

Heterosexual HIV and Sexual Partnerships Between Injection Drug Users and Noninjection Drug Users

Samuel M. Jenness, M.P.H.,¹ Alan Neaigus, Ph.D.,¹ Holly Hagan, Ph.D.,²
Christopher S. Murrill, Ph.D.,¹ and Travis Wendel, J.D.²

Abstract

Sex partnerships with injection drug users (IDU) are an understudied network-level risk factor for heterosexual HIV infection. Heterosexuals with no history of injection were recruited from high-risk areas in New York City through respondent-driven sampling. We examined the prevalence of IDU sex partnerships among these non-IDU, the factors associated with having a past year IDU partner, and the independent association of HIV infection and IDU sex partnerships in multiple logistic regression. Of the 601 non-IDU in this analysis, 13.8% had a sex partner in the past year with a history of injection. IDU partnerships were significantly more common among women and those with higher levels of unprotected sex and drug and alcohol use. Overall, 7.0% tested positive for HIV. HIV prevalence was higher ($p = 0.07$) for participants with IDU partners (9.6%) compared to those with no IDU partners (4.6%). In multiple logistic regression, participants with IDU partners were over twice as likely to be HIV-infected ($p = 0.08$). Sex partnerships with IDU were common and may play an important role in heterosexual HIV transmission in areas with large IDU populations. Prevention interventions to encourage the disclosure of injection history and risk reduction specifically for those with IDU partners are indicated.

Introduction

UNPROTECTED SEX between men and women contributes to a substantial proportion of HIV infections in the United States.¹ In New York City, 24% of persons living with HIV/AIDS and 33% of new HIV diagnoses in 2006 with a known risk factor were infected heterosexually.² Recent estimates of HIV incidence are similar.^{3,4} Heterosexual HIV disproportionately affects women and racial minorities,^{5,6} groups that also face higher HIV morbidity and mortality through late HIV diagnosis and delayed medical care.^{7,8}

Risk factors contributing to heterosexual HIV are complex. Several studies have investigated social and structural factors like poverty and gender power dynamics^{9,10} and the low rates of HIV testing compared to men who have sex with men (MSM) and injection drug users (IDU).^{11,12} Recent research suggests that individual-level factors, such as unprotected sex or multiple partners, do not fully explain the growth of the heterosexual HIV epidemic.^{13,14} Instead, network factors like concurrent partnerships have been linked with heterosexual risk^{15,16}; the racial segregation of sex partners and the increased likelihood of non-whites at otherwise low risk to have

higher-risk partners contributes to the racial disparities in heterosexual infections.^{17,18} Sex partnerships of varying risk levels have been documented, for example, between low-risk women and men with histories of bisexuality or incarceration.^{19,20}

Another example, and the focus of this study, is partnerships between IDU and non-IDU heterosexuals. Despite decreases in injection-related HIV risk, many IDU still engage in sexual risk behaviors.^{21,22} This is one reason that 8% of New York City heterosexual HIV diagnoses in 2001–2007 were attributed to IDU sex partnerships, according to local surveillance data.²³ Yet there has been little recent attention in the literature describing the dynamics of IDU/non-IDU sex partnerships and their overall contribution to the heterosexual HIV epidemic. One recent study described a convergence of HIV prevalence in IDU and noninjection drug users in a linked social network, but it was unknown whether sexual partnerships between these two groups contributed to HIV infection among the non-IDU.²⁴ As HIV infections directly attributed to injection drug use continue to decline,² further examination of the indirect effects of injection drug use on heterosexual HIV transmission is needed.

¹New York City Department of Health and Mental Hygiene, New York, New York.

²National Development and Research Institutes, Inc., New York, New York.

In this study, we describe the frequency of having a recent sex partner with a history of injection in a sample of sexually active non-IDU heterosexuals from high-risk neighborhoods in New York City. We then examine the factors associated with having an IDU partner and investigate the independent association of these partnerships with HIV infection. Our objectives are to characterize the sociodemographic and behavioral risk factors associated with IDU partnerships and provide evidence that these partnerships are a plausible risk factor for heterosexual HIV infection in an urban setting with a large IDU population.

