al., 2019). Prevention behaviors that reduce HIV risk, such as proper disposal of used syringes increased after the introduction of the SSP from 17% to 82% (Dasgupta et al., 2019), although safe syringe disposal did not differ by homeless status in our analysis.

Increasing availability of SSPs is one prevention intervention for reducing HIV transmission, however, the high prevalence of homelessness among HIV-negative PWID underscores the urgency of addressing housing issues to alleviate multimorbidity and poor health outcomes, including substance use and HIV. People who are stably housed decrease their drug use (Des Jarlais et al., 2007), seek treatment for substance use (Padgett et al., 2011), and reduce HIV risks (Aidala et al., 2016) more often than people experiencing homelessness. Intervention models, such as “Housing First,” provide a comprehensive system of services that encourage permanent supportive housing with wrap-around services (Padgett et al., 2015). This successful model addresses the syndemic of HIV, substance use and homelessness, and is far less penalizing than the traditional “treatment first” models that emphasize housing in temporary shelters where residents are first required to maintain sobriety (Padgett et al., 2015). Those limited models do not address multimorbidity and are not sustainable for people with opioid use disorders who require long-term and comprehensive solutions.

Conducting analysis of data from a national surveillance system is not without limitations. NHBS is a geographically diverse sample, however, it may not be representative of all PWID and the findings may not be generalizable to other geographic locations. Due to the cross-sectional nature of the survey, we could not capture the dynamic changes in homelessness status in which people may be homeless at one point in their lives and stably housed at another point. Furthermore, the definition of homelessness used in this survey does not differentiate between people experiencing current or chronic homelessness and those who are temporarily or unstably housed. However, we asked about housing in the past 12 months, which may over- or under-estimate experiences associated with homelessness. Except for the Kessler-6 scale, our data do not comprehensively capture psychiatric diagnoses or mental health symptoms that may be prevalent among PWID and people experiencing homelessness. Further characterization of these comorbidities may be useful for understanding injection risk behaviors. Finally, these data are self-reported and are, therefore, subject to recall error and social desirability bias.

Conclusions

Homelessness is highly prevalent among HIV-negative PWID and is associated with injection risk behaviors and non-fatal overdose. Evidence-based interventions and linkage efforts to support access to HIV and substance use disorder services and treatment among PWID is essential. Access to prevention services such as SSPs that provide overdose prevention (e.g. naloxone), integrated with comprehensive medical and behavioral health care, including medical care, HIV and HCV testing, and housing services, can reduce HIV transmission risk.

Acknowledgements

The authors thank National HIV Behavioral Surveillance (NHBS) staff and participants. We also acknowledge the contributions of the Behavioral Surveillance Team and the Behavioral and Clinical Surveillance Branch at CDC and the NHBS Study Group Members. NHBS Study Group Members include: Atlanta, GA: Pascale Wortley, Jeff Todd, David Melton; Baltimore, MD: Colin Flynn, Danielle German; Boston, MA: Monina Klevens, Rose Doherty, Conall O'Cleirigh; Chicago, IL: Antonio D. Jimenez, Thomas Clyde; Dallas, TX: Jonathon Poe, Margaret Vaaler, Jie Deng; Denver, CO: Alia Al-Tayyib, Daniel Shodell; Detroit, MI: Emily Higgins, Vivian Griffin, Corrine Sanger; Houston, TX: Salma Khuwaja, Zaida Lopez, Paige Padgett; Los Angeles, CA: Ekow Kwa Sey, Yingbo Ma, Hugo Santacruz; Memphis, TN: Meredith Brantley, Christopher Mathews, Jack Marr; Miami, FL: Emma Spencer, Willie Nixon, David Forrest; Nassau-Suffolk, NY: Bridget Anderson, Ashley Tate, Meaghan Abrego; New Orleans, LA: William T. Robinson, Narquis Barak, Jeremy M. Beckford; New York City, NY: Sarah Braunstein, Alexis Rivera, Sidney Carrillo Newark, NJ: Abdel R. Ibrahim, Afework Wogayehu, Luis Moraga; Philadelphia, PA: Kathleen A. Brady, Jennifer Shinefeld, Chrysanthus Nnumolu.; Portland, OR: Timothy W. Menza, E. Roberto Orellana, Amisha Bhattari; San Diego, CA: Anna Flynn, Onika Chambers, Marisa Ramos; San Francisco, CA: Willi McFarland, Jessica Lin, Desmond Miller; San Juan, PR: Sandra Miranda De León, Yadira Rolón-Colón, María Pabón Martínez; Seattle, WA: Tom Jaenicke, Sara Glick; Virginia Beach, VA: Jennifer Kienzle, Brandie Smith, Toyah Reid; Washington, DC: Jenevieve Opoku, Irene Kuo; CDC: Monica Adams, Christine Agnew Brune, Amy Baugher, Dita Broz, Janet Burnett, Susan Cha, Johanna Chapin-Bardales, Paul Denning, Dafna Kanny, Teresa Finlayson, Senad Handanagic, Terence Hickey, Kathryn Lee, Rashunda Lewis, Elana Morris, Evelyn Olansky, Taylor Robbins, Catlainn Sionean, Amanda Smith, Anna Teplinskaya, Lindsay Trujillo, Cyprian Wejnert, Ari Whiteman, Mingjing Xia.

