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Correlates of HIV Transmission Behaviors and HIV Testing in Predominately African American/Black Women with High-Risk Male Sex Partners

Rachel Jones[1] · Donald R. Hoover[2] · Lorraine J. Lacroix[1] · Casey M. Garvey[1]

Abstract

This study was conducted among predominately African American/Black women, aged 18–29, in Northeast cities with high HIV prevalence. Demographic, behavioral, and partner characteristics associated with condomless vaginal and anal sex acts with high-risk partners (CVS-HRP and CAS-HRP) and with HIV testing were explored. The high-risk sample was largely recruited online. Of 4972 women screened, 2254 (45.3%) were high-risk for HIV acquisition; 2214 were included. Bivariate and stepwise multivariate logistic regression models were fit. After adjusting for other factors, sex risk behavior did not differ by race and ethnicity. CAS-HRP was associated with believing condoms don't reduce HIV risk and with several high-risk behaviors, including; alcohol use, multiple partners, and sex with men who had sex with men, but, not with HIV testing. Half the sample had condomless sex with partners who never HIV tested and were themselves three times as likely to have never tested. These results point to the ongoing need for effective prevention strategies among at-risk heterosexual women.

Keywords HIV prevention · Black women · HIV risk behavior · HIV testing · Condomless vaginal and anal sex

Introduction

Nearly all HIV infection in women (86.3%) [1] and particularly among Black women (92.5%) [2], is attributed to heterosexual transmission. Although HIV infection rates among women have decreased during the past few years, Black heterosexual women remain the fourth largest United States (U.S.) transmission group [1]. As of 2017, the annual HIV diagnosis rate among Black women (24.9 per 100,000) was approximately 15 times that of white women (1.7 per 100,000) and five times that of Latinas (5.0 per 100,000), representing an ongoing disparity [1].

Black women are no more likely to engage in sex risk behaviors than are women of other racial groups [3]. But as Black women tend to have sex partners who are Black, the higher HIV prevalence in some Black communities [1], thus relates to an increased transmission risk per condomless sexual encounter for Black women [4, 5]. African Americans accounted for nearly half (43%) of all new HIV diagnoses in 2017 [4]. Most new HIV diagnoses are among men who have sex with men (MSM) and men who have sex with men and women (MSMW) [6], with the fifth largest transmission group in the U.S. being African American men whom are heterosexual [1]. The overwhelming consensus is that higher HIV prevalence in Black communities reflects a syndemic of stigma, economic inequities, racism, homophobia, and disparities in HIV treatment and viral load suppression when compared to the overall population [4, 5, 7].

Annual HIV testing is recommended for persons engaging in HIV risk behaviors [8]. Yet, data from the 2015 National HIV Behavioral Surveillance Survey (NHBS), indicated that compared to MSM and those who inject drugs, heterosexuals at increased HIV risk demonstrated the lowest percent to HIV test in the previous year. Based on a CD4 depletion model indicating disease progression, the diagnosis delay (a median of 4.9 years) was longest for men with HIV infection attributed to heterosexual transmission [9]. Early HIV diagnosis is important for prompt treatment to improve outcomes and prevent transmission. Yet, it is still estimated that

✉ Rachel Jones
  ra.jones@northeastern.edu

1 School of Nursing, Bouvé College of Health Sciences, Northeastern University, 360 Huntington Avenue, 102 Robinson Hall, Boston, MA 02115, USA

2 Department of Statistics and Biostatistics, Rutgers University, New Brunswick, NJ, USA

those who remain unaware of their HIV infection account for roughly 38% of current HIV transmissions in the U.S. [10].

Women's awareness that their male sex partner may be engaging in risk behaviors does not consistently translate to risk reduction as they continue to engage in condomless sex with these partners [11, 12]. This study explores other factors; the demographic, behavioral, and partner characteristics associated with increasing or lowering the likelihood or frequency of condomless vaginal and anal sex with their high-risk partner or multiple partners, and annual versus less frequent or never having HIV tested. Assessing women's risk behaviors and HIV testing in this context may help discern prevention needs among those at high-risk for HIV transmission.