Methods

Sampling and eligibility

This study is part of the National HIV Behavioral Surveillance (NHBS) study among high-risk heterosexuals conducted in New York City in 2006–2007. NHBS is a cross-sectional study with the objective to estimate HIV risk and prevalence among MSM, IDU, and high-risk heterosexuals.²⁵ High-risk heterosexuals were defined using an innovative design, explained in detail elsewhere,¹² accounting for the geographic and social clustering shown to increase heterosexual HIV transmission. Briefly, we used New York City HIV case surveillance data and United States Census poverty data to identify geographic areas at the ZIP code level at highest risk for heterosexual HIV transmission. These high-risk areas (HRAs) were ranked according to standardized rates of heterosexual HIV and poverty. Residing in or having a social connection to one of the top 30 HRAs was a study eligibility criterion.

Participants had a social connection if they were recruited into the study by a previous study participant who resided in an HRA. This was possible through the use of respondent-driven sampling (RDS), a peer-referral method for recruiting hard-to-reach populations.²⁶ The study team selected a small number ($n = 8$) of initial recruits through community outreach, asked them to recruit up to three peers, then asked this next wave of participants to recruit, and so on until we met our target sample size. Individuals residing outside an HRA were eligible only if they were recruited by a participant residing in an HRA, in order to maintain the connection to HRAs.

Other eligibility criteria were opposite-sex vaginal or anal sex in the past year, age between 18 and 50 years old, New York City residence, and English/Spanish comprehension. Current and former IDU were eligible to participate, but we removed them from this analysis. We also removed those with a reported history of male-to-male sex or HIV infection and those who were not tested for HIV or hepatitis C (HCV) in the study. Eligible participants were paid \$20 for the survey, \$10 for the HIV and HCV tests, and \$10 for each eligible participant (up to 3) that they recruited. Study procedures were approved by the Institutional Review Boards of the participating organizations.

Study measures

Participants were asked to enumerate their past year sex partners and how many of them had ever injected illicit drugs. They were also asked about the injection history of their last sex partner. For last partner, we categorized participants into

three groups based on partner status: a known injection history, an unknown injection history, and a known history of no injection. For past year partners, we categorized participants into the same groups but in a hierarchical fashion (first, had any partners with a known injection history; second, had any partners with an unknown history of injection; and third, had only partners with a known history of no injection) to maintain exclusivity, since some participants had multiple partners with different injection histories. We also asked participants about sociodemographics (gender, race, age, income, education, and arrest) and past year HIV risk factors: unprotected vaginal/anal sex with a casual or exchange (traded sex for money or drugs) partner or with at least three partners, noninjection crack use, at least weekly noninjection drug or binge alcohol use, and last sex partner with a history of incarceration.

Finally, participants were asked their HIV status and if they had been diagnosed with a sexually transmitted disease (STD) in the past year. Blood collected by a trained phlebotomist through venipuncture was tested on HIV1/2 ELISA and HIV1 western blot platforms (Bio-Rad Laboratories, Hercules, CA), and a HCV enzyme-linked immunosorbent assay (ELISA) platform (Abbott Laboratories, Chicago, IL). All surveys were administered in private by a trained interviewer.

Statistical analysis

Pearson χ^2 tests were used to examine the factors associated with having a past year IDU sex partner and with HIV infection. Because of potential nondisclosure or misrecall of partners' injection history, we also compared the sociodemographics and behavioral risks of participants with IDU partners to those with unknown partners. Multivariate logistic regression with maximum likelihood ratio statistics was used to calculate the adjusted odds ratios (AOR) and 95% confidence intervals (CI) for the association between HIV infection and past year IDU sex partnerships, controlling for the total number of past year sex partners. In addition to our main exposure variable, we entered any variable that was significant at $p \leq 0.10$ into the multivariate model and proceeded with a backwards elimination of variables. The AOR and 95% CI for the remaining variables significant at $p \leq 0.05$ are shown. We tested for an interaction between gender and partner IDU history and conducted a sensitivity analysis to estimate the effects of misreported injection history by excluding participants who tested HCV positive. Analyses were conducted using SAS 9.1 (SAS Institute, Cary, NC).

