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Prevalence and Correlates of Former Injection Drug Use Among Young Non-injecting Heroin Users in Chicago

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Abstract

Non-injecting heroin users (NIHU) 16–30 years-old were street recruited in Chicago between 2002–2005 to examine factors associated with having ever injected. Participants completed computerized self-administered interviews and provided specimens for HIV and hepatitis serotesting. Of 689 NIHU, 51.2% were non-Hispanic Black, 64.4% were male, and the median age was 25 years. Former injection was reported by 17.9%; of those, 66.7% injected <10 times. Multivariable analysis identified individual and social factors that place young NIHU at increased risk of injection. Targeted interventions are necessary to prevent transitions to injection and reduce transmission of HIV and viral hepatitis infections.

Keywords

heroin; non-injecting heroin use; injection drug use; transitions to injection; HIV infection; hepatitis B and C infection

Introduction

Drug injection increases individuals' risk for acquiring and transmitting HIV and other chronic viral infections, including hepatitis B (HBV) and hepatitis C (HCV) (Aceijas and Rhodes, 2007; Alter, 2007; CDC, 2005b; Trace et al, 2005; WHO, 2000; 2007). Heroin is the most often injected illicit substance in the United States, currently and historically (Broz and Ouellet, 2008; O'Donnell and Jones, 1968; Schoener et al, 2002). However, while the use of heroin in the U.S. increased during the 1990s and remains at high levels in many parts of the country (Community Epidemiology Work Group, 1998; 2008; Hughes and Rieche, 1995; Kinlock et al, 1998; Neaigus et al, 1998), new heroin users increasingly practice non-injecting routes of administration, particularly intranasal 'snorting' (Chitwood et al, 1998; Frank, 2000). Still, these non-injecting heroin users (NIHU) may turn to injection as their physical tolerance and dependence on the drug increase (Crofts et al, 1996; Darke et al, 2008; Des Jarlais et al, 1992; Griffiths et al, 1994; Kelley and Chitwood, 2004; Strang et al, 1997). Given that the onset of drug injection typically occurs between the ages 18–23 years,

Author Contributions:

D. Broz originated the analysis design, conducted the literature searches and the analyses, and wrote the first draft of the manuscript. D. Broz also contributed substantially to the implementation and data collection of the NIHU-HIT study. L.J. Ouellet was the principal investigator for NIHU-HIT study. As such, he oversaw all aspects of the implementation and conduct of the study and takes responsibility for the integrity of the data. In addition, he contributed substantially to interpreting the findings, and reviewing and editing the final manuscript. Both authors contributed to and have approved the final manuscript.

Conflict of Interest:

D. Broz and L.J. Ouellet have no conflicts of interest, including specific financial interest, relationship, and affiliation relevant to the subject matter discussed in the manuscript, that could inappropriately influence, or be perceived to influence, their work.

(Fuller et al, 2001; Hser et al, 1987; Nicolosi et al, 1992; Roy et al, 2002), young NIHU comprise the cohort in the U.S. most at risk of initiating injection. In addition, NIHU who have engaged in drug injection and then returned to non-injected routes of administration, are more likely than other NIHU to transition to drug injection (Des Jarlais et al, 1992; Neaigus et al, 2006; van Ameijden et al, 1994).

To date, few studies have described young NIHU, and even less is known about those who engaged in injection drug use before resuming or adopting non-injection methods for using heroin. Several studies in the U.S., Europe, and Australia recruited heroin users to investigate transitions between different routes of heroin administration, but most of these cohorts best represented older, longer-term users (Bravo et al, 2003; Chitwood et al, 2003; Darke et al, 2008; Griffiths et al, 1994; Latkin et al, 2001; Neaigus et al, 2001; Strang et al, 1999; Swift et al, 1999). For instance, studies of NIHU in New York City (Neaigus et al, 2001) and South Florida (Kelley and Chitwood, 2004) assembled samples with mean ages of 33 and 35 years, respectively that potentially underrepresent younger age groups at greatest risk of transitioning to drug injection. Greater knowledge about young NIHU and their experiences with drug injection will contribute to the design of interventions effective at preventing drug injection, a potentially significant step in reducing future transmission of HIV, HCV and other bloodborne pathogens (Carruthers and Loxley, 2002; Des Jarlais et al, 1992; Fuller et al, 2002; Hunt et al, 1999; Neaigus et al, 2006; Pugatch et al, 2003).

In this study we examine demographic, drug use and social network characteristics of 16–30 year old NIHU, and their HIV, HBV, and HCV infection burden. We also examine baseline correlates of former injection that indicate potential risk factors for injection transitions in this population.

Methods

Design and Study Population

The Non-injecting Heroin Use, HIV, and Injection Transitions study (NIHU-HIT) is a prospective study that used an open cohort design with continuous sampling to investigate the incidence and risk factors for transitions to drug injection and the prevalence, incidence, and risk factors for infection with HIV, HBV, and HCV among young NIHU recruited in community-based, non-program settings. Eligible participants were 16–30 years old, current NIHU, and English or Spanish speakers. Former injection drug users (IDUs) were eligible if they had not injected in the 6 months prior to baseline. All participants provided written consent. For approximately the last 6 months of the recruiting period, enrolment was limited to NIHU 16–23 years old; 42 (6%) enrolled during the reduced age recruitment.

We initially recruited participants using only respondent-driven sampling (RDS), a variant of chain-referral sampling useful for accessing hidden populations (Heckathorn, 1997; Lansky et al, 2007). RDS begins with a small number of “seed” recruiters identified by study staff who then are given a limited number of recruitment coupons and an incentive to refer eligible peers to the study. Recruitment grows by providing recruitment coupons and an incentive to referred peers who enrol in the study so that they, in turn, can refer their peers. When strict adherence to RDS methods did not produce sufficient numbers of enrollees for NIHU-HIT, we modified our procedures. First, we directly recruited participants through street outreach in neighbourhoods known to have a high prevalence of heroin use and illicit drug markets. Second, we placed advertisements in a local ‘alternative’ newspaper. Third, we relaxed RDS procedures so that potential participants could enrol without presenting a coupon. Fourth, we gave recruitment coupons to participants who entered the study without a coupon (e.g., street outreach), which violates RDS procedures by, in effect, turning these participants into “seed” recruiters for new recruitment chains

rather than being members of existing recruitment chains. Given these departures, RDS weighting procedures were not applied to the final data.

Experienced research staff explained the study's protocol and eligibility criteria and verified participants' age through photo identifications (e.g., driver's license) or other official documents containing names and birth dates. A key feature of the research design is that participants had an option to enrol in a concurrent study of young IDUs, thus minimizing the need to misrepresent their mode of drug administration for the purpose of gaining study enrolment. Current heroin use (past 3–5 days) was validated using a urine test for opiate metabolites (Biotechnostix, Canada) and we examined participants' arms and other visible body parts for recent injection stigmata (e.g., needle tracks). Additionally, information collected during the blood specimen collection and from subsequent study interviews were reviewed to confirm eligibility. Those with fresh needle marks or who indicated injecting within the 6 months prior to baseline were referred to the alternative study.

