EPIDEMIOLOGY

Herpes simplex virus 2 and syphilis among young drug users in Baltimore, Maryland

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Objectives: To examine the sex specific seroprevalence and correlates of herpes simplex virus 2 (HSV-2) and syphilis among a cohort of young drug users.

Methods: Drug users aged 15–30 years old who used heroin, cocaine, or crack were recruited between October 1999 and August 2002. Baseline interviews gathered information on sociodemographics, drug use and sexual behaviours. Serum was tested at baseline for HSV-2 and syphilis seroreactivity. For each sexually transmitted infection (STI), infected and non-infected participants were stratified by sex and compared using χ^2, Mann-Whitney tests, and logistic regression.

Results: Of the 543 participants recruited, 42.4% were female and 39.3% were African-American. The seroprevalence of STIs among females and males, respectively, were HSV-2: 58.7% and 22.0%; syphilis: 4.3% and 0.3%. In multivariate models, older age, African-American race, having over 30 lifetime sex partners, current HIV infection and previous incarceration were independently associated with HSV-2 infection among males. For females, older age, African-American race, sex trade, and daily heroin use were independently associated with HSV-2. For females, only a self reported previous syphilis diagnosis was associated with current syphilis seroreactivity in multivariate analyses.

Conclusions: Examination of this cohort revealed a particularly high seroprevalence of HSV-2 and syphilis, especially among female drug users. Few infected participants had been previously diagnosed with these infections.

Ulcerative sexually transmitted infections (STIs) such as herpes simplex virus type-2 (HSV-2) and syphilis have been associated with increased sexual transmission and acquisition of HIV.[1–3] Ulcerative STIs increase HIV susceptibility by disrupting mucosal integrity to create a portal for viral entry and inducing the proliferation and activation of HIV susceptible cells (for example, lymphocytes, macrophages).[4] HIV shedding has been shown to be higher in the presence of STI co-infection and, in the case of ulcerative STIs, HIV has been detected in ulcer exudates and bleeding of ulcers during sex allows for easier viral transmission.[3 5] A recent literature review concluded that ulcerative STIs increase HIV susceptibility fourfold among males and threefold among females. HIV infectiousness increases by twofold in the presence of STIs.[1]

Drug using populations are at a high risk for acquiring STIs as a result of factors such as high risk sexual partners and increased levels of high risk sexual behaviours associated with stimulants such as crack and cocaine.[6 7] These risks are often escalated among women because of the biological efficacy of STI transmission and the elevated prevalence of such behaviours, such as the exchange of sex for drugs or money.[8 9]

The consequences of STI/HIV co-infections are important among drug using populations as members of these populations are at higher risk than members of the general population of being HIV infected or having an HIV positive sex partner. However, few population based studies have measured STIs among drug using populations. The objective of this study was to examine the seroprevalence and correlates of ulcerative STIs (that is, HSV-2 and syphilis) among a community based cohort of young drug users, both injecting drug users (IDUs) and non-injecting drug users (NIDUs).

METHODS

Study population

Young drug users were recruited into the Risk Evaluation and Assessment of Community Health III (REACH III) cohort between October 1999 and August 2002. REACH III aimed to examine factors associated with injection and non-injection drug use, and infectious diseases among recently initiated young drug users. Eligibility criteria for all participants were (1) aged 15–30 years old; and (2) having initiated injection or non-injection use of heroin, crack, and/or cocaine within the previous 5 years. In addition, NIDUs were eligible if they reported using either heroin, crack and/or cocaine 2 days in the previous week and IDUs were eligible if they had injected at least once in the month before study entry. Injection status was verified by the presence of injection stigmas and by a series of injection drug related questions.

Recruitment

Targeted sampling methods[10] were used to recruit potential participants. Recruitment areas were identified though ethnographic observations and previous research with this target population.[11] Experienced street outreach workers approached people on the street in targeted neighbourhoods, attended community meetings, and posted study flyers. In addition to the study clinic, a van was used as a mobile study centre. This study van would regularly park in targeted neighbourhoods to recruit and screen potential participants.

