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Gender, transience, network partnerships and risky sexual practices among young persons who inject drugs

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Abstract

Persons who inject drugs (PWID) may be at risk of acquiring HIV and sexually transmitted infections (STIs) from risky sexual practices and elevated disease prevalence within their drug injection and sexual networks. We conducted a personal (egocentric) network study of young PWID (aged 18-30) from the Chicago metropolitan area. Logistic regression with generalized estimating equations evaluated associations between individual and network factors and sexual behaviors. Of 162 participants, 116 (71.6%) were non-Hispanic White and 135 reported on 314 sexual network members. Multiplexity - having network members with overlapping roles as injection and sexual partners - was associated with more condomless vaginal sex (aOR 5.55; 95% CI 1.62-19.0) and anal sex (aOR 6.79; 95% CI 2.49-18.5) and less exchange sex among women (aOR 0.12; 95% CI 0.03-0.40), adjusting for sociodemographic and sexual network characteristics. The contribution of individual and sexual network factors to HIV/STI transmission among young PWID warrants further research.

Keywords

Persons who inject drugs; Youth; Sexual Networks; Multiplexity; Sexual risk behavior

Introduction

Although incidence of HIV among persons who inject drugs (PWID) has fallen by 80% since the early 1980s, mostly due to reductions in syringe sharing associated with syringe exchange programs (SEP) and availability of sterile syringes at pharmacies (1), risky sexual behaviors may still increase risk of sexually transmitted infections (STIs), including sexually transmitted HIV, and hepatitis C virus (HCV) among PWID (2).

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Prevention efforts among PWID have historically focused on reducing risky injection practices such as sharing of syringes and other injection equipment due to the higher risk of HIV and HCV infection associated with parenteral compared to sexual exposure (3). However, sexual transmission of HIV among PWID may be underestimated, since HIV surveillance attributes HIV infections to injection drug use among persons reporting both injection and high risk heterosexual behaviors (3). Sexual risk factors have been found to be important factors in HIV transmission among female and male PWID (4). Data from several studies conducted in New York City and Baltimore have found similar prevalence of HIV among PWID and non-injection drug users who had never injected, suggesting an increasing role for sexual transmission of HIV in this population (4, 5).

Female PWID may be particularly vulnerable to acquisition of HIV and other STIs due to higher rates of exchanging sex for drugs or money (6, 7) and vulnerability to physical and sexual violence (7-10). Women who inject drugs are more likely to have male partners who also inject drugs, increasing their risk of sexual HIV acquisition due to overlapping sexual and injection networks (10-13); additionally, male partners often control injection equipment (12). Among females, engaging in high risk injection practices has been associated with having an injection partner who was also a sex partner (14), and injecting with partners is associated with HIV risk among female sex workers (FSWs) (15). Women are more likely than men to initiate injection with an intimate partner and to have assistance with drug injection from their partner (16). Finally, dependence on partners for drugs, housing, or financial stability may also increase women's vulnerability and decrease their ability to negotiate safer sex (9, 12).

Despite downward trends in injection drug use overall in the U.S. in recent years, worrisome increases have been observed among young people (17, 18), who are more likely to be non-Hispanic whites residing in non-urban areas (19). Moreover, high levels of risky injection and sexual behaviors (20, 21) and STIs (22) continue to be reported in this group; PWID report more sexual partners than their non-drug using counterparts due to greater likelihood of trading sex for money or drugs, and are less likely to use condoms consistently (3). However, recent data from the National Longitudinal Study of Adolescent Health suggested that elevated risk of STI among young PWID was more likely attributable to higher probability of having sex with a partner who was infected with an STI, rather than being explained by differences in sexual risk behaviors, thus implicating aspects of the sexual network in predicting risk of infection among PWID (3).

Characteristics such as network size and density (i.e., connectedness among members) and multiplexity (i.e., overlapping membership in multiple networks), have been associated with risky injection practices among PWID in several studies (23-27). More recently, social network characteristics have been shown to impact sexual risk behaviors among urban African-American women (28, 29) and men who have sex with men (30). While studies have documented risky sexual behavior among young PWID (14, 20), few have characterized the sexual networks of young PWID or examined the impact of network factors on sexual risk in this population.

Geographic mobility may also impact sexual risk and HIV/STI and HCV transmission among young PWID by fostering use of high risk strategies to acquire resources, such as injecting in public spaces, syringe sharing, and exchanging sex for drugs or money (31) or by altering the size and composition of social networks. Studies have consistently linked residential instability (i.e., having multiple residences over a short period) with high risk behaviors, including syringe sharing and sex exchange (27, 31-33), and HIV infection (34, 35). However, the impact of geographic mobility on sexual risk behaviors and networks of young PWID has not been well studied.