This research was conducted in a sample of high-risk, predominately African American or Black women, aged 18 to 29, in several urban Northeastern cities with high HIV prevalence. High-risk was determined by responses to an online screening survey to assess baseline eligibility into a prospective, randomized controlled trial (RCT) of HIV risk reduction. The results of those recruited online via Facebook and Instagram were compared to the more limited geographic sample that had been recruited face-to-face (FTF) in Boston and surrounding communities.

Background

Condomless Sex Risk Behavior

The 2016 NHBS data of heterosexuals at increased HIV risk showed that 93% of HIV negative women had engaged in condomless vaginal and 26% engaged in condomless anal sex in the previous 12 months. Among HIV-positive women those percentages were also high (73% and 22% respectively). A similar pattern was reported by heterosexual men over the past 12 months (HIV-negative = 88% and 20% respectively; HIV-positive = 71% and 13%). Nearly half (49%) of participants reported condomless sex with an HIV-discordant or unknown status partner at the most recent sexual encounter. These data underscore the importance of effective HIV prevention strategies to increase access to and use of condoms, preexposure prophylaxis (PrEP), and HIV testing for heterosexuals at increased HIV risk [13].

Heterosexual Anal Intercourse

Condomless receptive anal sex (CAS) remains the highest HIV sexual transmission risk [14]. In a meta-analysis considering the HIV transmission risk of receptive anal intercourse, findings of the sole heterosexual study that met the review criteria indicated a higher transmission risk

was conveyed to women when compared to MSM partners [15]. About 28% of current HIV infections among heterosexual women of all ages who do not inject drugs are estimated to be associated with anal sex, while for women aged 18–34, this percent rises to 40% [16]. Nonetheless, public health messages have not emphasized HIV transmission risk associated with heterosexual CAS [17].

Results from a sample of seronegative, heterosexual men and women who had participated in the 20-city 2013 NHBS indicated that, although white women and men were more likely than Black women and men to report heterosexual anal sex, no difference in race nor ethnicity was found for CAS at last sex act [17]. This study also indicated that those engaging in anal sex also engaged in other risk behaviors. For example, participating in heterosexual anal sex was associated with having; a higher-risk partner, multiple sex partners, injection drug use, and a sexually transmitted infection (STI). Not using a condom during the last anal sex act was statistically significantly associated with having a male partner who had sex with men. An inverse relationship between CAS, having a STI, and multiple partners, with HIV testing was also found [17].

HIV Testing

In 2006, the CDC recommended routine HIV screening for the general population, and at least annual testing for those at high HIV infection risk [8]. A workgroup at CDC recently suggested that asymptomatic subpopulations of MSM at high-risk may benefit from more frequent than annual testing [18, 19]. Never-the-less, as noted above, there are gaps in consistent annual testing in high-risk populations, including women. The CDC analyzed data between 2006 and 2016 from the national General Social Survey of adults. Only 39.6% had ever been HIV tested. Of those repeatedly tested, the median interval between HIV tests had been nearly 3 years. For women with HIV risk, 65.9% had ever been tested and 45.6% tested in the past year [20].

Given the importance of characteristics and behaviors associated with women's HIV transmission sex risk behavior and HIV testing frequency, this study seeks to identify demographic, behavioral, and partner characteristics associated with the frequency of condomless vaginal and anal sex with high-risk partners and with HIV testing frequency (never, over a year, and past year) in a sample of predominately Black women at high-risk. The high-risk sample was largely recruited online by Facebook advertising. Results of participants recruited online were compared to the more limited geographic FTF recruitment to assess representativeness of the online versus FTF sample.

Methods

Participants and Setting

The sample consisted of predominately African American or Black women, aged 18 to 29, in the urban Northeast who screened-in as high-risk for HIV transmission in an anonymous survey to determine eligibility into an RCT of HIV risk reduction. The high-risk inclusion criteria in this study were both acknowledged perception or uncertainty about a male sex partner(s)' risk behaviors and engaging in condomless sex with that partner. To access the target population in several Northeastern cities with high HIV prevalence, most of the sample was recruited online via Facebook or Instagram advertising. Women who did not screen in as high-risk as described below were excluded.