Initial screening, study enrolment, and data collection were conducted in three storefront fieldstations operated by the Community Outreach Intervention Projects – a research and service program based at the University of Illinois at Chicago. The study was approved by the University of Illinois at Chicago Institutional Review Board.

Data Collection

All NIHU-HIT participants completed a survey questionnaire administered by an audio-computer-assisted self-interviewing (ACASI) system in the privacy of an interview room. Using ACASI, the participants had an option to read and/or listen to a recording on a computer and responded to questions via keyboard or touch screen entry. The baseline questionnaire took approximately 1.5–2 hours to complete and participants were compensated \$30. Participants were asked to report on 1) socio-demographic characteristics, 2) current and past drug use, 3) drug markets and drug acquisition, 4) drug treatment and incarceration, 5) source of income, 6) sexual activity, 7) personal health and 8) social network characteristics, including contact with IDUs. Residence in Chicago was determined by asking participants to provide the names of cross-streets and, for those living outside of Chicago (almost always in the greater metropolitan area), the city/town where they lived or most often slept.

Former drug injection was determined by asking participants if they had ever injected illicit drugs, even if only once. Given the study eligibility criteria, participants who reported a history of injection did not inject in the 6 months before baseline. Race and ethnicity responses were categorized into three groups based on the structure of the NIHU-HIT data and consistency with published research: non-Hispanic (NH) Black, NH-White, and Hispanic and all others (Native American, Asian/Pacific Islander, or other). Given the small size of the 'all other' racial/ethnic category (n=15), participants in this group were added to the Hispanic category based on similarities in several characteristics, including age and history of injection. To assess the possible effect of this grouping, final candidate models were also analyzed with the "other" race/ethnicity group excluded from the sample; no significant differences were observed.

The selection and creation of all other independent variables reflect findings from published research and results from our univariable analyses of associations with history of injection. For all variables, participants had an option to answer "don't know" or "refuse to answer," though these responses were not used frequently (<3% for most variables). For variables that had 5% of such answers, the responses were coded into a separate category (referred to as 'unknown' in the tables) and were included in the analysis as dummy variables. This

approach allowed an assessment of the potential effect of the ‘unknown’ responses on the outcome and to avoid problems with smaller sample sizes due to missing data.

The Severity of Dependence Scale (SDS) was used to measure participants’ perceived level of heroin dependence for the prior 30 days (Gossop et al, 1995; Gossop et al, 1992). The scale consisted of five items, each measured on a four-point scale that ranged from 0–3. Item questions asked about the level of anxiety and worry about going without heroin, and the ability to stop heroin use. The scale comprised the sum of responses to these items, with scores ranging from 0–15; higher scores indicate greater dependence. A cut-off of 6 was used to indicate heroin dependence (Gossop et al, 1992). Participants who did not answer 1 item(s) were categorized as ‘undetermined’. A scale based on the Psychiatric Diagnostic Screening Questionnaire (PDSQ) was used to assess major depression disorder. PDSQ is a self-report scale developed to screen for DSM-IV disorders and has been validated in studies of substance use (Zimmerman et al, 2004). The 16-item depression scale consisted of questions based on the DSM-IV symptom criteria and all required a response of “yes” (score =1) or “no” (score=0). The final variables included an ‘undetermined’ category for participants who did not answer 1 item(s).

Laboratory Procedures

Blood specimens were drawn by venipuncture for all serologic testing. HIV-1 antibody was tested using the whole viral lysate enzyme linked immunosorbent assay (ELISA; Abbott Laboratories, Abbott Park, IL) and confirmed by Western blot (BioRad Laboratories, Hercules, CA). One participant did not provide a blood sample and was tested using the oral fluid specimen device OraSure (OraSure Technologies, Inc, Bethlehem, PA). HBV testing included detection of HBV surface antigen (HBsAg), and antibodies to HBV surface antigen (anti-HBs), core antigen (anti-HBc), and core IgM fraction (anti-HBc IgM) (Abbott), which allowed distinction between past infection and immunity resulting from vaccination (CDC, 2005a). HCV antibody testing used the Abbott HCV EIA-2 kit and positive specimens for participants with no injection history were confirmed using HCV recombinant immunoblot assay (RIBA). Four HBV and two HCV results are missing for baseline due to uninterpretable results or an inability to provide a blood specimen. All participants received pre- and post-test counselling about viral infection risk. Those who tested positive were informed of treatment options and referred for medical, substance abuse and other social services. Those who tested HBV negative were referred for HBV vaccination.

Statistical Analysis

Frequency tables, univariable, and stratified analyses described the baseline cohort of NIHU regarding individual characteristics, drug use practices and social network composition, and detected associations with history of injection. Associations between the independent variables, race/ethnicity and former injection assessed possible confounding and interaction effects, and helped identify variables for multivariable analysis. Chi-square tests are reported for categorical variables, and t-tests, Wilcoxon and Kruskal-Wallis tests for continuous variables. The Breslow-Day test of homogeneity assessed for interactions. Since women may be more likely to have drug use and sex partners who are IDUs, (Crofts et al, 1996; Evans et al, 2003; Frajzyngier et al, 2007; Morningstar and Chitwood, 1987; Powis et al, 1996) and to have a history of traumatic events, (Miller, 1999) analyses of these measures were initially stratified by gender. HIV, HBV, and HCV seroprevalence were examined by history of injection.

Multivariable logistic regression (Kleinbaum and Klein, 2002) was performed to develop the most parsimonious model for explaining factors associated with former injection. Variables that tested statistically significant at $p < 0.20$ in univariable analysis or that were indicated as

important factors in published research were included in the model-building process. Bivariate correlations and collinearity statistics were calculated for the final candidate variables to assess for potential multicollinearity. Logistic regression models were compared using the -2 log-likelihood test and the Akaike Information Criterion. Backward and stepwise elimination methods were conducted concurrently as exploratory techniques to guide the model selection, and the Hosmer-Lemeshow test of goodness-of-fit was assessed for the candidate final models. Wald X^2 two-sided p-values <0.05 were considered statistically significant. Adjusted odds ratios (OR) and 95% confidence intervals (CI) are reported for the final model. Analyses were conducted using SPSS 15.0 statistical software.

Results

Between June 2002 and January 2005, the NIHU-HIT study enrolled 689 eligible participants in Chicago. Of them, 82.1% had never injected illicit drugs and 17.9% were former injectors, though not in the 6 months prior to baseline. The majority of former injectors (66.7%) had injected <10 times and only 28.5% ever injected at least once per week (data not shown).