We analyzed data from a personal network study of young PWID to describe their sexual network characteristics and to examine whether characteristics of injection and sexual networks were associated with sexual risk behaviors, and whether sexual behaviors varied according to multiplexity, or overlap between injection and sexual networks (here on referred to as “multiplexity”).

Methods

Subjects and Recruitment

We analyzed data from a cross-sectional personal (egocentric) network study of young PWID and their injection, support, and sexual networks. Detailed description of sample recruitment, study design, and data collection methods has been previously published (27). Briefly, participants were recruited using flyers posted at four standalone field sites in Chicago, Illinois, U.S., located near major heroin and cocaine markets that attract both urban and suburban drug users as well as at venues that provide services to PWID in these areas. All individuals responding to posted flyers were directed to on-site research staff (not SEP service providers) for eligibility screening during regular hours of operation between September 2012 and June 2013. Most participants were registered members of a large Chicago SEP that operated out of the four field stations and a mobile unit. To be eligible for the study, individuals had to be between the ages of 18 and 30 and have injected drugs at least once in the past 30 days. Information on injection, social support, and sexual networks was collected via face-to-face interviews by trained research staff. Participants provided written informed consent and the study was approved by the Institutional Review Board of the University of Illinois at Chicago. The analytic sample consisted of 162 PWID with information on gender and sexual networks; of these, 135 had any sexual network and reported on 314 sexual network members for analysis. Having any same gender sex partners in the past 6 months was reported by 6% of males and 14% of females. Same gender partnerships were excluded from multivariable analysis (n=16 female and n=7 male same gender partners) because of different epidemiologic profiles and biological implications for HIV/STI transmission with same gender sex partners, and because there were too few same gender partnerships to explore interactions or conduct stratified analyses. The final analytic sample size for multivariable analysis was 291 opposite gender partnerships among 135 individuals. The analysis of exchange sex was restricted to women because too few men reported exchange sex to conduct subgroup analyses.

Measures

Variables were selected for inclusion in the analysis based on conceptual importance and prior literature. Gender and participant and network member age and race/ethnicity were included in all multivariable models. Sexual and injection network members were defined as individuals with whom the participant had sex or injected with more than once in the past 6 months. Multiplexity was defined as membership in both sexual and injection networks in the past 6 months. STI was defined as any self-reported diagnosis of gonorrhea, chlamydia, syphilis, or trichomoniasis in the past 6 months. Other variables included location (suburban only, urban only (Chicago), or both) and total number of residences in the past year. Transience was defined as having more than one place of residence in the past year, and cross-over transience was defined as transience that included residences in both Chicago and suburban locations in the past year. Participants also reported homelessness in the past 6 months, defined as living on the street or in a shelter at any time during the past 6 months. Network member characteristics, as reported by the ego, included age, race/ethnicity, meeting a partner in Chicago vs. elsewhere, living in the same household with the sexual partner, trust in the sexual partner, and partners' HIV and HCV status. Trust in each sexual network member was rated on a scale from 1 ("don't trust at all") to 10 ("trust with my life") based on a single question, created for this study: "On a scale from 1 to 10, how much do you trust this person [sexual partner]?", and was analyzed as a continuous variable. Partner HCV status was analyzed as positive vs. negative/unknown and HIV status was analyzed as unknown vs. known negative since no participants reported known HIV positive partners. Overall frequency of sexual activity, total sex partners, and condom use with regular/steady and casual partners in the past 6 months was collected from all participants. Additionally, partner-specific information on vaginal and anal sex, condom use, and exchange sex was collected for all sexual network members. Outcomes for multivariable analysis were based on partner-specific behaviors with sexual network members and included (1) condomless vaginal sex, defined as not always using condoms for vaginal sex, (2) anal sex (with opposite sex partners), and (3) exchange sex, defined as having sex in exchange for drugs or money. All outcomes were binary (yes/no) and were analyzed in separate models to compare and contrast predictors of each sexual behavior.

