High HIV Prevalence Among Low-Income, Black Women in New York City with Self-Reported HIV Negative and Unknown Status

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Abstract

Background: Black women are disproportionately affected by human immunodeficiency virus (HIV). This study investigates factors associated with newly identified HIV infection among previously self-reported HIV negative or unknown status black women living in high risk areas (HRAs) of New York City (NYC).

Methods: Heterosexuals residing in or socially connected to NYC HRAs were recruited using respondent driven sampling for participation in the United States Centers for Disease Control-sponsored National HIV Behavioral Surveillance System in 2010. Eligible individuals were interviewed and offered an HIV test. The analysis reported here focused on black women with valid HIV results who did not report being HIV positive, and examined factors related to HIV infection in this group.

Results: Of 153 black women who did not report being HIV positive at enrollment, 15 (9.8%) tested HIV positive. Age ≥ 40 years, ever injected drugs, and in the last 12 months had unprotected vaginal sex, exchange sex, last sex partner used crack, non-injection crack use, and non-injection heroin use were significantly associated with HIV infection ($p < 0.05$). Only ever injected drugs (prevalence ratio: 5.1; 95% confidence interval: 2.0, 12.9) was retained in the final model.

Conclusions: Black women who had reported being either HIV negative or unaware of their serostatus had high HIV prevalence. Efforts to identify and treat HIV positive black women in HRAs should target those with a history of injection drug use. Frequent testing for HIV should be promoted in HRAs.

Introduction

HETEROSEXUAL TRANSMISSION IS the second leading risk category for newly diagnosed human immunodeficiency virus (HIV) infections in both the United States (2009) and New York City (NYC) (2010) comprising 27% and 21% of all newly diagnosed infections, respectively.^{1,2} In 2010 in NYC, the majority (81%) of heterosexually acquired cases were among women, and 93% of all new HIV diagnoses among women with a known risk factor were heterosexually acquired.² Black women are disproportionately affected by HIV. In 2010 in NYC, 64% of women with newly diagnosed HIV infections were black,² whereas black women comprise only 24% of female NYC residents.³ In 2009, approximately 30% of all HIV positive black women in the U.S. with het-

erosexual transmission risk were in NYC.^{4,5} Prompt diagnosis and linkage to care is of particular concern for HIV-infected black women, considering that acquired immunodeficiency syndrome (AIDS) is a leading cause of death among black women who are between the ages of 25 and 54 years.⁶ In 2010 in NYC, there were 10.5 times as many deaths from AIDS among black women than there were among white women.²

In the United States, a greater proportion of blacks live below the poverty line than whites.⁷ Several studies have noted that HIV disproportionately affects those of low socioeconomic status (SES).^{8,9} A National HIV Behavioral Surveillance (NHBS) pilot study of 15,000 heterosexuals (NHBS-HET1) conducted in 2006–2007, confirmed that low SES was correlated with newly diagnosed HIV infection.¹⁰ Among the factors that may affect HIV risk in low-SES

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individuals in low-SES neighborhoods are the characteristics of sex partners and sex partner concurrency, socioeconomic and other structural factors that may increase the likelihood of engaging in risk behaviors, having high-risk partners, and exposure to prevention programs, such as HIV testing and individual and group counseling.^{11,12}

The current study investigated the factors associated with HIV infection among black women with self-reported HIV negative and unknown status, living in or socially connected to areas with high heterosexual HIV prevalence, and high rates of poverty in NYC. Understanding the factors associated with HIV infection among these women is important for developing interventions to target HIV testing and other initiatives for black women at high risk for infection, including efforts to prevent infection among the uninfected and promote early linkage to care and improved patient outcomes for those who are HIV infected.^{13,14}

Materials and Methods

Study population

Subjects were recruited to participate in the second round of the U.S. Centers for Disease Control and Prevention (CDC)-sponsored National HIV Behavioral Surveillance (NHBS) study of high-risk heterosexuals (HET2) in NYC from June to November of 2010. NHBS is an ongoing national, cross-sectional study that monitors HIV risk behaviors, testing history, exposure to and use of HIV prevention services, and HIV prevalence among men who have sex with men (MSM), injection drug users (IDU), and high-risk heterosexuals in 3-year cycles.^{15,16} NHBS is conducted in collaboration with the CDC by local public health departments, universities, and other collaborators.