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Table 1.

Characteristics of HIV-Negative persons who inject drugs by housing status, National HIV Behavioral Surveillance, 23 U.S. cities, 2018.

	Housing status						P value ^c	
	Homeless ^a (n = 7275)			Not Homeless (n = 3339)				Total (n = 10,614)
	No.	Col. %	No.	Col. %	No. ^b	Col. %		
Gender							0.0349	
Male	5078	69.8	2247	67.3	7325	69.0		
Female	2143	29.5	1076	32.2	3219	30.3		
Transgender	54	0.7	16	0.5	70	0.7		
Age (years)							<.0001	
18–29	1256	17.3	298	8.9	1554	14.6		
30–39	2231	30.7	630	18.9	2861	27.0		
40–49	1754	24.1	676	20.3	2430	22.9		
50	2034	28.0	1735	52.0	3769	35.5		
Race/ethnicity							<.0001	
Black	1883	25.9	1527	45.8	3410	32.2		
Hispanic/Latino ^d	1571	21.6	599	17.9	2170	20.5		
White	3220	44.3	1065	31.9	4285	40.4		
Other ^e	595	8.2	147	4.4	742	7.0		
Education							0.0077	
<High school	2075	28.5	923	27.6	2998	28.3		
High school diploma/GED	2980	41.0	1399	41.9	4379	41.3		
>High school	2217	30.5	1017	30.5	3234	30.5		
Employment status							<.0001	
Unemployed	4133	56.8	1145	34.3	5278	49.7		
Employed (full or part time)	953	13.1	677	20.3	1630	15.4		
Not in labor force/other ^f	2189	30.1	1517	45.4	3706	34.9		
Disability status							0.0023	
No disability	2286	31.5	1158	34.7	3444	32.5		
Has a disability	4979	68.5	2179	65.3	7158	67.5		

	Housing status						P value ^c
	Homeless ^a (n = 7275)			Not Homeless (n = 3339)			
	No.	Col. %	No.	Col. %	No.	Col. %	
Psychological distress							
No (0–12)	4008	55.2	2436	73.3	6444	60.9	<.0001
Yes (13–24)	3252	44.8	889	26.7	4141	39.1	
Health insurance							
No insurance	2090	28.9	699	21.0	2789	26.4	<.0001
Private plan	131	1.8	156	4.7	287	2.7	
Public plan	4904	67.8	2398	72.2	7302	69.2	
Public and private plans	38	0.5	26	0.8	64	0.6	
Other health insurance	68	0.9	44	1.3	112	1.1	
Marital status							
Married/living together	788	10.8	607	18.2	1395	13.1	<.0001
Single (separated, divorced, widowed)	2171	29.8	1092	32.7	3263	30.7	
Never married	4316	59.3	1640	49.1	5956	56.1	
Poverty status							
At or below federal poverty level	5586	77.2	2321	70.2	7907	75.0	<.0001
Above federal poverty level	1653	22.8	984	29.8	2637	25.0	
Incarceration							
Never incarcerated	786	10.8	530	15.9	1316	12.4	<.0001
Incarcerated, not in past 12 months	3339	45.9	2105	63.1	5444	51.3	
Incarcerated in past 12 months	3147	43.3	701	21.0	3848	36.3	
Injection substance use past 12 months							
Heroin	6510	89.5	3061	91.7	9571	90.2	0.4261
Speedball ^g	4097	56.3	1523	45.6	5620	53.0	<.0001
Powder or Crack Cocaine	3468	47.7	1226	36.7	4694	44.2	<.0001
Methamphetamine	3118	42.9	589	17.6	3707	34.9	<.0001
Prescription opioids ^h	1693	23.3	499	14.9	2192	20.7	<.0001
Binge drinking (past 30 days)	2082	28.9	793	24.0	2875	27.4	<.0001
Non-injection drug ⁱ use past 12 months							