Abbreviations: ELISA, enzyme linked immunosorbent assay; HSV, herpes simplex virus; IDUs, injecting drug users; NIDUs, non-injecting drug users; REACH III, Risk Evaluation and Assessment of Community Health III; RPR, rapid plasma reagin; STIs, sexually transmitted infections; TPHA, *Treponema pallidum* haemagglutinin assay

Table 1 Baseline sociodemographics, drug use, and sex behaviours of REACH III population by sex

	Females (n = 230)‡	Males (n = 313)‡
	% (n)†	% (n)†
Age (interquartile range)	25 (21–28)	24 (21–27)
Race:		
White	51.6 (118)	63.9 (200)***
African-American	48.5 (11)	32.6 (102)
Other	0	3.5 (11)
Homeless§	16.1 (36)	18.7 (57)
Injection drug user	69.1 (159)	75.7 (237)
Daily marijuana use§	13.0 (29)	14.9 (46)
Daily crack use§	9.6 (22)	2.9 (9)***
Daily cocaine use§	14.9 (34)	14.1 (44)
Daily heroin use§	72.1 (165)	74.6 (232)
Sex behaviours		
Lifetime partners (range)	8 (5–20)	15 (8, 30)***
Sex trade§	25.6 (58)	2.9 (9)***
>2 Sex partners in the last 6 months	33.3 (76)	23.5 (73)*
Current HIV infection	6.5 (15)	2.9 (9)*
Always use condom with§¶:		
Steady partner	17.8 (32)	14.9 (34)
Casual partner	52.2 (24)	40.2 (37)
Sex trade partner	64.4 (29)	55.6 (5)
Steady sex partner§:		
Snorts heroin	45.3 (86)	27.0 (63)***
Smokes crack	33.0 (63)	17.6 (41)***
Injected drugs	38.2 (73)	28.3 (66)*

*<0.05 **<0.01 ***<0.001.
†Except for continuous variables which are expressed as median and IQR.
‡Denominator may vary from column totals due to missing data, refusals to answer specific questions or skip patterns.
§Refer to the previous 6 months.
¶Refers to vaginal sex only.

Data collection

All eligible participants were invited to join the study and sign a written informed consent. Owing to the sensitive nature of both the study population and research topic, participants between the ages of 15–18 years (n = 19) were considered emancipated minors and therefore were able to provide consent for their participation. Participants underwent an interviewer administered baseline survey and venepuncture, accompanied by pretest counselling. Participants were compensated $20 for the completion of the baseline assessment. Participants returned after their baseline visit for test results, post-test counselling, and $10 compensation. Data were collected at baseline as well as at the 6 and 12 month follow up. The current analysis was restricted to data collected at baseline. If participants tested positive for HIV or syphilis, a referral for further medical evaluation was provided. HSV-2 serology was conducted in December 2002 for the purpose of this research project and, as described in initial consent procedure, these post hoc test results were not reported back to the participant. The study was approved by the committee on human research at the Johns Hopkins Bloomberg School of Public Health. A certificate of confidentiality was obtained.

Laboratory data

At the baseline visit, serum was collected and tested for HIV using an enzyme linked immunosorbent assay (ELISA) (Biomerieux Vironostika (Vironos), Durham, NC, USA), followed by confirmation of reactive samples using western blot (Bio-Rad, Redman, Washington). In addition, initial testing for syphilis was done by screening all samples with the rapid plasma reagin (RPR) test (Macro-Vue, Becton Dickenson, Cockeysville, MD, USA). All samples testing positive by RPR had confirmatory testing using *Treponema pallidum* haemagglutinin assay (TPHA) (Fujirebio, Wilmington, DE, USA). Samples that were reactive on both tests indicate recent or untreated infection. During primary syphilis the sensitivity of RPR and TPHA, respectively, is approximately 86% and 76%, while both tests are 100% sensitive in secondary syphilis. False negative cases can occur during early primary syphilis as seroconversion may occur up to 4 weeks after the appearance of the primary lesions.[12]