High-risk areas (HRAs) were defined as census tracts where 20% or more of the residents were living below the poverty threshold based on the 2000 U.S. Census. In NYC there were 2248 census tracts; of these, 555 (24.7%) were determined to be HRAs. NYC HIV case surveillance data by zip code (per 100,000 population) were also mapped to overlay with poverty data; cases were limited to those aged 13 or older, newly diagnosed between 2005 and 2008, and heterosexual risk for men and heterosexual or no identified risk for women. The HRA/HIV overlay map indicated three main clusters of poverty and heterosexual HIV in New York City: Central and North Brooklyn, Harlem, and South and Central Bronx. Respondent-driven sampling (RDS) was used for participant recruitment.¹⁷ NHBS-HET1 employed both RDS and venue-based sampling. CDC, along with the Principal Investigators of project sites, evaluated the data from NHBS-HET1 and determined that RDS is appropriate for recruiting high-risk heterosexuals, which are connected by strong social networks and ties.

Ethnographers selected 8 initial recruits ("seeds") from areas with high poverty and high rates of heterosexual HIV through community outreach. Those who demonstrated that they were well connected to other high-risk heterosexuals were chosen as seeds. Seeds were required to have had vaginal or anal sex with a person of the opposite sex in the past 12 months, be residents of HRAs, never have injected drugs, be male or female (not self-identify as transgender), and of low socioeconomic status (SES) (household income at or below the federal poverty guidelines and high school education or less).

After completion of the study interview and HIV testing, seeds were told to give one coupon to each of 3 friends, relatives or people they are close to who are between 18 and 60 years of age, who live in New York City, and that they have seen in the past 30 days; nonseed participants were not required to be residents of HRAs. Those who were referred to the study were screened for eligibility. Eligibility criteria were opposite-sex vaginal or anal sex in the past 12 months, age between 18 and 60 years, New York City residence, and English or Spanish comprehension. Those who were screened as eligible and provided their informed consent were given a structured survey interview administered in private by trained interviewers and were offered a voluntary HIV test. Those who completed the survey interview were provided with up to three coupons for peers they could refer to the study. Those who had higher SES or were current injection drug users were eligible to participate in the study, but were not eligible to recruit others. Non-seed participants had to be referred into the study by other participants. Successive waves were recruited until the desired sample size was reached. Subjects were compensated \$20 for completing the survey, \$10 for taking an HIV test, and \$10 for each eligible participant recruited.

Measures

The survey instrument was developed by the CDC in collaboration with local NHBS project sites. Several additional questions were developed and included in the structured interview to address local NYC research interests. Interview data were collected on demographics; sexual behavior with main, casual, and exchange partners; alcohol and drug use history; HIV testing experiences; medical history; and exposure to HIV prevention activities. Participant race was determined by asking participants what ethnicity/races they consider themselves. Mutually exclusive race/ethnicity variables were created with a hierarchy of Hispanic, white, black, other. Questions pertaining to sexual behavior were framed in terms of the past 12 months and at last sex, and questions pertaining to drug use were framed in terms of the past 12 months. All participants were offered an HIV test regardless of self-reported HIV status. Phlebotomists collected blood specimens using venipuncture. Specimens were screened for HIV antibody (Genetic Systems HIV-1/HIV-2 PLUS "O" EIA, Bio-Rad Laboratories) and positive specimens were confirmed using HIV1 Western blot platforms (Genetic Systems HIV-1 western blot, Bio-Rad Laboratories). Participants were asked to return in 2 weeks for their test results.

Statistical analysis

This analysis was limited to the portion of the sample that was female, black race, did not self-report HIV positive, and had a valid HIV study test result. Means and standard deviations (for normal continuous data); medians and interquartile ranges (IQR) (for non-normal continuous data); and the frequencies and percentages for each level of categorical variables were calculated.

RDS is a relatively new sampling method and analysis techniques are still being developed.¹⁸ RDS weighted estimates may not be generalizable to the target population, and large sample sizes may be needed to obtain precise weighted estimates.^{19–21} Methods incorporating weights in regression

models are still under development.^{22,23} The current study conducted unweighted analyses.

Associations between HIV infection and other variables, based on the findings of previously published research, were examined through the estimation of prevalence ratios (PR) and 95% confidence intervals (CI) using log-binomial general linear regression models. PRs were used instead of odds ratios (OR) because PRs are more consistent and interpretable than ORs for cross-sectional studies.^{24,25} Variables significant ($p < 0.1$) in bivariate analyses were considered for inclusion in the multivariate logistic regression model. Variables were entered and eliminated from the multivariate model in a forward stepwise manner using likelihood ratio tests to test for differences between the models; the final model was determined when no additional variables improved the model fit ($p > 0.05$). A stratum-specific analysis was conducted examining the association between HIV infection and other variables, excluding those with a history of injection drug use; because of the small sample size of this stratum-specific analysis, there was limited power for multivariate analysis. Analyses were conducted using SAS 9.2.