Statistical analysis

We compared sociodemographic characteristics, injection practices, and sexual behaviors by gender using Pearson chi-square tests for categorical variables and Wilcoxon rank-sum tests for non-normally distributed continuous variables. Multivariable logistic regression was conducted to examine factors associated with sexual behaviors with sexual network members using generalized estimating equations (GEE), with clustering on the participant (ego) to account for correlation among repeated observations, since participants could report on behaviors with multiple sexual network members. Because the odds ratio is known to over-estimate the relative risk when the outcome is common (>5%), we explored use of log-binomial link functions to generate prevalence ratios due to the relatively common occurrence of our outcomes. However, this strategy resulted in model convergence problems, which is possible with log-binomial regression with modest sample sizes, so logistic regression was used. While the relative associations and tests of statistical significance are valid, the magnitude of the effect estimates may be inflated, so effect size magnitudes should

be interpreted with caution. Variable selection for the multivariable models proceeded in an iterative process in which all variables with $p < 0.2$ in univariable analysis and those that were considered conceptually important based on prior literature were initially entered into the models. To maintain model parsimony given the modest sample size, models were then refined by removing variables with $p > 0.05$ using a stepwise process to arrive at the final models. Only variables with $p < 0.05$ were ultimately retained in the final multivariable models, with the exception of ego and alter age and race/ethnicity, which were maintained in all models regardless of statistical significance for consistency with other literature and to control for residual confounding. Analyses were conducted using STATA/SE version 14 for Windows (STATA Corp, College Station, TX).

Results

Sociodemographic and behavioral characteristics of participants by gender are shown in Table 1. Median age, race/ethnicity, marital status, homelessness, location of residence (e.g., Chicago, suburban), and level of transience was similar among males and females (Table 1). Men were significantly more likely than women (54% vs. 29%, $\chi^2 = 9.40$, d.f.=1, $p < 0.01$) to be employed with a regular job at the time of the survey.

Injection and sexual behaviors

Women were significantly ($p < 0.05$) more likely than men to inject most often with a sex partner, have an STI, have more sex partners, have higher frequency of sex, exchange sex for money or drugs, and report injection drug use by any sexual partners in the past 6 months. Overall condom use frequency was similar among men and women and was less common with regular partners than with casual partners (Table 1).

Sexual network characteristics and behaviors

The median sexual network size for males and females was 1 (range 1-12) (Table 2). Overall, 34% of the sample reported 2 sexual network members (30% of males and 43% of females; $\chi^2 = 2.89$, d.f.=2, $p = 0.236$) in the past 6 months. Women were significantly more likely than men to report multiplexity (57% vs. 30%; $\chi^2 = 11.1$, d.f.=1, $p = 0.001$). Across all sexual network partners, males were significantly ($p < 0.001$) more likely than females to report condomless vaginal sex (72% vs. 35%), while females were significantly ($p < 0.01$) more likely to report exchange sex (66% vs. 4%) and having sexual partners of unknown HIV status (34% vs. 9%). Men (19%) and women (14%) reported similar ($p > 0.05$) frequency of anal sex (Table 2).

Condomless vaginal sex

Table 3 summarizes individual and sexual network factors associated with condomless vaginal sex with network members. In univariable analysis, male gender, multiplexity, greater trust in sexual partners, and living in the same household were positively associated with condomless vaginal sex, while larger sexual network size and having a partner of unknown HIV status were inversely associated with condomless vaginal sex ($p < 0.01$ for all). With the exception of network size, all of these associations remained statistically significant

in multivariable analysis adjusting for age and race/ethnicity of participants and their network members (Table 3).

Anal sex

Table 4 shows individual and sexual network factors associated with reporting anal sex with network members. In both univariable and multivariable analysis, younger age, Hispanic race/ethnicity, cross-over transience, having an STI in the past 6 months, multiplexity, greater trust in sexual partners, and having an HCV positive sex partner were significantly ($p<0.05$ for all) associated with anal sex (Table 4).

Exchange sex among female PWID

Table 5 delineates individual and sexual network factors associated with exchange sex among female participants. In univariable analysis, women with larger sexual networks, older partners, and those who met sexual partners in an urban area (Chicago) were significantly ($p<0.05$) more likely to engage in exchange sex, while multiplexity was significantly protective ($p<0.001$) and greater trust in sexual partner was marginally ($p=0.07$) protective. In multivariable analysis, all of these associations remained statistically significant except for network size; higher trust also attained statistical significance in the multivariable model (Table 5).

Discussion

Our study reports on sociodemographic, behavioral and network factors associated with risky sexual behaviors among the emerging population of predominantly non-Hispanic white, non-urban young PWID. Although HIV prevalence in our study was low ($<1\%$), prevalence of self-reported recent STI was 7% overall and over three times higher among women than men. STIs increase the risk of HIV acquisition due to increased biological vulnerability and shared behavioral risks (36); thus, identifying and treating STIs have important public health implications for reducing rapid spread of infections within high-risk networks such as those of young PWID.