	Housing status					
	Homeless ^d (n = 7275)			Not Homeless (n = 3339)		
	No.	Col. %	No.	Col. %	No. ^b	Col. % ^c
No	1323	18.2	923	27.7	2246	21.2
Yes	5952	81.8	2415	72.4	8367	78.8
Age at first injection (years) – Median (IQR)	22 (18–28)			22 (18–30)		
11–29 years	5586	77.3	2470	74.2	8056	76.3
30 years	1637	22.7	860	25.8	2497	23.7

Abbreviations: GED: general educational development; IQR: interquartile range.

^a At any time during the past 12 months, lived on the street, in a shelter, a single room occupancy hotel, or in a car.

^b Variable categories may not sum to total due to missing responses.

^c P value from Wald chi-square test.

^d Hispanics/Latinos may be of any race.

^e “Other” includes American Indian/Alaska Native, Asian, Native Hawaiian/Pacific Islander, and multiple races.

^f Includes homemaker, full time student, retired, and other.

^g Heroin and cocaine injected together.

^h Painkillers such as Oxycontin, Dilaudid, morphine, Percocet, or Demerol.

ⁱ Non-injection drugs include: marijuana, powder or crack cocaine, benzodiazepines, ecstasy, heroin, methamphetamine, or prescription opioids.

Table 2.

Injection risk and prevention behaviors among HIV-Negative persons who inject drugs by housing status, National HIV Behavioral Surveillance, 23 U.S. cities, 2018.

	Housing status						Adjusted prevalence ratios aPR (95% CI) ^c	
	Homeless ^a			Not homeless				
	Total	n	%	Total	n	%		
<i>Injection risk behaviors</i>								
Shared syringes or other equipment ^d	7272	4772	65.6	3336	1576	47.2	1.35 (1.28–1.42)	1.26 (1.20–1.33)
Non-fatal opioid overdose	6962	2305	33.1	3235	573	17.7	1.77 (1.63–1.94)	1.64 (1.49–1.79)
<i>Prevention behaviors</i>								
Tested for HIV in past 12 months	7206	4245	58.9	3301	1590	48.2	1.18 (1.12–1.24)	1.18 (1.12–1.24)
Obtained sterile syringes from an SSP	7268	4198	57.8	3337	1406	42.1	1.12 (1.06–1.19)	1.09 (1.03–1.16)
Safe syringe disposal only	7273	1537	21.1	3337	617	18.5	0.89 (0.80–1.00)	0.91 (0.80–1.01)
Medication-assisted treatment ^e	6965	3743	53.7	3237	1735	53.6	0.96 (0.92–1.00)	0.96 (0.92–1.00)

Abbreviations: PR: prevalence ratios; aPR: adjusted prevalence ratios; CI: confidence intervals; SSP: syringe services program.

^a At any time during the past 12 months, lived on the street, in a shelter, a single room occupancy hotel, or in a car.

^b All models were clustered on recruitment chain and adjusted for the participant's personal network size and city.

^c Adjusted for network size, city, gender, age, race/ethnicity, poverty, disability status, and employment status.

^d A combined variable including syringe sharing (defined as using a needle or syringe that had been previously used by someone else in the past 12 months), shared injection equipment (including cookers, cotton, or water), and shared syringes to divide drugs.

^e Only includes people who reported using opioids in the past 12 months.