Stored baseline serum was tested for serological markers of HSV-2 using the HerpeSelect HSV-2 type specific ELISA (Focus Diagnostics, Cypress, CA, USA), which tests for the presence of HSV-2 antibodies against recombinant gG2 antigen. Reactive tests are thus indicative of current infection. This particular ELISA has been shown to have a high sensitivity and specificity (96.1–100%) in studies conducted among populations of varying prevalence. The type specificity of this ELISA is also very high (96.5% relative to western blot) (Focus Diagnostics, Cypress, CA, USA).

Survey instrument

Baseline questionnaires were administered to participants by experienced, trained interviewers, certified in HIV pretest and post-test counselling. The questionnaire ascertained a range of sociodemographic information and sexual and drug use behaviours. Examined sexual behaviours included age at first intercourse; history of STIs; number of lifetime sexual partners; history of sex trade involvement; condom use in the 6 months before being surveyed; frequency and type of sex in the past 6 months; and self reported drug and sex history of partners in the past 6 months. The examination of drug use behaviours included the types and frequency of drugs used in the past 6 months. A steady sex partner was defined as someone with whom the participant had a sexual relationship for more than 3 months, not including sex trade clients. A casual sex partner was defined as someone with whom the participant had a sexual relationship for less than

Table 2 Univariate analyses of HSV-2 seroprevalence of REACH III cohort by sex†

	Females (n = 230)			Males (n = 313)		
	No	% positive (n)††§	Crude OR (95% CI)	No	% positive (n)††§	Crude OR (95% CI)
Median age						
Among positives	–	26 (23–28)***	1.2 (1.1 to 1.3)‡‡	–	26 (23–28)***	1.2 (1.1 to 1.3)‡‡
Among negatives	–	22 (19–26)		–	24 (20–27)	
Race						
African-American	111	78.4 (87)***	5.5 (3.1 to 9.8)	103	35.3 (36)***	3.1 (1.8 to 5.4)
Other	0	–	–	11	27.3 (3)	2.1 (0.5 to 8.5)
White	118	39.8 (47)	1.0	195	15.0 (30)	1.0
Injection drug user						
Yes	159	58.5 (93)	1.0 (0.6 to 1.7)	237	21.9 (52)	1.0 (0.5 to 1.8)
No	71	59.2 (42)	1.0	76	22.4 (17)	1.0
Regular employment¶						
Yes	65	4.6 (3)*	0.5 (0.3 to 0.9)	178	18.5 (33)	0.6 (0.4 to 1.1)
No	164	64.0 (105)	1.0	135	26.7 (36)	1.0
Number of lifetime opposite sex partners						
<10	114	52.6 (60)	1.0	84	30.8 (33)**	1.0
10–30	64	57.8 (37)	1.2 (0.7 to 2.3)	106	18.9 (20)	1.5 (0.7 to 3.4)
30+	36	75.0 (27)	2.7 (1.2 to 6.3)	107	13.1 (11)	3.0 (1.4 to 6.3)
Same sex relationship ever						
Yes	59	64.4 (38)	1.4 (0.8 to 2.6)	10	50.0 (5)*	3.7 (1.0 to 13.2)
No	170	56.5 (96)	1.0	302	21.2 (64)	1.0
Traded sex¶						
Yes	59	81.0 (47)**	3.9 (1.9 to 8.1)	9	33.3 (3)	1.7 (0.4 to 7.3)
No	169	52.1 (88)	1.0	301	21.9 (66)	1.0
Ever incarcerated						
Yes	136	65.4 (89)*	1.9 (1.1 to 3.3)	107	25.7 (61)**	2.8 (1.3 to 6.2)
No	93	49.5 (46)	1.0	73	11.0 (8)	1.0
Previous gonorrhoea infection						
Yes	26	92.3 (24)***	10.1 (2.3 to 44.1)	28	42.9 (12)**	3.1 (1.4 to 6.8)
No	203	54.2 (110)	1.0	284	19.7 (56)	1.0
Previous chlamydia infection						
Yes	30	66.7 (20)	1.5 (0.7 to 3.4)	21	52.4 (11)**	1.2 (0.8 to 1.9)
No	199	57.3 (114)	1.0	289	19.4 (56)	1.0
Previous syphilis infection						
Yes	9	100 (9)**	–	2	50.0 (1)	3.6 (0.2 to 58.8)
No	220	56.8 (125)		310	21.6 (67)	1.0
Current HIV infection						
Yes	15	93.3 (14)**	10.9 (1.4 to 84.2)	9	77.8 (7)***	13.7 (2.8 to 67.4)
No	215	56.3 (121)	1.0	304	20.4 (62)	1.0
Sex partner ever injected drugs¶						
Yes	76	42.1 (32)**	0.4 (0.2 to 0.7)	77	23.4 (18)	1.0 (0.5 to 1.9)
No	125	64.0 (80)	1.0	183	23.0 (42)	1.0
Daily use of pot¶						
Yes	29	34.5 (10)**	0.3 (0.1 to 0.7)	46	15.2 (7)	0.6 (0.3 to 1.4)
No	194	62.1 (121)	1.0	262	22.9 (60)	1.0
Daily use of heroin and cocaine together¶						
Yes	38	76.3 (29)*	2.6 (1.1 to 5.7)	39	28.2 (11)	1.5 (0.7 to 3.2)
No	190	55.8 (106)	1.0	271	21.0 (57)	1.0
Daily heroin use¶						
Yes	165	63.0 (104)*	1.8 (1.0 to 3.3)	232	22.0 (51)	0.8 (0.5 to 1.8)
No	64	48.4 (31)	1.0	79	22.8 (18)	1.0
Years since debut of hard drug use‡‡						
Among positives	–	4 (3–7)*	1.1 (1.0 to 1.2)	–	5 (3 to 8)	1.1 (1.0 to 1.2)
Among negatives	–	4 (2–5)	1.0	–	5 (3 to 7)	1.0
Has sold drugs¶						
Yes	49	83.7 (41)***	4.6 (2.1 to 10.4)	117	24.8 (29)	1.3 (0.7 to 2.2)
No	179	52.5 (94)	1.0	195	20.5 (40)	1.0