Background Characteristics and Health Indicators

Over half of NIHU were NH-Black and male, and the median age was 25 years (Table 1). Former injectors compared to never injectors were more likely to be NH-White and less likely to be NH-Black, but they did not significantly differ by Hispanic ethnicity. Former injectors were significantly younger and did not differ by gender. Many participants reported indicators of socio-economic instability, including not completing high school, homelessness, income from illegal sources, and recent incarceration, though these did not differ between former and never injectors. A sizable proportion of NIHU lived in the metropolitan area outside the city of Chicago. NH-Blacks compared to other racial/ethnic groups were significantly ($p<0.05$) more likely to be older (mean age 26.5 years vs. 22.8 years), recently homeless (24.9% vs. 14.6%) and to reside in Chicago (92.1% vs. 48.2%) (data not shown).

Table 2 shows serology results and additional indicators of participants' overall health. Twenty (2.9%) NIHU were HIV seropositive and only 9 were aware of their infection. Most HIV infections were among never-injectors. Of the 680 HIV seronegative participants who knew their serostatus, former injectors more than never injectors believed that they were at high/medium risk for HIV infection via their sexual and drug use behaviours. HBV serology was available for 685 participants; of them, 96 (14.0%) were vaccinated against HBV. Of those unvaccinated, 63 (10.6%) tested seropositive for HBV, and seroprevalence did not differ by prior injection. Of 687 NIHU with completed HCV serologies, 16 (2.3%) were seropositive, with former injectors significantly more likely to test positive. Health problems were more frequently reported by former injectors including poor/fair health, overdosing on heroin, and psychological/behavioural disorder diagnoses. Over one-third of NIHU reported using illicit drugs to deal with emotional or psychiatric problems. Witnessing or experiencing extreme trauma (e.g., shooting, rape) was reported by over one-third of participants, with little difference by gender and former injection.

Substance Use

Nearly half of NIHU initiated heroin use at age <18 years, and former injectors were younger at first use than those who never injected (Table 3). All but one participant initiated heroin via non-injecting routes and 92.0% reported snorting as the most common lifetime method (data not shown). Participants used heroin on average for 6.2 years with no statistical difference between former and never injectors. Most NIHU currently used powder

heroin; only 6.4% reported using non-powder brown or tar heroin and former injectors were more likely to use this type. In the past 30 days, more than half of participants used heroin on 25–30 of those days, 12.9% used on 15–24 days, and about a third used during less than half of the past month, with no significant differences by history of injection. On the days they ingested heroin, most participants used 2 bags per day in the past month. Although lifetime (81.4%) and past-month (66.9%) heroin dependence was common among NIHU, it did not differ by history of injection. However, former injectors were more likely to report current and ever drug treatment. Of the 100 NIHU currently in treatment, 57.0% were prescribed methadone (data not shown). Nearly half of NIHU perceived heroin quality to be high, over half described purchasing ('copping') heroin as easy, and most saw it as readily available. Former injectors were more likely to perceive copping as exciting, but were also more likely to report being robbed/assaulted while copping. Compared to never injectors, former injectors were less likely to feel in control of future injection and more likely to report high possibility of resuming injection in the next 6 months. A third of NIHU reported being in situations where it would be easy to inject, and former injectors were significantly more likely to report such situations.

Table 4 shows lifetime and recent substance use, other than heroin, by history of injection. Compared to never-injectors, NIHU who ever injected were more likely to report use of all other substances except marijuana. The most frequently reported lifetime and past 6-month drug use was for marijuana, powder cocaine and crack. Few NIHU (10.3%) reported using crack and heroin on the same occasion in the past 30 days. Past 6-month use of 3 illicit drugs other than heroin was common (62.1%) and this did not differ by past injection. Over two-thirds of NIHU reported past-6-month alcohol drinking (data not shown) and 24.4% reported binge drinking (≥ 5 drinks) on nearly all alcohol drinking occasions; alcohol consumption did not differ by injection history.

Social Environment

Former injectors were significantly more likely than never injectors to have friends who were current injectors, crack users and powder cocaine users and to use non-injected heroin with persons who currently or ever injected drugs (Table 5). Former injectors were also more likely to use drugs in places where others were injecting and to share non-injecting drug paraphernalia (e.g., straws for snorting heroin). Few NIHU had main sex partners who ever or currently injected drugs, but former injectors were significantly more likely to have such relationships. Having any close relationships with IDUs (e.g., friends and/or main sex partners) was reported by nearly a quarter of NIHU, and former injectors were more likely to report such relationships than never injectors. All social network variables in Table 5 were examined for association with former injection by gender and no significant differences were observed, except for trading sex. Male former injectors were more likely than male never injectors to have ever exchanged sex for money/drugs (20.7% vs. 8.6%; $p < 0.05$), while no differences in sex trade by former injection were observed among women (data not shown).

Many NIHU reported unstable family environments while they were growing up including a parent who was an alcoholic or used cocaine/heroin regularly, and ever running away from home (Table 5). Former injectors were significantly more likely to report an alcoholic parent and to have run away from home, but less likely to have a parent who used cocaine/heroin. More NH-Black NIHU reported having a parent who ever used cocaine/heroin regularly compared to NH-White NIHU (47.8% vs. 18.4%, $p < 0.001$) (data not shown). Few (8.3%) participants lived with a current injector, but former injectors were significantly more likely to live with an injector than never injectors.

Multivariable Analysis

Table 6 displays the final multivariable model of independent correlates of former injection drug use among 16–30 year old NIHU. The model includes the interaction of race/ethnicity and crack use: for Hispanic/Other NIHU, crack use was positively and significantly associated with former injection, while the positive association for NH-Whites was not statistically significant. Crack use by NH-Blacks was negatively but not significantly associated with former injection. Additional correlates of former injection by NIHU were having a close relationship with IDUs as well as not knowing the injection status of those close to them; younger age at first heroin use; poor/fair health; having ever overdosed; currently living with IDUs; recently being in situations that would enable injection; and ever trading sex for money/drugs. Age and gender were included in the initial model but found not to be statistically significant ($p < 0.05$) and their removal did not affect parameters of the other variables.

Discussion

To our knowledge, we describe the largest cohort of young NIHU recruited to date for research. An important finding is that the prevalence of prior injection is relatively low (18%) and most former IDUs had injected infrequently (<10 lifetime injections). A comparable study of NIHU in New York City (NYC) reported that 33% of the sample ever injected and over half of former IDUs had injected 10 times (Neaigus et al, 2001). This difference may in part be explained by the study's age eligibility criteria. The NYC cohort was substantially older (mean 33.5 years, range 18–58), and never injectors and infrequent injectors were significantly younger than frequent injectors. The NYC cohort also represented longer-term users, with an average duration of use nearly double that reported in our study. Longer duration of use has been associated with injecting (Griffiths et al, 1994; Strang et al, 1999). However, with nearly a decade difference on average in age and year of heroin use initiation between the two samples, the lower proportion of former injectors among Chicago NIHU may also reflect a generational difference in perceptions and avoidance of injection (Boyle and Brunswick, 1980; Frank, 2000; Golub and Johnson, 1999). That is, as people in HIV high-prevalence neighbourhoods became increasingly aware of injection-related HIV/AIDS in the early to mid-1990s, strong norms may have developed against injecting drugs that effectively discouraged this practice by initiates to heroin use (Ouellet et al, 1995a; Ouellet et al, August 11–13, 1993). Thus, while research indicates that long-term drug use puts NIHU at high-risk of injection, interventions intended to prevent injection among persons in such communities may be able to capitalize on norms aligned against injection. This potential advantage is not likely to exist, however, in historically low HIV prevalence communities, where similar strong norms against injecting may not have developed. Further research on this issue is needed.