Our findings suggest that risky sexual practices (e.g., condomless vaginal sex, heterosexual anal sex and exchange sex) are prevalent among young PWID, potentially placing them at risk for sexual transmission of STIs and HIV. Although sexual behavior outcomes were somewhat related, distinct risk factors for each outcome emerged. Multiplexity was associated with increased likelihood of condomless vaginal sex (Table 3) and anal sex (Table 4), but negatively associated with exchange sex (Table 5). Greater trust in sexual partners was positively associated with condomless vaginal sex in multivariable analysis and anal sex in univariable analysis; however, it was negatively associated with exchange sex in multivariable analysis, supporting the need for further research on the role of intimate relationships in HIV and STI transmission among young PWID in general and women in particular. Other characteristics and behaviors were inconsistently related to risky sex outcomes. For example, sex with a partner of unknown HIV status was inversely associated with condomless vaginal sex in multivariable analysis, but was not significantly associated with anal sex or exchange sex among women. Understanding the perceived risk and

implications for HIV/STI transmission associated with different sexual practices may be important for intervention development. Recent STI history was associated with anal sex but not with condomless vaginal sex or exchange sex in multivariable analyses. Understanding the mechanisms by which specific individual sexual behaviors, relationship dynamics, and network characteristics interact to influence HIV/STI transmission among young PWID warrants further research. Our study did not collect event-level data on specific sexual encounters, but these types of data are important for a more nuanced understanding of the contribution of individual and contextual characteristics to risk behaviors within various relational contexts. Recent work by Janulis found significant within-person variation in injection risk behavior across injection episodes, suggesting the importance of partner and contextual factors in predicting injection risk, although this variation was incompletely explained by differences in partner characteristics and situational factors measured in that study (37). More detailed characterization of the types and quality of relationships with different partners, as well as event-specific injection contexts, may help to clarify relationship and contextual influences on event-level and global individual risk behaviors.

Exchange sex was common among women in our study and may reflect increased vulnerability to acquisition of HIV and other STIs through both risky sexual behavior and network factors. Women who engage in exchange sex are at elevated risk of sexual and physical violence and often have limited ability to negotiate condom use, particularly when they are under the influence of substances or undergoing withdrawal (6, 12, 38). Studies conducted in the U.S. and international settings have consistently found strong associations between injection drug use and exchange sex among women, which has been linked to persistent gender disparities in HIV infection among women globally (6, 11). In our study, women were less likely to engage in exchange sex with a partner who belonged to both their injection and sexual network (multiplexity) compared to partners belonging only to the sexual network (Table 5), suggesting that exchange sex networks may be distinct from other sexual networks. This could also reflect the conservative definition of sexual network partnership, i.e., someone with whom participant had sex at least twice in the past 6 months. As such, a single episode of exchange sex was not captured by our survey. However, while women may not label ongoing sexual relationships with injection partners as “exchange sex”, it is still possible that they may experience sexual coercion from these partners or provide sex for drugs.

Consistent with prior research (39, 40), condom use was generally more frequent with casual partners compared with regular/steady partners; nonetheless, 14% of women and 9% of men reported inconsistent condom use with casual partners in the past 6 months (Table 1). Because we did not collect data on single exchange sex episodes (i.e., among those who did not meet definition as sexual partners), we are not able to compare these individuals with sexual partners in our study. However, approximately 60% of men and women reported generally using condoms inconsistently with their regular/steady partners, and few reported always using condoms with all partners. If condomless sex occurs with regular/steady partners who are members of high-risk networks, the potential for disease transmission may be increased, particularly if condom use is also inconsistent with casual or exchange sex partners. Research focused on PWID and other non-injecting populations suggests that expectations of non-condom use to signify intimacy, express love, trust, and commitment

may take precedence over concerns about disease transmission (6, 8, 12, 13, 41, 42). As such, sexual partners who also inject together may face compounding risks.