*<0.05 **<0.01 ***<0.001.
†Only those variables that were significant ($p<0.05$) for one or other of the sexes are shown.
‡Except for continuous variables which are expressed as median and interquartile range among positives and negatives.
§Denominator may vary from column totals owing to missing data, refusals to answer specific questions or skip patterns.
¶In the previous 6 months.
††p value calculated by χ^2 or Fisher's exact test for categorical variables and by Mann-Whitney two sample statistic for continuous variables.
‡‡OR expresses the increase in odds associated with a 1 year increase.

3 months, including ''one night stands'' but not sex trade clients. Sex trade referred to any instance whereby the participants had received money or drugs in exchange for sex. The frequency of many of the sexual and drug use behaviours was measured on a six point scale from ''never in the last 6 months'' to ''every day.'' Self reported STIs were assessed by asking the participants if they had ever been told by a health professional that they had gonorrhoea, syphilis, chlamydia, or genital herpes.

Statistical analyses

All analyses were stratified by sex because of significant differences in HSV-2 and syphilis seroprevalence between the sexes and the potential for effect modification of behavioural effects on STI seroprevalence by sex. The infection seroprevalence was defined as the proportion of subjects with positive tests at their baseline visit. A 95% binomial confidence interval (CI) was calculated for each seroprevalence. Sex specific sociodemographic, behaviour, and

seroprevalence data were compared using descriptive statistics (χ^2 statistics, Mann-Whitney tests or Fisher's exact tests, if cell numbers were less than 10).

For HSV-2 and syphilis separately, sex specific correlates were identified using descriptive statistics to analyse the distribution of variables (demographics, sexual behaviours, drug use behaviours) between those infected and those not infected. Sex specific syphilis analyses were not conducted for males as only one male tested positive for syphilis.