Ethics

All study procedures involving human subjects were approved by the New York City Department of Health and Mental Hygiene (DOHMH) and National Development and Research Institutes Institutional Review Boards.

Results

Sample recruitment

Eight seeds initiated recruitment chains, which ultimately recruited 625 individuals, of whom 523 (83.7%) were eligible and agreed to participate in the study. Of the 523 heterosexuals who participated in the study, 212 were female (40.5%). Two white and 41 Latina participants, as well as 9 self-reported HIV positive participants were excluded from the analysis. Of the remaining 160 participants, 7 were excluded because they did not have valid HIV test results. The final sample size for this analysis was 153.

Demographics

Participant characteristics are shown in Table 1. The median age was 42 years (IQR: 26, 49). The majority of participants were neither married nor cohabiting ($n = 133$, 86.9%) and were unemployed ($n = 115$, 75.2%). About half had not graduated from high school ($n = 74$, 48.4%) and had an annual income of $< \$10,000$ ($n = 88$, 57.5%). There were 34 (22.2%) participants who were currently homeless, 60 (39.2%) who were homeless in the past 12 months, and 28 (18.3%) who had been incarcerated in the past 12 months. Study participants resided in Brooklyn ($n = 91$, 59.5%), Manhattan ($n = 46$, 30.1%), the Bronx ($n = 12$, 7.8%), and Queens ($n = 4$, 2.6%).

Healthcare utilization

Most participants ($n = 126$, 82.4%) had health insurance at the time of the study and 127 (83.0%) had a healthcare visit in the previous 12 months. More than half ($n = 92$, 60.1%) of participants reported having an HIV test in the past 24 months; and among those who reported ever testing for HIV

($n = 133$, 86.9%), in the past 24 months participants tested a median number of one time (IQR: 0, 3).

Sexual behavior in the past 12 months

Almost all participants ($n = 143$, 93.5%) reported having unprotected vaginal sex and approximately half ($n = 78$, 51.0%) reported having unprotected anal sex. Over one-third ($n = 53$, 34.6%) had sex in exchange for drugs or money. Twenty-six (17.0%) had participated in group sex.

Characteristics of last sex

At last sex, 103 (67.3%) participants had sex with a main partner, 32 (20.9%) with a casual partner, and 18 (11.8%) with an exchange partner. Most participants had unprotected sex ($n = 129$, 84.3%), and 83 (54.2%) consumed drugs and/or alcohol during this encounter. More than a quarter ($n = 44$, 28.8%) of participants reported that their partner was at least 5 years older than they were. Half did not know the HIV status of their partner ($n = 82$, 53.6%), 70 (45.8%) believed their partner was HIV negative, and 1 (0.7%) believed her partner was HIV positive. With regard to last sex partner's drug use, 23 (15.0%) had ever injected drugs and 45 (29.4%) had ever used crack. More than half ($n = 93$, 60.8%) reported that their partner had ever been incarcerated. Excluding those whose last sex partner was an exchange partner, more than half of participants ($n = 86$, 64.2%) reported ever having sex with others during their sexual relationship with their last sexual partner.

Drug and alcohol use

Eighty-seven (56.9%) had four or more alcoholic drinks in one sitting in the past 12 months. Less than one-fifth ($n = 28$, 18.3%) ever injected drugs, although only 5 (3.3%) reported injecting drugs in the past 12 months. For non-injection drug use in the past 12 months, 45 (29.4%) used crack, 37 (24.2%) used heroin, and 35 (22.9%) used cocaine.