Residential transience was reported by more than half of participants in our study (Table 1). Having multiple residences in the past year itself was not a significant predictor of risky sexual behaviors. However, transience between areas of high (Chicago) and low (surrounding suburbs of Chicago) HIV prevalence (i.e., cross-over transience) was positively associated with anal sex (Table 4), though not with condomless vaginal sex (Table 3) or exchange sex (Table 5) in multivariable analyses. Prior studies of street youth have found high rates of sexual risk, particularly in the context of survival sex (43). The lack of association between transience and exchange sex among women in our study may have been due to limited power due to the small sample size, or to different underlying characteristics of the populations studied. Future studies should consider examining the effects of geographic mobility on specific sexual practices within the contexts of varying partnership types or relationship dynamics. Given that sexual behaviors may be context- or partner-specific, interventions are needed to address individual-level risk within the context of dyadic, social, and structural drivers of HIV, HCV, and STIs among PWID, including those who engage in sex work (6). Furthermore, homelessness and transience may both result from drug abuse and compound vulnerability to HIV, HCV, and STIs by increasing likelihood of engaging in survival sex and limiting healthcare access due to financial instability and limited employment opportunities (44). Further research on the effects of transience on health outcomes in this population is warranted.

Limitations

Small sample size limited our power for subgroup analyses and testing of interactions, which resulted in wide confidence intervals for some estimates. Furthermore, the cross-sectional nature of the study did not allow us to examine temporal associations. The study was limited to a single geographic region and the majority of participants were recruited from a large SEP, which limits the generalizability of the findings to other populations of PWID. Measures of sexual behaviors, condom use, and relationship types were only available for core network members and not those with whom the participant had sex with less than twice in the past 6 months. The prevalence of HIV in our sample was too low to examine as an outcome and STI was measured by self-report. Data were collected via face-to-face interview and sexual and drug use behaviors may have been underreported due to social desirability bias. Finally, our measure of trust was based on a single item created for this study, which limits our understanding of the reliability and validity of this construct.

Conclusions

Our study is one of first to simultaneously examine the role of individual (e.g., gender), geographic mobility (i.e., transience), and network characteristics (e.g., size, multiplexity, partner trust) on sexual risk behaviors among the emerging generation of young PWID. Our findings support a need for further research on the impact of injection and sexual network characteristics, particularly multiplexity, on sexual transmission of HIV and other STIs among PWID using biological outcomes and prospective study designs. In addition, the role

of social and intimate partner dynamics on sexual behaviors and disease transmission within and between high-risk networks warrants further study. Finally, given that high prevalence of sexual risk behavior among young PWID in our study could represent significant potential for sexual transmission of HIV and other STIs among this population, prevention programs for young PWID should incorporate information on sexual risk reduction and emphasize the importance of routine screening for HIV and STIs.

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Socio-demographic, sexual, and injection behavior of young persons who inject drugs by gender, N=162^a

Table 1

	Male, n (%) (N=106)	Female, n (%) (N=56)	Pearson Chi-Square	d.f.	p-value
<i>Sociodemographic characteristics</i>					
Age					
18-24	30 (28.3)	23 (41.1)	2.71	1	0.099
25-30	76 (71.7)	33 (58.9)			
Median (IQR)	27 (24-29)	26 (23-28)			0.156
Race/Ethnicity					
NH White	77 (72.6)	39 (69.6)	0.18	2	0.912
Hispanic	16 (15.1)	9 (16.1)			
NH Black/Other race	13 (12.3)	8 (14.3)			
Marital status					
Single	89 (84.0)	42 (75.0)	5.01	2	0.082
Married	10 (9.4)	4 (7.1)			
Divorced/separated	7 (6.6)	10 (17.9)			
Employed with regular job	57 (53.8)	16 (28.6)	9.40	1	0.002
Homeless in past 6 months	56 (53.3)	27 (49.1)	0.26	1	0.610
Residence in past year					
Chicago only	40 (38.1)	18 (32.1)	0.69	2	0.707
Suburban only	37 (35.2)	23 (41.1)			
Both (cross-over transience)	28 (26.7)	15 (26.8)			
Multiple places of residence in past year (transient)	62 (58.5)	34 (60.7)	0.08	1	0.784
<i>Sexual and injection behaviors in past 6 months</i>					
Inject most often with					
Sex partner	25 (23.6)	26 (46.4)	8.96	2	0.011
Friend/acquaintance/family member/other	67 (63.2)	24 (42.9)			
No one	14 (13.2)	6 (10.7)			
Reported STI^b in past 6 months	4 (3.8)	8 (14.3)	5.90	1	0.015