Young NIHU in this study exhibited individual, drug-use and social environmental characteristics previously identified as risk factors for transitioning to injection. Former injectors were more likely to report such factors than never injectors, supporting research that identified former injectors at increased risk for resuming injection (Des Jarlais et al, 1992; Neaigus et al, 2006; van Ameijden et al, 1994). In univariable analysis, race/ethnicity was the individual-level characteristic most strongly associated with history of injection; compared to other racial/ethnic groups, NH-Whites were more likely and NH-Blacks less likely to have ever injected. Other recent studies comparing IDUs and non-IDUs reported similar findings (Fuller et al, 2002; Kelley and Chitwood, 2004; Sherman et al, 2005; Strang et al, 1999; Swift et al, 1999). However, we found that race/ethnicity and crack use interacted in the association with former injection in our final multivariable model. Crack use highly correlated with injection among Hispanics, and although the effect of crack use among NH-Blacks and NH-Whites was statistically not significant, the direction of the

effects suggest a potential positive association among NH-Whites and a negative association among NH-Blacks.

The effect of crack cocaine on transitions to injection has been studied previously, though no study has reported an effect-modifying relationship with race/ethnicity. The NYC study of NIHU found that recent crack use was protective for initiation of injection among NIHU who never injected (Des Jarlais et al, 2007b). Other studies suggest that using crack cocaine may increase the likelihood of injection transitions (Fuller et al, 2001; Roy et al, 2003; Sherman et al, 2005) or have no influence (Fischer et al, 2006). A 3-city study of 18–29 year old crack users found that Hispanic crack users were three times more likely to transition to injecting than non-Hispanic participants (Irwin et al, 1996). Although the sample size of Hispanic NIHU in the present study limited our ability to further explore possible subgroup differences, others have found variations between Puerto Ricans and Mexican Americans in drug use patterns (Amaro et al, 1990) and injection risk practices (Estrada, 1998) that warrant future research. Of note, in the 1990's there was considerable concern that crack smokers who initially snorted heroin to 'come down' from the effects of crack might eventually transition to injecting heroin (Des Jarlais et al, 1994; Frank and Galea, 1993; Irwin et al, 1996). While the use of crack was common in our study, only a few NIHU reported using heroin or crack in ways that suggested their primary intention was to moderate the effects of one on the other, and there were no differences by history of injection.

The association of younger age at first heroin use with injection is consistent with previous research (Fuller et al, 2001; Neaigus et al, 2001; Sherman et al, 2005). At least one study suggested that younger initiates to substance abuse were more likely to exhibit psychological distress that, in turn, might hasten progression into heavier drug use (Brook et al, 1998). In our study, younger initiates to heroin use were significantly more likely to report lifetime diagnoses with psychological/behavioural conditions (data not shown). For the sample as a whole, psychological conditions were not significant correlates of prior injection in the multivariable model, though other indicators of health were, including self-described current health as poor/fair and having ever overdosed on heroin. Overdose is a major cause of premature death among heroin users (Smyth et al, 2006; Warner-Smith et al, 2001) and IDUs (Gossop et al, 1996; McGregor et al, 1998; Vlahov et al, 2008). In our study, concerns over health may have influenced former injectors to transition back to non-injecting use. Concerns about physical health, HIV/AIDS and fear of overdose have been identified in some studies as factors that may inhibit injection initiation (Des Jarlais et al, 1992; French and Safford, 1989; Kelley and Chitwood, 2004; Ouellet et al, 1995b; Swift et al, 1999; Witteveen et al, 2006).

Compared to never injectors, those who ever injected were more likely to have close relationships with IDUs, to live with IDUs, and to have been in situations conducive to drug injection. These associations are consistent with findings from other studies in which non-IDUs whose social networks included IDUs were at greater risk of injecting (Des Jarlais et al, 1992; Neaigus et al, 2006; Ouellet et al, 1998; Roy et al, 2003; Sanchez et al, 2006; Strang et al, 1999; van Ameijden et al, 1994). Clearly, social environment directly and indirectly affects individuals' behavioural choices, (Fisher and Fisher, 1992; Latkin, 1998), including high-risk drug use behaviours (Latkin et al, 1996). Sherman and colleagues demonstrated that drug injection is a learned behaviour and relates to individuals' patterns of social relationships (Sherman et al, 2002), and that seeing someone (most commonly 'friends') inject was significantly associated with initiating injection (Sherman et al, 2005).

Our finding that trading sex for money/drugs is associated with injection has been reported previously (Fuller et al, 2002; Sanchez et al, 2006). The authors of a study of recent-onset

IDUs and NIHU in South Florida hypothesized that engaging in criminal activities, such as sex-trading, may reflect a greater involvement in the heroin addict subculture lifestyle that may lead to drug injection (Sanchez et al, 2006). Given that sex trading by both IDUs and non-IDUs has been well documented as a risk for HIV infection, (Astemborski et al, 1994; Edlin et al, 1994; Neaigus et al, 1996) it may contribute to the increased HIV incidence observed among new IDUs (Fennema et al, 1997; Vlahov et al, 1990).

We found no differences by injection history in HIV and HBV seroprevalence. The lack of association may be partly the result of the participants' young age and relatively short duration of heroin use and because most former IDUs injected infrequently. However, other studies have also documented similar HIV prevalence levels for non-IDUs and IDUs, suggesting that among both groups of drug users the sexual transmission of HIV increasingly accounts for new infections (Chitwood et al, 2003; Des Jarlais et al, 2007a; Strathdee and Sherman, 2003). While our and other studies suggest that NH-Black drug users may be less likely to inject, (Broz and Ouellet, 2008; Fuller et al, 2002; Kelley and Chitwood, 2004; Maxwell and Spence, 2005; Neaigus et al, 2006; Sherman et al, 2005; Strang et al, 1999; Swift et al, 1999; van Ameijden et al, 1994) those who do inject will remain at elevated risk for HIV infection through both sexual and drug use practices due to the high background prevalence of HIV in African-American communities. Conversely, HCV seroprevalence in our study was significantly higher among former injectors, which reflects the greater efficiency of HCV transmission through parenteral routes (Aceijas and Rhodes, 2007; MacDonald et al, 2001). However, the relatively low HCV seroprevalence among young NIHU, including those who have injected drugs, indicates an opportunity for preventing HCV infection in this population.