High-risk was defined as having in the past 3 months, at least one condomless vaginal or anal sex occurrence, with either, 1) a high-risk male partner, 2) multiple male partners, or 3) an HIV positive male partner, and/or, 4) having a diagnosis of gonorrhea and/or chlamydia. A male partner was considered high-sex-risk if he was perceived to have engaged in sex with other women, sex with men, or injected drugs within the past 3 months.

Data Collection

Guided by the CDC high-impact approach to HIV prevention [21], zip codes with relatively high HIV incidence in predominately Black communities in the urban Northeast were targeted for recruitment into the screening survey. The FTF recruitment was conducted in underserved communities, at streets near bus stops and laundromats, public assistance offices, the vicinity of a Health-In-Motion mobile unit run by the School of Nursing, and at a Women, Infant and Children Center. Flyers were distributed by research assistants (RAs) or study recruiters. Women expressing interest accessed the private and secure study website on their own mobile devices or on a study-provided tablet computer, to anonymously consent to screen, and then complete the online screening survey. The tablet computers were connected to a study-provided mobile hotspot carried by the RAs in their pocket or backpack, to establish a free, wireless, internet connection. Research team members were present to answer any questions during the consenting and screening process. After reviewing the consent, a box was checked to indicate agreement. The RAs were undergraduate women students whom were culture, age, and gender representative of the target population and recruiters who had been recommended by local community organizations. The RAs and recruiters were

trained by the study team and supervised on-site by the Project Director.

Online participants were recruited via Facebook advertisements as well as on Instagram and third-party mobile applications that utilize the Facebook login credentials. Advertisements were created by the study team in consultation with the RAs, whom were representative of the target population [22]. The advertisements consisted of an image, a headline, and short caption targeting women who were dating or in a romantic relationship with a man. An example of an ad headline was, "Tired of his lies? Does he have others on the side? Join the W2W study & you could earn $100 in gift cards!" Keeping in mind that websites, including Facebook, use cookies to track online activities, the ads did not mention HIV [22]. When potential participants clicked on the ad, they were directed to a dedicated secured study website, separate from the Facebook platform. All study activities were located on the secured website. The study website was entitled "Women2Women: A Study of Relationships with Men." This innocuous name protected participants from being identified as participating in an HIV prevention study. Ads were displayed each day until the daily ad budget was reached.

Once on the study website, the procedure was identical to those recruited FTF. The online recruitment flyer and consent were reviewed. Consent was provided by checking agreement to participate [22]. The advantages of online recruitment were that recruitment could occur overnight, on weekends, during inclement weather, when recruiters and/or research assistants were otherwise unavailable, and capacity to reach women in several cities.

The screening survey was programmed as a computer assisted self-interview (CASI). Using an adaptive web design meant the platform could accommodate participants to complete the survey while using their own smartphones, tablets, or computers on different operating systems. Those categorized as high-risk by the CASI algorithm were invited to the 6-month long RCT and randomized. The sample in this study consisted of those who completed the survey and were categorized as high-risk. These data were collected from September 2015 to September 2018. All procedures and protocols were approved by the Institutional Review Board of Northeastern University.

Instruments

Sex risk behavior data were collected on the frequency of vaginal and anal sex and condom use during the previous 3 months. Participants were asked to offer a first name or pseudonym for each sex partner one through five, so that data on sexual behavior were collected in the context of each specific partner relationship. To determine partner risk behavior, data were collected concerning the participant's perception of

her partner's behaviors of sex with other women, sex with men, and/or injecting drugs. The high-risk partner (HRP) was determined by responses of > 0 to any of these 3 items: how likely is it that your partner 1) had sex with another woman, 2) had sex with men, or, 3)injected drugs in the past 3 months? There was a 4-point response metric from definitely not ($= 0$) to definitely did ($= 3$). If a woman had multiple partners all were considered high-risk. Only women having condomless sex with: an HRP > 0, multiple partners, or an HIV+ partner or otherwise, whom themselves reported Gonorrhea and/or Chlamydia in the past 3 months were included in the study. The HIV testing data were collected on having ever tested, tested greater than 1 year ago, and having last tested in the past year.