Multivariate logistic regression analyses were conducted to identify significant independent effects of demographics and behaviour variables on HSV-2, stratified by sex, and for syphilis, among females only. Any variable associated with the outcome at a significance level of 0.10 in univariate analyses was entered into logistic regression models. Potential confounders such as age and race were included in all regression models. If no meaningful changes were noted in the coefficients or the overall model, these variables were not included. Adjusted estimates of the odds ratios (AOR) and 95% CIs were obtained. All analyses were performed using Stata Version 7.0 (Stata Corp, College Station, TX, USA).

RESULTS

The sample's sociodemographic characteristics, drug use patterns, and sexual behaviours are displayed in table 1. Of 543 participants recruited, 42.4% were female and the median age of the population was 24 years (interquartile range (IQR): 21–28 years). Of the total population, 72.9% were IDUs. The drug of choice among this cohort was heroin, while lower proportions reported the use of marijuana, crack, and cocaine.

Males reported a significantly higher number of lifetime sexual partners than females ($p<0.0001$). In the 6 months before study entry, females were significantly more likely than males to report trading sex for money or drugs ($p<0.001$), and having a steady partner who snorted heroin ($p<0.001$), smoked crack ($p<0.001$), and ever injected drugs ($p<0.03$). Females also reported higher levels of HIV and all self reported STIs.

Herpes simplex type 2

Of the 543 participants, 37.6% (n = 204; 95% CI: 33.5 to 41.8) tested positive for HSV-2 and only 1.3% (n = 7) of the population had been previously diagnosed with herpes. HSV-2 seroprevalence was significantly higher among females than males (58.7% versus 22.0%, respectively, $p<0.001$).

The results of univariate analyses of HSV-2 seroprevalence, stratified by sex, are shown in table 2. Older age, African-American race, being incarcerated, over 30 lifetime partners of the opposite sex, current HIV infection, and previous self reported gonorrhoea infection were associated with HSV-2 association for both sexes. There were no significant differences in the proportion of HSV-2 seroreactivity between IDUs and NIDUs

For males, an additional significant correlate of HSV-2 infection was a previous self reported chlamydia infection. Additional significant univariate correlates for females included trading sex, lacking regular employment, having sold drugs, and self reporting of a previous syphilis infection. A number of drug use variables were positively associated with infections among females including daily heroin use and daily use of heroin and cocaine together. Use of marijuana and having a sex partner who was an IDU in the previous 6 months were inversely associated with HSV-2 infection among females.

Table 3 displays the results from sex specific multivariate logistic regression models of HSV-2 seroprevalence. Significant independent variables for HSV-2 infection among females were older age, African-American race, trading sex and daily heroin use. Among males, older age, African-American race, testing HIV positive, ever being incarcerated and more than 30 lifetime female sex partners were independently associated with HSV-2 infection.

Syphilis

Of the 543 participants, 2.0% (n = 11; 95% CI 1.0% to 3.6%) tested positive for syphilis using both RPR and TPHA. Syphilis seroreactivity was 4.3% (n = 10) among females and 0.3% (n = 1) among males ($p<0.001$). Of the 10 female seroreactors, 90% were African-Americans and 80% also tested positive for HSV-2. In total, 27% (3/11) of the seroreactors reported being previously diagnosed and treated for syphilis, however only one reported diagnoses in the previous 6 months. There was no significant difference in the proportion of syphilis seroreactivity between IDUs and NIDUs (1.5% versus 3.4%, respectively, p = 0.2).

The results of female specific univariate and multivariate syphilis analyses are shown in table 4. In univariate analyses, older age, African-American race, and a self reported previous syphilis infection were significantly associated with seroreactivity, while having a sex partner who ever injected drugs was protective. In multivariate analyses, only a previous syphilis diagnosis was associated with current syphilis seroreactivity (AOR = 10.3; 95% CI: 1.9 to 56.9).