Limitations

Several study limitations need to be acknowledged. First, the primary comparison of interest between former IDUs and never IDUs is subject to some degree of potential misclassification. Despite using several strategies to determine history of injection, a small number of participants who reported that they never injected drugs may have injected. However, NIHU were recruited concurrently with IDUs for another study, which minimized the need to misrepresent their mode of drug administration to gain study enrolment. The low seroprevalence of HCV further supports confidence in the accurate classification of non-injection drug use. Second, the study relied predominantly on self-reported data, which may introduce bias due to inaccurate recall and socially desirable reporting. Self-reported risk behaviour data has been documented to be reliable and valid in several studies of drug users, (Anthony et al, 1991; Dowling-Guyer et al, 1994; Goldstein et al, 1995; Langendam et al, 1999), however, and the ACASI interviewing system has been found to improve validity (Des Jarlais et al, 1999; Metzger et al, 2000; Turner et al, 1998) and minimize socially desirable reporting when asking about sensitive behaviours (Ghanem et al, 2005; Perlis et al, 2004). Third, the extent to which our findings are generalizable to other young NIHU is unknown, though we validated recent heroin use using a urine test and employed multiple recruiting methods, including methods associated with RDS, to reach a wide cross-section of the NIHU population. Given that the characteristics of local illicit drug markets, and the types and purity of heroin, influence the mode of drug administration, (Andrade et al, 1999; Ciccarone, 2008), young NIHU in Chicago may not represent heroin users in other areas. Finally, the cross-sectional nature of the analysis limits our ability to infer temporality. For instance, for some former IDUs, potential risk factors for transitions to injection, such as poor health, may have influenced making a transition away from injecting.

Conclusions

Findings from this study regarding the characteristics of young NIHU and their experience with drug injection may be useful to future research studies, surveillance programs and public health interventions targeting this population. Given our stringent recruiting and screening procedures, and the opportunity to concurrently recruit young NIHU with IDUs in the same age group, the frequency of former injection detected in our study should provide guidance for the expected proportions in similar populations. These findings suggest that among young NIHU there is a sizable minority who have experimented with injection and thus are at high risk of returning to injection. Furthermore, the low level of frequent former IDUs among NIHU in this study implies that those who have engaged in sustained injection are unlikely to return to non-injecting modes of use during the relatively early years of their heroin use. Finally, many young NIHU in this study reported factors that place them at high-risk for transitioning to drug injection and, if that occurs, it likely will accelerate the spread of HIV, HBV, and HCV in the United States. Although only a few NIHU perceived themselves at high-risk for HIV infection, we detected HIV and HBV prevalence levels well in excess of the general population (CDC, 2008; McQuillan et al, 1999). We also found a low level of HBV vaccination. Given that numerous studies consistently report younger, recently initiated IDUs at an increased risk for blood-borne infections (Fennema et al, 1997; Garfein et al, 1996; Hagan et al, 2007; Nelson et al, 2002; van Ameijden et al, 1994; Vlahov et al, 1990), young NIHU comprise an important population that would benefit from targeted interventions aimed at preventing transitions to injection, and reducing other drug use and sexual risk behaviours. Because former injectors are more likely to have close social contact with IDUs and to be in situations that present opportunities to inject, they are a particularly vulnerable subgroup that requires creative intervention strategies to prevent transitions to injection.

Given the complexity of the pathways that lead from non-injecting drug use to drug injection, programs aimed at preventing this transition should consider a comprehensive approach that involves drug treatment, individual behavioral interventions, and more broadly social interventions. Research by Kelley and Chitwood (2004), for example, found that participation in drug treatment by NIHU slowed progressions to injection. An individual-level intervention evaluated in a randomized control trial with NIHU and found significant reduction in transitions to injection (Des Jarlais et al., 1992). The intervention addressed facts about HIV/AIDS and needle use, lures into drug use and injection, ways to handle situations that could lead to drug injection, and anti-injecting rationales and resistance skills (Casriel et al, 1990). By conducting the intervention in a group setting, the researchers believed they also encouraged peer support for resisting injection. Beyond interventions with NIHU, Hunt and colleagues evaluated an individual-level intervention that targeted IDUs appeared to reduce their influence on the likelihood of non-injecting drug users engaging in injection (Hunt et al, 1998). The intervention, which probably could be implemented at little cost in drug treatment and needle exchange programs, involved a single session that addressed participants' own injection initiation, their initiation of others, risks from initiation for themselves and others, elements of their own behaviour that could promote injecting by others, and, responses to situations that could lead to initiation. One of the most striking findings of our and other research on young noninjecting 'hard' drug users in the United States is the strong aversion to injection of African Americans compared to Whites and Latinos, not only in word – which is common in all groups – but in practice. Researchers interested in developing injection prevention interventions should further explore both the roots of this aversion and the day-to-day elements that support it. Given the influence of young African Americans on youth culture generally (Watkins, 2006), we suspect that group-level interventions (e.g., schools) could be made more effective in preventing drug injection and the use of 'hard' drugs such as heroin and crack cocaine, by

employing the example set by young African Americans. Lastly, involving peers in the design and delivery of intervention programs has shown promise in studies of IDUs (Garfein et al, 2007).

Additional evaluations of intervention strategies for preventing drug injection are needed and their design should be informed by recently published findings, including this paper's, that identify at-risk populations and potentially modifiable individual, drug use and social determinants of injection transitions. Although the ultimate goal of injection-prevention is cessation of drug use, concurrent objectives should aim to provide education about health and social consequences of the different modes of drug administration, harm reduction strategies to practice safer drug use (non-injecting and injecting) as well as safer sexual behaviors, and tools for building supportive social networks.