Techniques for weighting RDS study data in logistic regression are still developing. Several studies have used the RDS weight for the dependent variable in a regression model to account for peer-referral biases.^{27,28} We took a different approach by including the participant's personal network size as an independent variable in our regression model, which adjusts for participants with large network sizes (an RDS-related recruitment bias).²⁶ However, we did not adjust for homophily (preferential in-group recruitment, another RDS recruitment bias) because we wanted to retain the inherent network relationships in the sample for this type of network-level risk factor analysis. Additionally, homophily adjustment could also underestimate the effects of the study design incorporating the social clustering of HIV infection and risk.

TABLE 1. INJECTION DRUG USE HISTORY OF PAST YEAR SEX PARTNER(S) AND LAST SEX PARTNER AMONG NEW YORK CITY HIGH-RISK HETEROSEXUALS WITH NO INJECTION HISTORY, 2006–2007, n = 601

Partner IDU History	Total	
	n	%
Past year partner(s)		
Yes	83	13.8
Unknown	145	24.1
No	373	62.1
Last sex partner		
Yes	31	5.2
Unknown	68	11.3
No	502	83.5

IDU, injection drug users.

Results

Of study sample (n = 850), we excluded participants with a history of injection (n = 188), male-to-male sex (n = 31), self-reported HIV infection (n = 4), and those not tested for HIV (n = 14) or HCV (n = 9) in the study. This left 601 for the analysis. In the past year, 14% had an IDU sex partner, another 24% had a partner with unknown injection history, and 62% had only non-IDU partners (Table 1). At last sex, 5% had an IDU partner, 11% had a partner of unknown injection history, and 84% had a non-IDU partner.

As Table 2 indicates, fewer participants were male (43%) than female (57%). Most were black, non-Hispanic (79%).

Nearly half were between 40 and 50 years old (46%), with a median age of 38. In the past year, 66% reported an annual income below \$10,000, 44% had not graduated high school, and 26% had been arrested. Many had unprotected sex with a casual/exchange partner (55%) or with at least 3 partners (42%), 28% had an incarcerated last sex partner, 27% used crack, and 52% used noninjection drugs and 35% binged on alcohol at least weekly in the past year. One quarter had a recent STD diagnosis and 5% were infected with HCV. Participants who were female (p = 0.03), in poverty (p = 0.02), had unprotected sex with casual/exchange partners (p < 0.01) or at least 3 partners (p < 0.01), had an incarcerated last sex partner (p < 0.01), used crack (p < 0.01), used noninjection drugs (p < 0.01) or binged on alcohol (p = 0.02) at least weekly, and who had an STD diagnosis (p = 0.02) were more likely to report an IDU partner. Participants with IDU partners were similar to those with unknown history partners on most variables (data not shown), but were more likely to be female (p = 0.04), have an incarcerated last sex partner (p < 0.01), and use noninjection drugs at least weekly (p = 0.01).

Overall, 7.0% tested positive for HIV (Table 3). At the bivariate level, HIV prevalence was higher (p = 0.07) for participants who had IDU partners (9.6%) compared to those with only non-IDU partners (4.6%). Additionally, participants who were over 40 years old (p < 0.01), in poverty (p = 0.01), had a STD diagnosis (p = 0.04), or were HCV-infected (p < 0.01) were more likely to be HIV-infected. At least weekly noninjection drug use was negatively associated with HIV (p = 0.03). In the final multiple logistic regression model, participants with any IDU partners were over twice as likely