HIV infection

HIV prevalence in this sample was 9.8% (95% CI: 5.6%, 15.7%). Of the 15 participants who were HIV positive, 13 (86.7%) had seen a healthcare provider in the past 12 months, but of these only 5 (38.5%) had been offered an HIV test by their healthcare provider. Among those who were HIV positive, 7 (46.7%) reported that they had never had an HIV test. For those 8 (53.3%) who had ever been tested for HIV, the median time since the last HIV test was 2.8 years (IQR: 0.4, 14.6), and 4 (50.0%) reported testing for HIV in the past 12 months. For those 11 (73.3%) HIV positive women who had not tested for HIV in the past 12 months, the main reason reported for not testing was that they were afraid of finding out they had HIV ($n = 8$, 72.7%). All those who were HIV infected were neither married nor cohabiting ($n = 15$, 100.0%). HIV infection was significantly ($p < 0.05$) associated with age ≥ 40 years, reporting exchange sex in the past 12 months, no unprotected vaginal sex in the past 12 months, last sex partner ever used crack, ever injected drugs, non-injection crack use in the past 12 months, and non-injection heroin use in the past 12 months (Table 1). Currently homeless and ever homeless were marginally ($p < 0.1$) associated with HIV infection. Only ever injected drugs (PR: 5.1; 95% CI: 2.0, 12.9) was retained in the final model. A stratum-specific analysis, which only included

TABLE 1. VARIABLE ASSOCIATIONS WITH HUMAN IMMUNODEFICIENCY VIRUS INFECTION AMONG HIGH-RISK BLACK WOMEN IN NEW YORK CITY (N=153)

Variable	n (%)	HIV positive %	PR (95% CI)	p
Demographics				
Age (years)				
18–39	70 (45.8%)	1.4%	1.0	0.02
≥40	83 (54.2%)	16.9%	11.8 (1.6, 87.6)	
Highest level of education completed				
At least high school	79 (51.6%)	8.9%	0.8 (0.3, 2.1)	0.69
Some high school or less	74 (48.4%)	10.8%	1.0	
Unemployed				
Yes	115 (75.2%)	9.6%	0.9 (0.3, 2.7)	0.86
No	38 (24.8%)	10.5%	1.0	
Annual income				
<\$10,000	88 (57.5%)	9.1%	1.0	0.73
≥\$10,000	65 (42.5%)	10.8%	1.2 (0.5, 3.1)	
Borough of residence				
Manhattan	46 (30.1%)	6.5%	1.0	0.32
Brooklyn	91 (59.5%)	12.1%	1.9 (0.5, 6.3)	
Bronx	12 (7.8%)	8.3%	1.3 (0.1, 11.2)	0.83
Queens	4 (2.6%)	0.0%	–	
Currently homeless				
Yes	34 (22.2%)	17.6%	2.3 (0.9, 6.1)	0.08
No	119 (77.8%)	7.6%	1.0	
Homeless in the past 12 months				
Yes	60 (39.2%)	15.0%	2.3 (0.9, 6.2)	0.09
No	93 (60.8%)	6.5%	1.0	
Incarcerated in the past 12 months				
Yes	28 (18.3%)	14.3%	1.6 (0.6, 4.7)	0.37
No	125 (81.7%)	8.8%	1.0	
Healthcare utilization				
Currently has health insurance				
Yes	126 (82.4%)	9.5%	0.9 (0.3, 2.8)	0.80
No	27 (17.6%)	11.1%	1.0	
Health care visit in the past 12 months				
Yes	127 (83.0%)	10.2%	1.3 (0.3, 5.5)	0.69
No	26 (17.0%)	7.7%	1.0	
Sexual behavior				
Unprotected vaginal sex in the past 12 months				
Yes	143 (93.5%)	8.4%	0.3 (0.09, 0.8)	0.02
No	10 (6.5%)	30.0%	1.0	
Unprotected anal sex in the past 12 months				
Yes	78 (51.0%)	9.0%	0.8 (0.3, 2.2)	0.73
No	75 (49.0%)	10.7%	1.0	
Exchange sex in the past 12 months				
Yes	53 (34.6%)	17.0%	2.8 (1.1, 7.5)	0.04
No	100 (65.4%)	6.0%	1.0	
Participated in group sex in the past 12 months				
Yes	26 (17.0%)	3.8%	0.3 (0.05, 2.5)	0.30
No	127 (83.0%)	11.0%	1.0	
Characteristics of last sex				
Partner type				
Main	103 (67.3%)	7.8%	1.0	0.41
Casual	32 (20.9%)	12.5%	1.6 (0.5, 5.0)	
Exchange	18 (11.8%)	16.7%	2.1 (0.6, 7.3)	0.22
Unprotected vaginal or anal sex				
Yes	129 (84.3%)	8.5%	0.5 (0.2, 1.5)	0.21
No	24 (15.7%)	16.7%	1.0	

(continued)

TABLE 1. (CONTINUED)