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Table 1

Demographic and socio-economic characteristics among young non-injecting heroin users, by injection drug use (IDU) history

<i>Characteristic</i>	Total (n, %) n=689	Former IDU n=123 (17.9)	Never IDU n=566 (82.1)
Race/Ethnicity^{***}			
Non-Hispanic Black	353 (51.2)	41 (33.3)	312 (55.1)
Non-Hispanic White	154 (22.4)	43 (35.0)	111 (19.6)
Hispanic	167 (24.2)	36 (29.3)	131 (23.1)
Other	15 (2.2)	3 (2.4)	12 (2.1)
Hispanic (n=167)			
Mexican	87 (52.1)	14 (40.0)	73 (55.3)
Puerto Rican	52 (31.1)	13 (37.1)	39 (29.5)
Other Hispanic/Mixed	28 (16.8)	8 (22.9)	20 (15.2)
Age (years)^{**}			
16–20	146 (21.2)	30 (24.4)	116 (20.5)
21–25	213 (30.9)	53 (43.1)	160 (28.3)
26–30	330 (47.9)	40 (32.5)	290 (51.2)
Mean [*] (sd), Median	24.7 (4.1), 25	23.8 (3.7), 24	24.9 (4.1), 26
Sex			
Male	444 (64.4)	82 (66.7)	362 (64.0)
Female	245 (35.6)	41 (33.3)	204 (36.0)
Sexual orientation^{a*}			
Heterosexual	557 (81.3)	92 (76.7)	465 (82.3)
Homosexual/Bisexual	67 (9.8)	19 (15.8)	48 (8.5)
Unknown	61 (8.9)	9 (7.5)	52 (9.2)
Completed high school^{b§} (n=670)			
No	397 (59.3)	63 (52.1)	334 (60.8)
Yes	273 (40.7)	58 (47.9)	215 (39.2)
Homeless (past 6 months)			
No	552 (80.1)	94 (76.4)	458 (80.9)
Yes	137 (19.9)	29 (23.6)	108 (19.1)
Resided outside of Chicago[*] (past 6 months)			
No	487 (70.7)	74 (60.2)	413 (73.0)
Yes	202 (29.3)	49 (39.8)	153 (27.0)
Illegal source of income^{c§} (past 6 months)			
No	327 (47.5)	51 (41.5)	276 (48.8)
Yes	362 (52.5)	72 (58.5)	290 (51.2)
Incarcerated^d (past 6 months)			
No	545 (79.1)	100 (81.3)	445 (78.6)
Yes	144 (20.9)	23 (18.7)	121 (21.4)

Note. sd=standard deviation of the mean.

* statistical significance at $p < 0.05$,

** statistical significance at $p < 0.001$,

^s statistical significance at $p < 0.20$ (included in multivariable modeling).

^a Four persons indicated no lifetime sexual activity and were not asked about sexual orientation. Percentages are based on $n = 685$.

^b High school completion was only assessed for participants ≥ 18 years of age.

^c Illegal income = selling drugs, stealing/boosting, other illegal sources, sex for money.

^d Incarcerated = In jail, prison, or juvenile center.

Table 2

Health and prior diagnoses among young non-injecting heroin users, by injection drug use (IDU) history

	Total (n, %) n=689	Former IDU n=123 (17.9)	Never IDU n=566 (82.1)	OR (95%CI)
<i>Seroprevalence and HIV risk perceptions</i>				
HIV seropositive	20 (2.9)	3 (2.4)	17 (3.0)	0.81 (0.23–2.80)
HCV seropositive **	16 (2.3)	11 (9.0)	5 (0.9)	11.10 (3.78–32.57)
HBV seropositive (n=589) ^a	63 (10.6)	13 (12.5)	50 (10.3)	1.24 (0.65–2.38)
Believes his/her sexual risk for HIV/AIDS is high or medium * (n=680) ^b	76 (11.2)	20 (16.4)	56 (10.1)	1.75 (1.01–3.05)
Believes his/her drug use risk for HIV/AIDS is high or medium * (n=680)	44 (6.5)	15 (12.3)	29 (5.2)	2.55 (1.32–4.92)
<i>Psychological conditions</i>				
Ever diagnosed ^c with a psychological or behavioral condition **	76 (11.0)	25 (20.3)	51 (9.0)	2.58 (1.52–4.36)
Ever diagnosed ^c with depression **	47 (6.8)	18 (14.6)	29 (5.1)	3.17 (1.70–5.93)
Current possible major depressive disorder (DSM-IV based scale)				
No	552 (80.1)	94 (76.4)	458 (80.9)	1.00
Yes	69 (10.0)	16 (13.0)	53 (9.4)	1.47 (0.81–2.68)
Undetermined	68 (9.9)	13 (10.6)	55 (9.7)	1.15 (0.61–2.19)
Ever used illicit drugs to treat psychiatric or emotional problems				
No	403 (58.5)	68 (55.3)	335 (59.2)	1.00
Yes	236 (34.3)	49 (39.8)	187 (33.0)	1.29 (0.86–1.94)
Unknown	50 (7.3)	6 (4.9)	44 (7.8)	0.67 (0.28–1.64)
<i>Health status and other personal susceptibility indicators</i>				
Current health is poor/fair *	129 (18.7)	35 (28.5)	94 (16.6)	2.00 (1.27–3.13)
Ever overdosed on heroin **	43 (6.2)	20 (16.3)	23 (4.1)	4.58 (2.43–8.65)
Ever tattooed	434 (63.0)	78 (63.4)	356 (62.9)	1.02 (0.68–1.53)
Ever witnessed/experienced trauma ^d				
No	368 (53.4)	74 (60.2)	294 (51.9)	1.00
Yes	267 (38.8)	44 (35.8)	223 (39.4)	0.78 (0.52–1.18)
Unknown	54 (7.8)	5 (4.1)	49 (8.7)	0.41 (0.16–1.05)

Note. Percentages refer to column percentages.

Logistic regression analyses calculated odds ratios (OR) and corresponding 95% confidence intervals (CI) for associations with IDU history.

* statistical significance at $p < 0.05$.

** statistical significance at $p < 0.001$.

^a Excludes participants who were ever vaccinated.

^b 15 participants were aware of their HIV status and were excluded.

^c Diagnosed by a doctor or other health care professional.

^d Trauma = shooting, rape, serious assault, sexual abuse, or any other extremely upsetting event..

Table 3

Heroin use practices among young non-injecting heroin users, by injection drug use IDU) history