TABLE 2. FACTORS ASSOCIATED WITH HAVING ANY INJECTION DRUG USERS AS SEX PARTNERS IN THE PAST YEAR AMONG NEW YORK CITY HIGH-RISK HETEROSEXUALS WITH NO INJECTION HISTORY, 2006–2007, n = 601

Characteristic	Total		Any IDU Partners (%)	Crude OR	95% CI	p
	n	%				
Overall	601	100.0	13.8	—	—	—
Gender						0.03
Male	256	42.6	10.2	1.00		
Female	345	57.4	16.5	1.75	1.07–2.87	
Race/ethnicity						0.73
Black, non-Hispanic	472	78.5	13.6	1.00		
Other	129	21.5	14.7	0.91	0.52–1.58	
Age						0.66
18–39	325	54.1	13.2	1.00		
40–50	276	45.9	14.5	1.11	0.70–1.77	
Sociodemographics (past year)						
Income <10k	396	65.9	16.2	1.89	1.10–3.25	0.02
< High school graduate	267	44.4	13.9	1.01	0.63–1.61	0.98
Arrested	158	26.3	15.8	1.25	0.75–2.08	0.39
Behavioral risks (past year)						
Unprotected sex with casual/exchange partners	332	55.2	19.0	2.92	1.71–4.96	<0.01
Unprotected sex with ≥3 partners	252	41.9	20.2	2.51	1.56–4.05	<0.01
Last sex partner incarcerated >3 months (ever)	165	27.5	23.6	2.76	1.71–4.44	<0.01
Noninjection crack use	163	27.1	22.1	2.36	1.46–3.80	<0.01
Noninjection drug use ≥1×/week	311	51.8	19.6	2.97	1.77–4.98	<0.01
Binge alcohol use ≥1×/week	208	34.6	18.3	1.73	1.08–2.76	0.02
STD diagnosis	150	25.0	19.3	1.76	1.07–2.89	0.02
Hepatitis C infected (ever)	28	4.7	21.4	1.76	0.69–4.47	0.23

OR, odds ratio; CI, confidence interval.

TABLE 3. FACTORS ASSOCIATED WITH UNDIAGNOSED HIV INFECTION AMONG NEW YORK CITY HIGH-RISK HETEROSEXUALS WITH NO INJECTION HISTORY, 2006–7, n = 601

Characteristic	HIV Infected (%)	Crude OR	95% CI	p	Adjusted OR	95% CI	p
Overall	7.0	—	—	—	—	—	—
Gender							
Male	6.6	1.00					
Female	7.3	1.10	0.58–2.08	0.77			
Race/ethnicity							
Black, non-Hispanic	7.8	2.11	0.81–5.48	0.12			
Other	3.9	1.00					
Age							
18–39	2.5	1.00			1.00		
40–50	12.3	5.57	2.53–12.24	<0.01	5.67	2.48–12.93	<0.01
Sociodemographics (past year)							
Income <10k	8.8	2.74	1.20–6.29	0.01			
< High school graduate	8.2	1.41	0.75–2.64	0.28			
Arrested	4.4	0.54	0.24–1.24	0.14			
Past year IDU partners							
No	4.6	1.00			1.00		
Unknown	11.7	2.78	1.38–5.61	<0.01	2.43	1.13–5.22	0.02
Yes	9.6	2.23	0.93–5.37	0.07	2.25	0.88–5.76	0.08
Other behavioral risks (past year)							
Unprotected sex with casual/exchange partners	7.2	1.09	0.58–2.05	0.80			
Unprotected sex with ≥3 partners	6.8	0.94	0.50–1.78	0.84			
Last sex partner incarcerated ≥3 months (ever)	9.1	1.51	0.78–2.93	0.21			
Noninjection crack use	9.8	1.72	0.90–3.31	0.10			
Noninjection drug use ≥1×/week	4.8	0.49	0.26–0.95	0.03			
Noninjection drug use ≥1×/week	4.8	0.49	0.26–0.95	0.03			
STD diagnosis	10.7	1.95	1.02–3.75	0.04			
Hepatitis C infected (ever)	21.4	4.07	1.56–10.66	<0.01			

OR, odds ratio; CI, confidence interval.