Variable	n (%)	HIV positive %	PR (95% CI)	p
Drug or alcohol use				
Yes	83 (54.2%)	9.6%	1.0 (0.4, 2.5)	0.94
No	70 (45.8%)	10.0%	1.0	
Partner at least 5 years older than participant				
Yes	44 (28.8%)	9.1%	0.9 (0.3, 2.7)	0.85
No	109 (71.2%)	10.1%	1.0	
Partner's HIV status				
Negative	70 (45.8%)	5.7%	1.0	
Positive	1 (0.7%)	0.0%	—	1.0
Unknown	82 (53.6%)	13.4%	2.3 (0.8, 7.0)	0.13
Partner ever injected drugs				
Yes	23 (15.0%)	17.4%	2.1 (0.7, 5.9)	0.18
No/unknown	130 (85.0%)	8.5%	1.0	
Partner ever used crack				
Yes	45 (29.4%)	20.0%	3.6 (1.4, 9.5)	0.01
No/unknown	108 (70.6%)	5.6%	1.0	
Partner ever incarcerated				
Yes	93 (60.8%)	12.9%	2.6 (0.8, 8.8)	0.13
No/unknown	60 (39.2%)	5.0%	1.0	
Ever had sex with other people during the sexual relationship with this partner*				
Yes	86 (64.2%)	8.1%	1.0	
No	48 (35.8%)	10.4%	1.3 (0.4, 3.8)	0.66
Drug and alcohol use				
Had more than 5 alcoholic drinks in one sitting in the past 12 months				
Yes	87 (56.9%)	9.2%	0.9 (0.3, 2.3)	0.77
No	66 (43.1%)	10.6%	1.0	
Ever injected drugs				
Yes	28 (18.3%)	28.6%	5.1 (2.0, 12.9)	0.0006
No	125 (81.7%)	5.6%	1.0	
Injected drugs in the past 12 months				
Yes	5 (3.3%)	0.0%	0.8 (0.04, 14.8)	0.45
No	148 (96.7%)	10.1%	1.0	
NI crack use in the past 12 months				
Yes	45 (29.4%)	20.0%	3.6 (1.4, 9.5)	0.01
No	108 (70.6%)	5.6%	1.0	
NI cocaine use in the past 12 months				
Yes	35 (22.9%)	8.6%	0.8 (0.3, 2.8)	0.78
No	118 (77.1%)	10.2%	1.0	
NI heroin use in the past 12 months				
Yes	37 (24.2%)	18.9%	2.7 (1.1, 7.1)	0.04
No	116 (75.8%)	6.9%	1.0	

*Excludes those whose last sex partner was an exchange partner.
HIV, human immunodeficiency virus; NI, non-injection; PR, prevalence ratio.

those who never injected drugs ($n=125$), found an HIV prevalence of 5.6%; those that did not engage in unprotected vaginal sex in the past 12 months, had an exchange partner at last sex (compared with those who had a main partner at last sex), last sex partner ever used crack, and non-injection crack use in the past 12 months were significantly ($p<0.05$) associated with HIV infection (Table 2).

Discussion

This study found a high prevalence of HIV infection (9.8% among all participants and 5.6% excluding those with a his-

tory of IDU) compared to both the general population ($<0.1\%$) and black women >13 years of age in the United States (1.8%).²⁶ Excluding those with a history of IDU and men who ever had sex with men, the national NHBS-HET2, including all 21 study sites, had an HIV prevalence of 1.1% among those who did not report a previous positive result; by subgroup, the prevalence was 1.1% for females and 1.3% for blacks.²⁷ The current study's HIV prevalence was also considerably higher than that found at baseline (1.5%) in the HIV Prevention Trials Network (HPTN) 064, a large, multisite longitudinal study of predominantly black women in high prevalence HIV areas; this difference could be due to

TABLE 2. STRATUM-SPECIFIC ANALYSIS OF VARIABLE ASSOCIATIONS WITH HIV INFECTION AMONG NEVER INJECTING HIGH-RISK BLACK WOMEN IN NEW YORK CITY (N=125)