DISCUSSION

In this study of ulcerative STIs among a community based cohort of injection and non-injection drug users, we found a particularly high seroprevalence of ulcerative STIs among

Table 3 Logistic regression models for HSV-2 seroprevalence: REACH III cohort by sex

	Females (n = 230)	Males (n = 313)
Variable	**AOR (95% CI)**	**AOR (95% CI)**
Older age	1.1 (1.0 to 1.2)	1.1 (1.0 to 1.2)
African-American	6.0 (2.8 to 12.7)	2.6 (1.4 to 4.8)
Sex trade†	3.2 (1.2 to 8.6)	–‡
Daily use of heroin†	3.6 (1.6 to 7.7)	–‡
Lifetime opposite sex partners		
<10	1.0	1.0
10–30	1.3 (0.6 to 2.7)	1.6 (0.7 to 3.9)
>30	1.8 (0.6 to 5.5)	2.6 (1.1 to 6.1)
Current HIV infection	–‡	11.1 (1.8 to 67.5)
Ever been incarcerated	–‡	2.7 (1.1 to 6.6)

AOR, adjusted odds ratios; 95% CI, 95% confidence intervals.
†In the previous 6 months.
‡Variables were not included in final regression model as they were not significant in either univariate or multivariate analyses .

Table 4 Statistically significant correlates for syphilis seroreactivity of females (n = 230) from the REACH III cohort†

	Total no	Positive‡§ % (n)	Odds ratio (OR) (95% CI)	Adjusted OR (95% CI)
Median age				
Among positives	–	28 (27–28)*	1.3 (1.0 to 1.7)††	1.3 (0.96 to 1.6)††
Among negatives	–	25 (21–28)	1.0	1.0
African-American				
Yes	111	8.1 (9)**	10.3 (1.3 to 82.9)	3.9 (0.4 to 35.9)
No	118	0.9 (1)	1.0	1.0
Self reported previous syphilis Infection				
Yes	9	33.3 (2)**	15.2 (3.1 to 73.7)	10.3 (1.9 to 56.9)
No	220	3.2 (8)	1.0	1.0
Sex partner ever injected drugs¶				
Yes	76	0*	–‡‡	–‡‡
No	125	6.4 (8)		

*p<0.05 **p<0.01 ***p<0.001.
†Because of the single syphilis seroreactor among males, analyses were only conducted among females.
‡Except for continuous variables which are expressed as median and interquartile range among positives and negatives.
§Denominator may vary from 230 owing to missing data, refusals to answer specific questions or skip patterns.
¶In the previous 6 months.
††OR for age expresses the increase in odds associated with a 1 year increase in age.
‡‡Could not be included in logistic model owing to zero cell.

female drug users, especially African-American females; however few participants had been previously diagnosed with these infections. In addition, there were no significant differences in HSV-2 or syphilis seroprevalence between IDUs and NIDUs.

The HSV-2 and syphilis seroprevalence data among female drug users in our study (58.7% and 4.3%, respectively) were higher than those reported for the general population. HSV-2 seroprevalence was reported to be 25.6% among females in the 1988–94 National Health and Nutrition Examination Survey III (NHANES)[13] and 24.6% among females aged 18–30 at health clinics in Pittsburgh.[14] Syphilis seroreactivity among females was measured at 0.8% in the NHANES-III.[15] In contrast, our male HSV-2 seroprevalence (22%) was more similar to that of 17.8% determined among males in the NHANES-III survey.[13] It is important to note that the seroprevalence data from this research may not be generalisable to other cities because of the relatively high STI rates in Baltimore.[16] However, the HSV-2 and syphilis data reported in this study were very similar to those reported from national inner city STD clinics and drug treatment populations of the same age.[17 18]

The low proportion of people reporting previous diagnoses with these STIs, especially HSV-2, is alarming yet not surprising. Previous HSV-2 research in the general population has demonstrated that the majority of seropositive people were unaware of their infection status as a result of unrecognised or atypical infections.[13 19 20] Drug users have been shown to have low healthcare utilisation,[21] and therefore will not likely seek screening for these infections, other than when it is required—for example, routine syphilis screening at correctional institutes in Maryland. This lack of awareness of infection status also suggests that few individuals are taking appropriate measures to treat, control, or prevent transmission of their infections. These factors combined with the high proportion of infected females and the high number of sex partners create the potential for high transmission of infection, and demonstrate the importance for screening programmes and prevention programmes which include education on symptom recognition.