(AOR = 2.25; 95% CI = 0.88–5.76) as those with only non-IDU partners to be HIV-infected, with marginal significance ($p = 0.08$). Those with any partners of unknown IDU history had a similar increased odds of HIV infection (AOR = 2.43; 95% CI = 1.13–5.22). Participants over 40 were also more likely than those under 40 to be HIV-infected (AOR = 5.67; 95% CI = 2.48–12.93). There was no significant interaction between gender and IDU partnerships in the regression model tests. In the sensitivity analysis to examine under-reporting of participant injection history by removing all HCV-positive participants ($n = 28$), the main association was significant and the magnitude was similar.

Discussion

Several studies have suggested that network-level risks have a greater impact than individual-level risks on heterosexual HIV and STD transmission.^{13,14} One such risk, sex partnerships with IDU, is understudied and thus the focus of our analysis. We found that IDU sex partnerships were common and associated with HIV infection in our target population.

Prevalence of IDU sex partnerships

Even with recent declines in HIV incidence among IDU, largely because of the success of sterile syringe distribution,²⁹ many IDU continue to engage in risky sexual behavior.³⁰ We know that 8% of heterosexual HIV diagnoses in New York

City between 2001–2007 were attributed to sex with IDU,²³ but the overall prevalence of these partnerships and the risk they present to heterosexuals is unknown. Des Jarlais et al.²⁴ found that HIV prevalence among IDU and non-IDU drug users in shared social networks was similar, but did not examine sexual partnerships between these groups. Others have investigated IDU partnerships among current or former IDU or HIV-infected persons,^{31,32} but not heterosexuals without a history of injection.

In our sample of sexually active non-IDU heterosexuals with a residential or social connection to areas of New York City with historically high levels of heterosexual HIV and poverty, we found that 1 in 7 (14%) reported a recent IDU partner. Comparisons with past studies are difficult because of the novel study design, but these results are not surprising since the neighborhoods targeted for sampling substantially overlapped with the local IDU population centers.² Interestingly, the difference in the proportion reporting IDU partners in the past year versus an IDU for a last sex partner (14% versus 5%) means that most participants who had an IDU partner also had a non-IDU partner, which may increase HIV risk secondarily to heterosexuals with no IDU partners.

Factors associated with IDU sex partnerships

Past research found that sex partnerships between otherwise low-risk individuals and high-risk partners are associated with heterosexual HIV/STDs.^{17,32} In contrast, we observed an overlapping of individual-level and partner risk: IDU

partnerships were associated with risky unprotected sex and heavy noninjection drug and alcohol use. Crack use in particular has been identified as a risk for heterosexual HIV.³³ Although sexually high-risk IDU have been shown to use crack,³⁴ the larger forces of drug markets and the sex trade may also sexually connect high-risk heterosexuals and IDU.³⁵

IDU sex partnerships were also associated with network, structural, and biological HIV risk factors. Another significant network factor was having an incarcerated partner, previously found to be associated with increased STD rates,²⁰ partially because of the sex-ratio imbalances in highly-incarcerated communities.^{36,37} IDU partnerships were also more common among those in poverty, a structural risk factor for heterosexual HIV.³⁸ The higher likelihood of STDs among those with IDU partners may indicate non-HIV disease transmission from IDU partners, but could just reflect the high levels of unprotected sex among participants. Finally, IDU partnerships were more common among women, probably because most IDU are men.³⁹ We should note that none of these factors were independently associated with HIV in our study.