<i>Heroin use</i>	Total(n,%) n=689	Former IDU n=123 (17.9)	Never IDU n=566 (82.1)	OR (95%CI)
Age at first heroin use ^a (years)				
17 [*]	321 (47.6)	72 (59.0)	249 (45.1)	1.75 (1.18–2.61)
18	353 (52.4)	50 (41.0)	303 (54.9)	1.00
Mean [*] (<i>sd</i>)	18.5 (3.7)	17.8 (3.2)	18.7 (3.7)	
Median (range)	18 (11–29)	17 (13–27)	18 (11–29)	
Duration of heroin use ^a (years)				
5	366 (54.3)	68 (55.7)	298 (54.0)	1.00
6	308 (45.7)	54 (44.3)	254 (46.0)	0.93 (0.63–1.38)
Mean (<i>sd</i>)	6.2 (4.5)	6.0 (4.1)	6.3 (4.6)	
Median (range)	5 (1–18)	5 (1–16)	5 (1–18)	
Type of heroin (past 30 days)				
Powder white or brown	587 (85.2)	99 (80.5)	488 (86.2)	1.00
Non-powder brown or tar [*]	44 (6.4)	15 (34.1)	29 (5.1)	2.55 (1.32–4.93)
Unknown	58 (8.4)	9 (7.3)	49 (8.7)	0.91 (0.43–1.90)
Days heroin was used in the past 30 days ^a				
14	199 (30.1)	41 (33.6)	158 (29.3)	1.00
15–24	85 (12.9)	14 (11.5)	71 (13.2)	0.76 (0.39–1.48)
25–30	377 (57.0)	67 (54.9)	310 (57.5)	0.83 (0.54–1.29)
Used 2 bags per day (past 30 days)	612 (88.8)	108 (87.8)	504 (89.0)	0.89 (0.49–1.62)
<i>Heroin dependence and treatment experience</i>				
Ever felt addicted [§] (self described)	561 (81.4)	107 (87.0)	454 (80.2)	1.65 (0.84–2.90)
Severity of Dependence Scale (SDS) (past 30 days)				
Dependence not indicated (SDS 5)	173 (25.1)	26 (21.1)	147 (26.0)	1.00
Dependence indicated (SDS 6)	461 (66.9)	87 (70.7)	374 (66.1)	1.32 (0.82–2.12)
Undetermined	55 (8.0)	10 (8.1)	45 (8.0)	1.26 (0.56–2.80)
Ever in treatment [*]	406 (58.9)	84 (68.3)	322 (56.9)	1.63 (1.08–2.47)
Currently in treatment [*]	100 (14.5)	28 (22.8)	72 (12.7)	2.02 (1.24–3.30)
<i>Heroin market experience</i>				
Quality is very good/good ^a (past 30 days)	295 (43.3)	54 (44.3)	241 (43.0)	1.05 (0.71–1.56)
Availability is a lot/enough ^a (past 30 days)	597 (87.8)	104 (84.6)	493 (88.5)	0.71 (0.41–1.24)
‘Copping’ is very easy/easy ^a (past 30 days)	352 (52.8)	65 (53.3)	287 (52.7)	1.03 (0.69–1.52)
Ever found copping exciting ^a [*]	152 (22.6)	42 (34.1)	110 (20.0)	2.08 (1.36–3.19)
Ever was robbed/assaulted while copping ^a ^{**}	277 (33.8)	63 (52.1)	164 (29.8)	2.56 (1.71–3.82)
<i>Attitudes and situations enabling injecting</i>				
“I am in control of whether I will inject in the next 6 months”				
No	119 (17.3)	30 (24.4)	89 (15.7)	1.00

<i>Heroin use</i>	Total(n,%) n=689	Former IDU n=123 (17.9)	Never IDU n=566 (82.1)	OR (95%CI)
Yes [*]	513 (74.5)	82 (66.7)	431 (76.1)	0.56 (0.35–0.91)
Unknown	57 (8.3)	11 (8.9)	46 (8.1)	0.71 (0.33–1.54)
“No matter what, I will inject in the next 6 months”				
No	574 (83.3)	91 (74.0)	483 (85.3)	1.00
Yes ^{**}	46 (6.7)	18 (14.6)	28 (4.9)	3.41 (1.81–6.43)
Unknown	69 (10.0)	14 (11.4)	55 (9.7)	1.35 (0.72–2.53)
Have been in situations where it would be easy to inject ^{**} (past 6 months)	232 (33.7)	78 (63.4)	154 (27.2)	4.64 (3.08–6.99)

Note. Percentages refer to column percentages.

Logistic regression analyses calculated odds ratios (OR) and corresponding 95% confidence intervals (CI) for associations with IDU history.

^{*} statistical significance at $p < 0.05$,

^{**} statistical significance at $p < 0.001$,

[§] statistical significance at $p < 0.20$ (included in multivariable modeling)

^a Variables have 1.0% to 4.1% missing. Percentages are based on non-missing totals.

Table 4

Lifetime and recent substance use other than heroin among young non-injecting heroin users, by injection drug use (IDU) history

<i>Cocaine Use</i>	Total (n, %) n=689	Former IDU n=123 (17.9)	Never IDU n=566 (82.1)	OR (95%CI)
Ever used powder cocaine *	486 (70.5)	97 (78.9)	389 (68.7)	1.70 (1.06–2.71)
Used powder cocaine * (past 6 months)	242 (35.1)	53 (43.1)	189 (33.4)	1.51 (1.02–2.25)
Ever used crack cocaine *	466 (67.6)	96 (78.0)	370 (65.4)	1.88 (1.19–2.99)
Used crack cocaine [§] (past 6 months)	361 (52.4)	73 (59.3)	288 (50.9)	1.41 (0.95–2.09)
Frequently ^a used crack cocaine and heroin together ^b (past 30 days)	71 (10.3)	12 (9.8)	59 (10.4)	0.93 (0.48–1.79)
Ever used speedball *	352 (51.1)	78 (63.4)	274 (48.4)	1.85 (1.24–2.76)
<i>All other substances</i>				
Frequently ^a drank 5 alcohol drinks (past 6 months)	168 (24.4)	34 (27.6)	134 (23.7)	1.23 (0.79–1.91)
Used any 3 illicit drugs other than heroin (past 6 months) [§]	428 (62.1)	84 (68.3)	344 (60.8)	1.39 (0.92–2.11)
Ever used Ritalin **	91 (13.2)	34 (27.6)	57 (10.1)	3.41 (2.11–5.52)
Ever used opioids other than heroin *	393 (57.0)	83 (67.5)	310 (54.8)	1.71 (1.14–2.59)
Ever used amphetamines **	138 (20.0)	44 (35.8)	94 (16.6)	2.80 (1.82–4.30)
Ever used MDMA ^c **	262 (38.0)	65 (52.8)	197 (34.8)	2.10 (1.42–3.11)
Ever used tranquilizers/barbiturates **	217 (31.5)	56 (45.5)	161 (28.4)	2.10 (1.41–3.13)
Ever used nitrous oxide **	137 (19.9)	46 (37.4)	91 (16.1)	3.12 (2.03–4.79)
Ever used inhalants (e.g., paint, glue) *	110 (16.0)	30 (24.4)	80 (14.1)	1.96 (1.22–3.15)
Ever used PCP ^d *	348 (50.5)	75 (61.0)	273 (48.2)	1.68 (1.13–2.50)
Ever used hallucinogens (e.g., LSD ^e) **	260 (37.7)	71 (57.7)	189 (33.4)	2.72 (1.83–4.06)
Ever used GHB ^f or Ketamine **	91 (13.2)	37 (30.1)	54 (9.5)	4.08 (2.53–6.57)
Ever used marijuana	661 (95.9)	120 (97.6)	541 (95.6)	1.85 (0.55–6.22)

Note. Percentages refer to column percentages.

Logistic regression analyses calculated odds ratios (OR) and corresponding 95% confidence intervals (CI) for associations with IDU history.

* statistical significance at $p < 0.05$,

** statistical significance at $p < 0.001$,

[§] statistical significance at $p < 0.20$ (included in multivariable modeling).

^a Frequent = “all the time” or “almost all the time.”