The increased seroprevalence of ulcerative STIs among females, African-Americans and older aged participants is common in STI literature.[14 15 19 22–25] Correlates identified for HSV-2 infection among males were related to high risk sexual behaviours; independent correlates of infection included an increased number of lifetime female sex partners and current HIV infection. For females, both high risk sex and drug use behaviours were identified as correlates of HSV-2 infection. In multivariate analyses, after controlling for age and race, only trading sex for drugs or money and daily heroin use were identified as independent correlates of infection. Interestingly, in univariate analyses of females, having a sex partner who was an IDU was associated with lower HSV-2 and syphilis seroprevalence; this may be explained in part by the lower proportion of African-Americans who have IDUs as sexual partners and, as discussed above, African-American race is associated with seroreactivity.

This study supports previous literature describing the overlap between sexual relationships and drug use among female drug users,[8 9 26 27] which, as in the current study, has previously been attributed to the higher proportion of females than males who exchanged sex for drugs or money and had drug using sex partners. This difference speaks to the importance of developing interventions for women which focus on the root causes, such as drug addiction and economic dependence on men, that influence transactional sex.

This study was subject to several limitations. The identification of correlates for syphilis seroreactivity was severely limited by the low seroprevalence. The syphilis serology itself is a limitation as the difficulty in interpreting the meaning of positive syphilis serology (that is, new versus treated infections) may have been exacerbated by the high prevalence of injection drug use which can result in false positive RPR results. The cross sectional study design, the use of serological assays, and the limitation of many behavioural questions to the previous 6 months did not allow the determination of causal relations between behaviours and STI acquisition. However, this bias may have been reduced by the young age of this population as infections may have been identified relatively soon after acquisition (for example, syphilis is commonly acquired in the 20s or early 30s[28]). The self reported behavioural variables are subject to social desirability biases; however, it is hoped that extensive training of interviewers reduced these biases. In addition, baseline questionnaires did not collect information on sexual network and mixing patterns, which may be extremely informative in explaining the high seroprevalence of infection among African-Americans compared to white people.

This study has attempted to provide a more accurate estimate of STI seroprevalence among young urban drug users than previous studies by using a community recruited cohort and including both IDUs and NIDUs. The study

Key messages

- The seroprevalence of HSV-2 and syphilis is high (58.7% and 4.3%, respectively) among young female drug users in Baltimore City
- Few infected participants knew of their infection status, indicating that STI screening and education programmes should be implemented as a part of outreach services to young drug users
- Injection and non-injection drug users had similar seroprevalence of infection and therefore harm reduction programmes for all drug users should focus on safe sex messages

population demonstrated a high level of sexual risk and a high seroprevalence of HSV-2 and syphilis, especially among female participants, which places all of the population at high risk for the sexual transmission of infections, including HIV. Although the majority of previous research among drug users has focused on injection risk behaviours of IDUs for disease prevention, this study indicates that the sexual behaviours of both IDUs and NIDUs are of public health importance. Intervention and outreach programmes for young drug users should offer STI testing, education on the identification of STIs, and promote safe sex messages in order to prevent the further transmission of all STIs.

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CONTRIBUTORS

SSP coordinated HSV-2 testing, performed data analysis, and prepared the manuscript; SGS contributed to the writing of manuscript, acts as principal investigator of the cohort and therefore helped with coordination of data collection and data management; SAS provided the initial idea for this research, was involved with initial coordination of cohort, and reviewed the manuscript; TET was involved with the development and review of the manuscript

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