Factors associated with HIV infection

Two factors were independently associated with HIV infection: older age and IDU sex partner status. Compared to participants under 40 years old, those aged 40–50 were over 5 times as likely to be HIV-infected. National estimates have found that HIV incidence rates are highest among those aged 30–50 across all risk groups; heterosexual infections may occur at a slightly older age than MSM or IDU infections.³ It is surprising, however, that the 12.3% HIV prevalence observed among those aged 40–50 represents undiagnosed infection. One cause may be the infrequency of HIV testing in this risk group.¹²

Participants who had any recent IDU sex partners were over twice as likely to be HIV-infected as those with no IDU partners. Although this result was not significant at $p < 0.05$, the primary reason was the small sample size of HIV-infected participants with any IDU partners. This finding should also be interpreted with caution because there may be residual confounders like lifetime history of male-to-male sex.¹⁹ Further, many studies have found that HIV-infected persons generally reduce risk behaviors after diagnosis.⁴⁰ Specifically, HIV-infected IDU aware of their status have been shown to increase condom use.^{29,41} Yet others have recently observed that many HIV-infected IDU still continue to engage in sexual risks.⁴²

HIV infection was also more likely among those with partners of unknown IDU history. Nearly one quarter of participants fell into this category. Partner disclosure and participant recall of injection history may be lower for casual or less recent partners, as well as partners who are not current injectors.^{43,44} But the question remains why HIV prevalence between those with IDU partners and those with unknown partners was similar. One reason is that these unknown status partnerships may be a proxy for other risks, such as multiple casual partnerships, where discussion of IDU history is less likely. However, HIV infection was not significantly associated with other risk factors in our analysis, including unprotected sex with a casual or exchange partner, and we controlled for the overall number of sex partners in the regression model. Some of these unknown partnerships may

reflect IDU partnerships that are not disclosed to or recalled by the participant. Some evidence for this is: (1) the proportion of sexually active IDU socially networked (through the RDS method) to non-IDU in our overall sample (22%) was higher than the proportion of non-IDU reporting any IDU partners (14%); (2) 5% of non-IDU in our sample were HCV seropositive, which may signal sexual transmission from IDU partners with unknown injection history⁴⁵; (3) the two groups were statistically similar on all sociodemographic and risk variables except gender, partner incarceration, and non-IDU. In addition to unmeasured confounders, this may explain the high HIV prevalence among this unknown group.

Limitations

This study has the following limitations. First, this study is cross-sectional and cannot establish a causal relationship between IDU partnerships and HIV infection. As mentioned, there may be other unmeasured individual and network-level risk factors contributing to HIV infection. Second, participants may misreport their own IDU history or that of their sex partners, given the stigma of drug injection and the level of casual partnerships observed. This would distort the association of IDU sex partnerships and HIV infection. Finally, these data are neither representative of all New York City heterosexuals, nor of our specific target population of high-risk heterosexuals.

Conclusions

Sexual partnerships between IDU and non-IDU should be a continuing focus for HIV research,⁴⁶ especially in areas with large IDU populations. In this era of declining injection drug use, it will be important to know more about the behavioral risks and disease outcomes among sexually-active IDU and their non-IDU partners. More generally, network-level factors, such as sex with bisexual male partners, deserve more research attention as heterosexual HIV risk factors.

With the expansion of the heterosexual HIV epidemic, and given the unexpectedly high HIV prevalence and lack of HIV testing observed in our sample,¹² it will be increasingly important to target IDU for sexual risk reduction.⁴⁷ But since many heroin users have transitioned from injection to non-injection use, targeting IDU only for interventions will fail to reach both former IDU and the sex partners of current and former IDU.²¹ A broader approach supported by our findings would be to target prevention efforts to heterosexuals in geographic areas with historically high rates of heterosexual and IDU-related HIV infection. Several behavioral interventions have been successful at reducing the sexual risk behaviors of drug users and their sexual partners.^{41,48} The expansion and adaptation of these interventions to focus on disclosing injection history, as well as encouraging condom use and HIV/STD testing and treatment among those in IDU partnerships, may work toward preventing heterosexual HIV transmission.

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Address correspondence to:

Samuel M. Jenness, M.P.H.

HIV Epidemiology Program

New York City Department of Health and Mental Hygiene

346 Broadway, Suite 707D

New York, NY 10013

E-mail: sjenness@health.nyc.gov