Variable	n (%)	HIV positive %	PR (95% CI)	p
Demographics				
Age (years)				
18–39	69 (55.2%)	1.4%	1.0	0.06
≥40	56 (44.8%)	10.7%	7.4 (0.9, 59.6)	
Highest level of education completed				
At least high school	70 (56.0%)	5.7%	1.0 (0.2, 4.5)	0.95
Some high school or less	55 (44.0%)	5.5%	1.0	
Unemployed				
Yes	90 (72.0%)	5.6%	1.0 (0.2, 4.8)	0.97
No	35 (28.0%)	5.7%	1.0	
Annual income				
<\$10,000	67 (53.6%)	3.0%	1.0	0.19
≥\$10,000	58 (46.4%)	8.6%	2.9 (0.6, 14.3)	
Borough of residence				
Manhattan	42 (33.6%)	4.8%	1.0	0.63
Brooklyn	71 (56.8%)	7.0%	1.5 (0.3, 7.3)	
Bronx	8 (6.4%)	0.0%	–	
Queens	4 (3.2%)	0.0%	–	
Currently homeless				
Yes	22 (17.6%)	4.5%	0.8 (0.1, 6.2)	0.81
No	103 (82.4%)	5.8%	1.0	
Homeless in the past 12 months				
Yes	44 (35.2%)	9.1%	2.5 (0.6, 10.5)	0.23
No	81 (64.8%)	3.7%	1.0	
Incarcerated in the past 12 months				
Yes	21 (16.8%)	4.8%	0.8 (0.1, 6.5)	0.86
No	104 (83.2%)	5.8%	1.0	
Healthcare utilization				
Currently has health insurance				
Yes	102 (81.6%)	6.9%	–	–
No	23 (18.4%)	0.0%	–	–
Health care visit in the past 12 months				
Yes	102 (81.6%)	5.9%	1.4 (0.2, 10.7)	0.77
No	23 (18.4%)	4.3%	1.0	
Sexual behavior				
Unprotected vaginal sex in the past 12 months				
Yes	117 (93.6%)	4.3%	0.2 (0.04, 0.7)	0.02
No	8 (6.4%)	25.0%	1.0	
Unprotected anal sex in the past 12 months				
Yes	60 (48.0%)	6.7%	1.4 (0.3, 6.2)	0.62
No	65 (52.0%)	4.6%	1.0	
Exchange sex in the past 12 months				
Yes	37 (29.6%)	10.8%	3.2 (0.7, 13.5)	0.12
No	88 (70.4%)	3.4%	1.0	
Participated in group sex in the past 12 months				
Yes	22 (17.6%)	0.0%	–	–
No	103 (82.4%)	6.8%	–	–
Characteristics of last sex				
Partner type				
Main	89 (71.2%)	3.4%	1.0	0.33
Casual	25 (20.0%)	8.0%	2.4 (0.4, 13.4)	
Exchange	11 (8.8%)	18.2%	5.4 (1.0, 28.8)	
Unprotected vaginal or anal sex				
Yes	106 (84.8%)	4.7%	0.4 (0.1, 2.1)	0.31
No	19 (15.2%)	10.5%	1.0	
Drug or alcohol use				
Yes	63 (50.4%)	6.3%	1.3 (0.3, 5.6)	0.71
No	62 (49.6%)	4.8%	1.0	

(continued)

TABLE 2. (CONTINUED)

Variable	n (%)	HIV positive %	PR (95% CI)	p
Partner at least 5 years older than participant				
Yes	40 (32.0%)	7.5%	1.6 (0.4, 6.8)	0.53
No	85 (68.0%)	4.7%	1.0	
Partner's HIV status				
Negative	63 (50.4%)	4.8%	1.0	
Positive	0 (0.0%)	0.0%	—	—
Unknown	62 (49.6%)	6.5%	1.4 (0.3, 5.8)	0.68
Partner ever injected drugs				
Yes	9 (7.2%)	11.1%	2.1 (0.3, 16.0)	0.45
No/Unknown	116 (92.8%)	5.2%	1.0	
Partner ever used crack				
Yes	26 (20.8%)	15.4%	5.1 (1.2, 21.3)	0.03
No/Unknown	99 (79.2%)	3.0%	1.0	
Partner ever incarcerated				
Yes	68 (54.4%)	8.8%	5.0 (0.6, 40.6)	0.13
No/Unknown	57 (45.6%)	1.8%	1.0	
Ever had sex with other people during the sexual relationship with this partner*				
Yes	69 (61.1%)	1.4%	1.0	
No	44 (9.1%)	9.1%	6.3 (0.7, 54.3)	0.10
Drug and alcohol use				
Had more than 5 alcoholic drinks in one sitting in the past 12 months				
Yes	70 (56.0%)	4.3%	0.6 (0.1, 2.5)	0.48
No	55 (44.0%)	7.3%	1.0	
NI crack use in the past 12 months				
Yes	26 (20.8%)	15.4%	5.1 (1.2, 21.3)	0.03
No	99 (79.2%)	3.0%	1.0	
NI cocaine use in the past 12 months				
Yes	23 (18.4%)	0.0%	—	—
No	102 (81.6%)	6.9%	—	—
NI heroin use in the past 12 months				
Yes	18 (14.4%)	5.6%	1.0 (0.1, 7.8)	0.99
No	107 (85.6%)	5.6%	1.0	