	Male, n (%) (N=106)	Female, n (%) (N=56)	Pearson Chi-Square	d.f.	p-value
Any sex partners	88 (83.0)	52 (92.9)	3.02	1	0.082
Total sex partners, Median (IQR)	1 (1-3)	2 (1-9.5)	2.85 ^c	1	0.004 ^d
Any same gender sex partners	6 (5.7)	8 (14.3)	3.45	1	0.063
Frequency of sex					
Once a week or less	59 (55.7)	21 (38.2)	4.43	1	0.035
More than once a week	47 (44.3)	34 (61.8)			
Frequency of condom use					
Inconsistent with casual partners	10 (9.4)	8 (14.3)	3.72	3	0.293
Inconsistent with regular/steady partners only	63 (59.4)	34 (60.7)			
Always use condoms with all partners	15 (14.2)	10 (17.9)			
No sex	18 (17.0)	4 (7.1)			
Exchanged sex for money or drugs	7 (6.6)	24 (42.9)	31.1	1	<0.001
Past 6 month sex partner ever injected drugs	41 (38.7)	37 (69.8)	13.7	1	<0.001

^aExcludes 1 transgender individual and 1 with missing gender

^bSTI includes any report of gonorrhea, chlamydia, syphilis, or trichomoniasis

^cZ-score

^dp-value by Wilcoxon rank-sum test

Column totals may not sum to 162 due to missing data.

Abbreviations: D.F., degrees of freedom; IQR, interquartile range; STI, sexually transmitted infection

Table 2
Sexual network characteristics of young persons who inject drugs by gender

<i>Sexual network characteristics</i>	Male, n (%) (N=106)	Female, n (%) (N=56)	p-value
Sexual network size			
>1	32 (30.2)	24 (42.9)	0.236 ^a
1	54 (50.9)	25 (44.6)	
0	20 (18.9)	7 (12.5)	
Median (IQR)	1 (1-2)	1 (1-5)	0.013 ^b
Any multiplexity with injection network	32 (30.2)	32 (57.1)	0.001 ^c
<i>Partner-specific characteristics^d</i>			
Trust in sexual partner, Mean (SD)^e	6.49 (3.40)	5.63 (3.17)	0.388
Condomless vaginal sex	101 (71.6)	53 (35.3)	<0.001
Anal sex	27 (19.2)	21 (14.1)	0.229
Exchange sex	6 (4.3)	99 (66.0)	<0.001
HCV positive	3 (2.1)	8 (5.3)	0.181
HIV unknown status	13 (9.2)	51 (34.0)	0.003
Met in Chicago	53 (39.0)	86 (59.7)	0.271
Live in same household	25 (18.3)	28 (20.3)	0.214

^aP-value by Pearson chi-square test, $\chi^2=2.89$, d.f.=2

^bP-value by Wilcoxon rank-sum test, $z=2.50$, d.f.=1

^cP-value by Pearson chi-square test, $\chi^2=11.1$, d.f.=1

^d135/162 individuals provided information on 291 opposite-gender sexual network members (males=141, females=150). P-values were generated from GEE logistic or linear regression models with the outcome regressed on gender.

^eBased on a scale ranging from 1 ("don't trust at all") to 10 ("trust with my life").

Abbreviations: IQR, interquartile range; SD, standard deviation

Table 3
Individual and sexual network factors associated with condomless vaginal sex with network members^a

	Univariable OR (95% CI) (N=129; obs=291)	p-value	Multivariable OR ^b (95% CI) (N=127; obs=270)	p-value
<i>Respondent characteristics</i>				
Male gender	3.34 (1.71-6.52)	<0.001	4.17 (1.66-10.4)	0.002
Age 25-30 vs. 18-24	0.77 (0.38-1.57)	0.477	0.47 (0.21-1.05)	0.067
Race/ethnicity				
White NH	1.00 (Ref)		1.00	
Hispanic	0.80 (0.37-1.74)	0.574	1.25 (0.43-3.64)	0.686
Black NH/Other	1.11 (0.36-3.43)	0.855	2.42 (0.59-9.85)	0.217
Marital status				
Single	1.00 (Ref)		--	--
Married	2.70 (0.56-12.9)	0.213	--	--
Divorced/separated	0.85 (0.28-2.59)	0.769	--	--
HCV status				
Negative	1.00 (Ref)		--	--
Positive	0.82 (0.25-2.71)	0.747	--	--
Unknown	0.99 (0.47-2.08)	0.981	--	--
Homeless in past 6 months	0.56 (0.29-1.10)	0.091	--	--
Residence in past year				
Chicago only	1.00 (Ref)		--	--
Suburban only	1.20 (0.53-2.70)	0.667	--	--
Both (cross-over transience)	0.79 (0.33-1.84)	0.569	--	--
Any STI in past 6 months	0.64 (0.23-1.78)	0.389	--	--
Used any crack/cocaine, meth, or amphetamines in past 6 months	0.65 (0.32-1.32)	0.234	--	--
Sexual network size 2 vs. 1	0.11 (0.05-0.25)	<0.001	--	--
<i>Sexual network member characteristics</i>				
Multiplexity with injection network	9.09 (2.59-32.0)	0.001	5.55 (1.62-19.0)	0.006
Trust in sex partner^c	1.22 (1.08-1.37)	0.001	1.15 (1.01-1.31)	0.031
Partner age in years^d	0.97 (0.94-1.01)	0.116	0.97 (0.92-1.02)	0.199
Partner race				
White NH	1.00 (Ref)		1.00 (Ref)	
Black NH	0.82 (0.35-1.91)	0.643	0.47 (0.18-1.24)	0.129
Hispanic	1.03 (0.49-2.18)	0.940	0.88 (0.39-1.98)	0.758
Other	0.53 (0.15-1.84)	0.314	1.14 (0.17-7.61)	0.891
Met partner in Chicago	0.49 (0.16-1.44)	0.195	--	--
Partner HIV unknown status	0.10 (0.02-0.41)	0.001	0.30 (0.10-0.88)	0.029