^b Used heroin and crack cocaine on the same occasion but separately.

^c MDMA - 3,4-methylenedioxymethamphetamine.

^d PCP – Phencyclidine.

^e LSD - Lysergic acid diethylamide.

^f GHB - 4-hydroxybutanoic acid.

Table 5

Social networks of young non-injecting heroin users, by injection drug use (IDU) history

<i>Drug use and sex networks</i>	Total(n,%) n=689	Former IDU n=123 (17.9)	Never IDU n=566 (82.1)	OR (95%CI)
Friends ^a are current injectors				
No	462 (67.1)	40 (32.5)	422 (74.6)	1.00
Yes ^{**}	160 (23.2)	65 (52.8)	95 (16.8)	7.22 (4.59–11.35)
Unknown	67 (9.7)	18 (14.6)	49 (8.7)	3.88 (2.06–7.28)
Friends are current crack users				
No	356 (51.7)	48 (39.0)	308 (54.4)	1.00
Yes [*]	277 (40.2)	66 (53.7)	211 (37.3)	2.01 (1.33–3.03)
Unknown	56 (8.1)	9 (7.3)	46 (8.3)	1.23 (0.57–2.67)
Friends are current powder cocaine users				
No	391 (56.7)	59 (48.0)	332 (58.7)	1.00
Yes [*]	228 (33.1)	53 (43.1)	175 (30.9)	1.70 (1.13–2.58)
Unknown	70 (10.2)	11 (8.9)	59 (10.4)	1.05 (0.52–2.11)
Used heroin w/ ever injectors (past 30 days)				
No	393 (57.0)	41 (33.3)	352 (62.2)	1.00
Yes ^{**}	200 (29.0)	69 (56.1)	131 (23.1)	4.52 (2.93–6.99)
Unknown	96 (13.9)	13 (10.6)	83 (14.7)	1.35 (0.69–2.62)
Used heroin w/ current injectors (past 30 days)				
No	450 (65.3)	59 (48.0)	391 (69.1)	1.00
Yes ^{**}	145 (21.0)	52 (42.3)	93 (16.4)	3.71 (2.40–5.73)
Unknown	94 (13.6)	12 (9.8)	82 (14.5)	0.97 (0.45–1.89)
Used heroin or other drugs where others injected ^{**} (past 6 months)	200 (29.0)	66 (53.7)	134 (23.7)	3.73 (2.49–5.59)
Shared receptively non-IDU paraphernalia w/ ever injectors ^b (past 6 months)				
No	481 (69.8)	60 (48.8)	421 (74.4)	1.00
Yes ^{**}	146 (21.2)	51 (41.5)	95 (16.8)	3.77 (2.44–5.82)
Unknown	62 (9.0)	12 (9.8)	50 (8.8)	1.68 (0.85–3.34)
Main sex partner ever injected				
No	605 (87.8)	94 (76.4)	511 (90.3)	1.00
Yes ^{**}	36 (5.2)	20 (16.3)	16 (2.8)	6.80 (3.40–13.59)
Unknown	48 (7.0)	9 (7.3)	39 (6.9)	1.26 (0.59–2.68)
Main sex partner is a current injector				
No	625 (90.7)	101 (82.1)	524 (92.6)	1.00
Yes ^{**}	21 (3.0)	14 (11.4)	7 (1.2)	10.38 (4.09–26.35)
Unknown	43 (6.2)	8 (6.5)	35 (6.2)	1.19 (0.53–2.63)
Close relationship ^c w/ injectors				
No	460 (66.9)	39 (31.7)	421 (74.4)	1.00
Yes	165 (23.9)	69 (56.1)	96 (17.0%)	7.76 (4.94–12.18)

<i>Drug use and sex networks</i>	Total(n,%) n=689	Former IDU n=123 (17.9)	Never IDU n=566 (82.1)	OR (95%CI)
Unknown	64 (9.3)	15 (12.2)	49 (8.7)	3.31 (1.70–6.43)
Ever exchanged sex for money or drugs [§]	116 (16.8)	26 (22.8)	88 (15.5)	1.60 (0.99–2.58)
<i>Other social network/environment</i>				
Parent was an alcoholic [*]	297 (43.1)	66 (53.7)	231 (40.8)	1.68 (1.14–2.49)
Parent used heroin or cocaine regularly [*]	244 (35.4)	34 (27.6)	210 (37.1)	0.65 (0.42–0.99)
Ever ran away from home [*]	265 (38.5)	58 (47.2)	207 (36.6)	1.54 (1.04–2.29)
Currently lives w/ injectors [*]	57 (8.3)	16 (13.0)	41 (7.2)	1.92 (1.04–3.54)
Membership in a street gang				
Never in a gang	353 (51.2)	76 (61.8)	277 (48.9)	1.00
Currently active, non-active or former [§]	284 (41.2)	44 (35.8)	240 (42.4)	0.67 (0.44–1.01)
Unknown [*]	52 (7.5)	3 (2.4)	49 (8.7)	0.22 (0.07–0.74)

Note. Percentages refer to column percentages.

Logistic regression analyses calculated odds ratios (OR) and corresponding 95% confidence intervals (CI) for associations with IDU history.

^{*} statistical significance at $p < 0.05$;

^{**} statistical significance at $p < 0.001$;

[§] statistical significance at $p < 0.20$ (included in multivariable modeling).

^a People with whom participants spend most of their free time, like friends.

^b Paraphernalia to use heroin, such as straws, pipes, syringes.

^c Close relationship includes people with whom participants spend most of their free time, like friends, or a main sex partner.

Table 6

Multivariable logistic regression analysis of baseline correlates of former injection drug use among young non-injection heroin users

Correlates	AOR ^a (95% CI)	Wald test
Race/ethnicity and ever used crack interaction		
Effect of crack use among NH-Blacks	0.61 (0.29–1.30)	0.199
Effect of crack use among NH-Whites	2.42 (0.61–9.54)	0.208
Effect of crack use among Hispanics/Others	5.09 (1.79–14.45)	0.002
Age at first heroin use is 17 years	1.63 (1.02–2.62)	0.042
Current health is poor/fair	2.18 (1.26–3.75)	0.005
Ever overdosed	2.68 (1.24–5.79)	0.012
Close relationship ^b w/ injectors		
No	1.00	
Yes	5.78 (3.33–9.36)	<0.001
Unknown	4.05 (1.94–8.46)	<0.001
Currently lives w/ injectors	2.82 (1.31–6.09)	0.008
In situations where it would be easy to inject (past 6 months)	2.55 (1.55–4.20)	<0.001
Ever exchanged sex for money or drugs	2.22 (1.18–4.17)	0.013

Note. n=674 due to missing (15, 2.2%).

^aOdds ratios (OR) are adjusted (A) for all variables in the model.

^bClose relationship includes people with whom participants spend most of their free time, like friends, or a main sex partner.