*Excludes those whose last sex partner was an exchange partner.
HIV, human immunodeficiency virus; NI, non-injection; PR, prevalence ratio.

differences in sampling methodologies or possibly lower HIV prevalences among participants in the other cities included in the HPTN study.²⁸

In the final model, only history of injection drug use was associated with HIV infection among this population of high-risk women who did not self-report being HIV positive. Injection drug use is considered to be a more efficient means of HIV transmission compared with sexual transmission.²⁹ Former IDUs may have acquired their infection while they were injecting drugs either parenterally or through engaging in high risk sexual behavior associated with injection drug use, such as exchange sex and having high numbers of partners.³⁰ Former IDUs could also be part of sexual networks that include current and former injection drug users.³¹ Research indicates that sexual transmission is surpassing injection transmission as the means of transmission among NYC IDUs; a 2009 study by Des Jarlais et al. found that female, black, and younger (<40 years of age) IDUs were disproportionately infected with herpes simplex type 2.³² A study of drug use in NYC, found that for those who had transitioned from injection

to non-injection drug use, the duration of abstinence from injection was approximately 10 years;³³ likewise, the time since last injection for all those who reported ever injecting drugs in the current study was a median of 12 years (IQR: 3, 23), indicating a greater potential for heterosexual transmission. Moreover, former injection drug users may be less likely than their current injector counterparts to be targeted by public health programs, which encourage regular testing for HIV infection.

Factors associated with HIV infection in bivariate analyses may provide insight into factors, which can guide HIV prevention efforts. HIV is an incurable chronic condition and those who are older have likely had a longer duration of potential exposure, and also lived through the period of the HIV epidemic before the widespread use of anti-retroviral therapy. There may also have been an age-cohort effect among older participants. Older participants may have similarly aged sex partners who may also be at increased risk for HIV. Older women may also be less likely to regularly access reproductive health services where they would be more likely to be

offered HIV testing compared to other healthcare visits,³⁴ and healthcare providers may stereotype older women as sexually inactive and, therefore, not recommend HIV testing.³⁵

Non-injection heroin and crack use, along with last sex partner's crack use were associated with HIV infection. Although non-injection drug use is not a route of HIV transmission, substance use has been associated with engaging in high risk sexual behavior.³⁶ Non-injecting drug users may also belong to sexual networks with those who are at greater risk for HIV infection including those who inject drugs.³⁷ In the current study, ever injecting drugs was associated with both 12 month use of non-injection crack ($p < 0.0001$) and non-injection heroin (< 0.0001). In the stratum-specific analysis excluding those who had ever injected drugs, non-injection crack use in the past 12 months remained significantly associated with HIV infection, but non-injection heroin use in the past 12 months was no longer significantly associated with HIV infection. Crack use, in particular, has been found to be associated with HIV especially among women, who may be more likely to engage in unprotected sex with exchange clients.³⁸ The current study also found exchange sex in the past 12 months to be associated with HIV infection. Persons who exchange sex for drugs or money may receive additional incentives to have unprotected sex.³⁹ Women who engage in transactional sex may also be reluctant to test for HIV if they fear a positive diagnosis that could decrease their ability to earn money or drugs through sex.

Surprisingly, unprotected vaginal sex in the past 12 months was found to be inversely associated with HIV infection among this group of women. This is likely a spurious association as unprotected vaginal sex in the past 12 months was reported by almost all (93.5%) study participants. This result may also reflect a greater likelihood of engaging in unprotected sex by those persons who (accurately) perceive their risk of HIV infection from their partner(s) to be low. The study questionnaire asks about condom use with main, casual, and exchange partners, but detailed partner-level behavioral data were not collected.