	Univariable OR (95% CI) (N=129; obs=291)	p-value	Multivariable OR ^b (95% CI) (N=127; obs=270)	p-value
Partner HCV positive	1.89 (0.08-46.1)	0.696	--	--
Live in same household	18.3 (2.83-119.1)	0.002	9.41 (2.21-40.0)	0.002

^aGEE models excluded same-gender sex partners (16 female partners were reported by 7 female egos and 7 male partners were reported by 5 male egos).

^bOdds ratios are adjusted for all variables for which estimates are presented.

^cBased on a scale ranging from 1 ("don't trust at all") to 10 ("trust with my life").Odds ratio represents the association with the outcome per one unit increase in trust.

^dOdds ratio represents the association with outcome per one year increase in partner age.

Abbreviations: GEE, generalized estimating equations; OR, odds ratio; CI, confidence interval; STI, sexually transmitted infection; NH, non-Hispanic

Table 4
Individual and sexual network factors associated with having anal sex with network members^a

	Univariable OR (95% CI) (N=129, obs=290)	p-value	Multivariable OR ^b (95% CI) (N=127, obs=280)	p-value
<i>Respondent characteristics</i>				
Male gender	1.68 (0.72-3.89)	0.229	12.2 (4.20-35.5)	<0.001
Age 25-30 vs. 18-24	0.39 (0.18-0.83)	0.015	0.25 (0.10-0.63)	0.003
Race/ethnicity				
White NH	1.00 (Ref)		1.00 (Ref)	
Hispanic	3.11 (1.33-7.27)	0.009	3.90 (1.50-10.2)	0.005
Black NH/Other	1.29 (0.41-4.03)	0.658	1.15 (0.37-3.57)	0.808
Marital status				
Single	1.00 (Ref)		--	--
Married	1.09 (0.22-5.39)	0.916	--	--
Divorced/separated	0.94 (0.28-3.16)	0.919	--	--
HCV status				
Negative	1.00 (Ref)		--	--
Positive	0.35 (0.04-2.94)	0.335	--	--
Unknown	0.95 (0.42-2.16)	0.901	--	--
Homeless in past 6 months	0.69 (0.32-1.49)	0.346	--	--
Residence in past year				
Chicago only	1.00 (Ref)		1.00 (Ref)	
Suburban only	2.78 (0.87-8.81)	0.083	3.44 (1.20-9.85)	0.022
Both (cross-over transience)	3.79 (1.20-11.9)	0.023	3.44 (1.16-10.2)	0.026
Any STI in past 6 months	3.34 (1.21-9.24)	0.020	9.48 (2.88-31.2)	<0.001
Used any crack/cocaine, meth, or amphetamines in past 6 months	1.51 (0.64-3.58)	0.349	--	--
<i>Sexual network characteristics</i>				
Sexual network size 2 vs. 1	1.18 (0.53-2.64)	0.685	--	--
Multiplexity with injection network	2.86 (1.23-6.65)	0.015	6.79 (2.49-18.5)	<0.001
Trust in sex partner^c	1.18 (1.03-1.35)	0.018	--	--
Partner age in years^d	0.98 (0.94-1.03)	0.476	1.04 (0.99-1.08)	0.089
Partner race				
White NH	1.00 (Ref)		1.00 (Ref)	
Black NH	0.89 (0.37-2.19)	0.807	1.60 (0.36-7.17)	0.537
Hispanic	1.80 (0.92-3.52)	0.086	3.49 (1.39-8.73)	0.008
Other	2.82 (0.92-8.69)	0.071	6.11 (1.68-22.2)	0.006
Met partner in Chicago	0.58 (0.26-1.32)	0.197	--	--
Partner HIV unknown status	NA ^e		--	--