Currently homeless and homeless in the past 12 months were marginally ($p < 0.1$) associated with HIV infection. Housing instability has previously been associated with HIV risk behaviors,^{40,41} while improved housing conditions have been associated with reductions in risky drug and sexual behaviors.⁴² New York City is one of the most expensive cities in the United States to live.⁴³ The NYC Housing Authority (NYCHA) houses and provides rental assistance to over 635,000 New Yorkers, but the demand for these programs is high and there are currently over 100,000 applicants wait-listed for apartments in public housing.⁴⁴

All HIV infected participants in the current study were neither married nor cohabiting. Those who are married or cohabiting may be more likely to limit the number of sexual partners.^{45,46} Although, other research suggests that black women are more likely to be infected by a steady partner.^{47,48}

As expected, those who were HIV positive reported low rates of HIV testing. New York State amended the HIV testing law effective September 2010, so that all those between the ages of 13 and 64 years must be offered an HIV test for primary care or hospital visits.⁴⁹ Offering HIV testing at medical visits may not be effective, however, if those who are most at-risk of infection decline to test.^{50,51} Fear of a positive diagnosis was found to be the main reason for not testing in the current

study and has also been reported in other studies.^{52,53} Future research should explore how to encourage HIV testing in this population of high risk women. HIV testing campaigns should continue to address potential discrimination and stigma associated with a positive diagnosis and emphasize the benefits of early diagnosis.

Limitations

This study is subject to several limitations. The cross-sectional nature of this study precludes the determination of temporal relationships. Although one of the advantages of RDS is that this sampling method has the potential to reduce bias by producing long recruitment chains, it is possible that this study oversampled from well-connected social networks that differ from the target population, particularly with respect to sexual or drug use factors. Research has indicated that bias may be introduced into RDS studies in many of the same ways as non-RDS studies, such as if individuals are differentially motivated to participate.⁵⁴ The study questionnaire elicited sensitive information regarding sexual behavior and HIV status and participants may not have felt comfortable disclosing this information to study staff interviewers. The anonymous nature of this study precludes confirmation of apparent new HIV diagnoses with the NYC HIV surveillance registry to establish whether the diagnosis had been previously reported. The results may also have been affected by selection bias; those who were more impoverished may have been more inclined to participate in the study than those who were not. The limited sample size may have restricted the power to detect differences within the target population and may have hindered the inclusion of other relevant variables in the final model, especially with regard to the stratum-specific analysis, which included only those without a history of injection drug use. A study with a larger sample size and greater statistical power is needed to confirm the results of this study. CDC protocol specified that those participants who reported injecting drugs in the past 12 months were ineligible to recruit study subjects and the truncating of current injection drug user networks in this sample may have led to an underestimate of HIV prevalence among heterosexuals in these HRAs. Nonetheless, only 5 (3.3%) participants reported injecting drugs in the past 12 months and none of these were HIV positive. Other factors which may be associated with HIV infection among low-income black women such as childhood sexual abuse, sex ratio imbalances, relocation due to neighborhood gentrification, and laboratory-confirmed sexually transmitted infections were not measured in this study.⁵⁵ Also, the lack of additional biological data, including CD4 cell counts, viral load, and BED HIV-1 capture enzyme immunoassay, prevented an inference for estimating duration of HIV infection, although it is likely that many had a relatively long duration of infection. BED HIV-1 capture enzyme immunoassay was used in NYC NHBS-HET1, which had a similar study population to that of NYC NHBS-HET2, with the exception that NHBS-HET1 was somewhat younger since the eligible age range was 18 to 50 years (compared to 18 to 60 years in NHBS-HET2). NYC NHBS-HET1 found high annual HIV incidence, even after removing all IDU and MSM, although no significant difference in incidence was found by gender, race/ethnicity, or age, which is likely due to limited power from the small number who were recently infected.⁵⁶

Conclusion

The results of the current study indicate that many low-income black women with a history of drug use living in or socially connected to neighborhoods with high rates of HIV are HIV infected and unaware of their status. The NYC DOHMH-initiated *Bronx Knows* program has been successful at increasing HIV testing rates in the Bronx and similar results are expected from the *Brooklyn Knows* program, which is currently underway.⁵⁷ Frequent HIV testing is imperative for high-risk groups to identify new infections, so that cases can be linked to care in order to improve patient outcomes and prevent HIV transmission.^{13,14} Partner services could also be a useful method of HIV prevention given that many respondents reported multiple sex partners and this study found a high seroprevalence among those who are not aware of their HIV status. Low-income black women with a history of drug use should be targeted for HIV testing and prevention campaigns, since they may be an overlooked group at high risk for HIV infection. Injection drug users and high risk heterosexuals are often thought of as distinctly different groups at risk for HIV infection, but there is potential overlap in risk for heterosexual current and former IDUs and non-IDUs who have sex partners who are IDUs.^{31,58} Comprehensive harm reduction strategies should also be considered for those at-risk for HIV infection and are part of, or sexually connected to, drug using networks.

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