	Univariable OR (95% CI) (N=129, obs=290)	p-value	Multivariable OR ^b (95% CI) (N=127, obs=280)	p-value
Partner HCV positive	3.73 (1.20-11.7)	0.023	6.42 (1.36-30.4)	0.019
Live in same household	1.74 (0.84-3.60)	0.135	--	--

^a GEE models excluded same-gender sex partners (16 female partners were reported by 7 female egos and 7 male partners were reported by 5 male egos).

^b Odds ratios are adjusted for all variables for which estimates are presented.

^c Based on a scale ranging from 1 ("don't trust at all") to 10 ("trust with my life"). Odds ratio represents the association with the outcome per one unit increase in trust.

^d Odds ratio represents the association with outcome per one year increase in partner age.

^e Model did not converge

Abbreviations: GEE, generalized estimating equations; OR, odds ratio; CI, confidence interval; STI, sexually transmitted infection; NH, non-Hispanic

Table 5
Individual and sexual network factors associated with exchange sex among females^a

	Univariable OR (95% CI) (N=47; obs=150)	p-value	Multivariable OR ^b (95% CI) (N=47; obs=146)	p-value
<i>Respondent characteristics</i>				
Age 25-30 vs. 18-24	0.59 (0.19-1.79)	0.350	0.57 (0.16-2.05)	0.393
Race/ethnicity				
White NH	1.00 (Ref)		1.00 (Ref)	
Hispanic	1.91 (0.47-7.68)	0.365	1.49 (0.23-9.80)	0.681
Black NH/Other	3.06 (0.51-18.3)	0.220	4.65 (0.79-27.3)	0.088
Marital status				
Single	1.00 (Ref)		--	--
Married	0.83 (0.07-10.2)	0.887	--	--
Divorced/separated	0.78 (0.18-3.41)	0.741	--	--
HCV status				
Negative	1.00 (Ref)		--	--
Positive	0.32 (0.07-1.39)	0.127	--	--
Unknown	0.68 (0.16-2.83)	0.593	--	--
Homeless in past 6 months	1.63 (0.53-4.99)	0.395	--	--
Residence in past year				
Chicago only	1.00 (Ref)		--	--
Suburban only	0.70 (0.17-2.95)	0.628	--	--
Both (cross-over transience)	1.43 (0.36-5.73)	0.612	--	--
Any STI in past 6 months	2.19 (0.61-7.84)	0.228	--	--
Used any crack/cocaine, meth, or amphetamines in past 6 months	0.90 (0.28-2.89)	0.853	--	--
<i>Sexual network characteristics</i>				
Sexual network size 2 vs. 1	20.4 (4.10-101.6)	<0.001	--	--
Multiplexity with injection network	0.07 (0.02-0.25)	<0.001	0.12 (0.03-0.40)	0.001
Trust in sex partner^c	0.91 (0.82-1.01)	0.070	0.70 (0.61-0.79)	<0.001
Partner age in years^d	1.04 (1.01-1.08)	0.009	1.15 (1.07-1.23)	<0.001
Partner race				
White NH	1.00 (Ref)		1.00 (Ref)	
Black NH	0.84 (0.27-2.63)	0.764	0.72 (0.20-2.59)	0.617
Hispanic	1.40 (0.67-2.92)	0.372	1.88 (0.64-5.54)	0.251
Other	1.08 (0.54-2.15)	0.825	1.59 (0.34-7.53)	0.557
Met partner in Chicago	2.79 (1.20-6.50)	0.018	--	--
Partner HIV unknown status	1.52 (0.52-4.40)	0.441	--	--
Partner HCV positive	0.39 (0.02-7.53)	0.530	--	--
Live in same household	0.37 (0.12-1.19)	0.096	--	--

^a GEE models excluded same-gender sex partners (16 female partners were reported by 7 female egos and 7 male partners were reported by 5 male egos).

^b Odds ratios are adjusted for all variables for which estimates are presented.

^c Based on a scale ranging from 1 (“don’t trust at all”) to 10 (“trust with my life”). Odds ratio represents the association with the outcome per one unit increase in trust.

^d Odds ratio represents the association with outcome per one year increase in partner age.

Abbreviations: GEE, generalized estimating equations; OR, odds ratio; CI, confidence interval; STI, sexually transmitted infection; NH, non-Hispanic