Demographic data included: age, age at first intercourse, race/ethnicity, hours of work per week, contraceptive use, and number of children. Data were also collected on: a diagnosis of a sexually transmitted infection (STI) in the past 3 months, and if so, the STI type was elicited by a drop down menu; personal HIV status; non-injection and injection drug use and alcohol consumption before or during sex over the past 3 months; number of sex partners in past year, weekly frequency of sex per year, average use of condoms during the past year, and partner/s HIV testing frequency and status.

Data Analysis

Condomless vaginal and condomless anal sex acts with a high-risk partner (CAS-HRP) during the past 3 months were ascertained. The top quintile of number of condomless vaginal sex acts with a high-risk partner (TQ-CVS-HRP) in the last 3 months occurred as ≥ 35 acts (vs. < 35 acts). Both TQ-CVS-HRP and CAS-HRP were created as categorical outcome variables. Time from most recent HIV test was categorized as ≤ 1 year (baseline), > 1 year, and never tested. Data collected from those recruited online were compared to data from the smaller sample of participants recruited FTF in Boston and surrounding neighborhoods using chi square tests.

Scaled items with never $= 0$, sometimes $= 1$, most times $= 2$, always $= 3$ were compared between demographic groups using trend tests and were included in the logistic regression models as ordinal variables, with odds ratios as per unit increase in score from 0 to 3. Otherwise associations between predictor variables and condomless sex with high-risk partners as defined by TQ-CVS-HRP and CAS-HRP and for HIV testing outcomes were compared using chi square tests. Non-ordered multi-level variables were fit into logistic models of those outcomes as being categorical.

Bivariate logistic regression models were fit with lower-risk behavior as the baseline for unprotected sex outcomes, and HIV testing in the past year as the baseline category for

HIV testing outcomes. For each high-risk sex behavior or HIV testing outcome (vs. baseline) stepwise logistic regression models were then fit using a p value of 0.05 to enter the model and of 0.10 to remain in the model. Also, since geographical residence was not taken on the full sample, this variable was not considered in these models to prevent data loss. However, once the final models were obtained, geographical site of recruitment was added to the final model to obtain the multivariate associations for this variable. Statistical significance was considered at, $p \leq 0.05$.

Results

Description of Participants

Of the 4972 women screened, 2254 (45.3%) were identified as high-risk, of whom 2214 (98.2%) had complete data and were included in these analyses. Excluded observations were those who were HIV positive at the time of screening (n $= 12$), had missing baseline risk data (n $= 8$) and the level of sex risk had been misclassified (n $= 20$), resulting in a study sample of 2214. Most participants were African American or Black, (n $= 1554$, 70.2%); 420 (19.0%) identified as Latina, and 147 (6.6%) were white (see Table 1). The remaining identified as Native American/American Indian, Asian, and Middle Eastern (n $= 93$, 4.2%). Most were recruited online via Instagram or Facebook advertising (n $= 1942$, 87.7%) with the rest from neighborhood venues in Boston and surrounding communities (n $= 271$, 12.2%). The mean age was 24. We observed that: 722 (32.6%) had less than a high school education, 1227 (55.4%) did not have children, 1654 (74.7%) were employed outside the home, and 1062 (49.1%) had first sex at or before 15 years of age. The most commonly used drug before or during sex in the past 3 months was marijuana (n $= 765$, 34.6%). Most of the sample consumed alcohol before or during sex in the past 3 months (n $= 1487$, 67.2%), only 48 injected drugs during the past 3 months.

Not surprising, since engaging in condomless sex with a high-risk partner was a study inclusion criterion, almost all (n $= 2189$, 98.9%) engaged in at least one CVS-HRP act during the past 3 months. Those in the top quintile (TQ) of the nearest round number of CVS acts with an HRP (TQ-CVS-HRP) (n $= 445$, 20.1%) had engaged in 35 acts or more during this three-month period. This TQ was compared to the remaining 80% as shown in the left column of Table 1. As shown in Table 2, there were 463 (20.9%) who engaged in at least one act of condomless anal sex with a high-risk partner (CAS-HRP).

Among the 2213 who responded to this item, the highest participation in HIV testing occurred in the past year (n $= 1156$, 52.1%). This was followed by an HIV test over 1

Table 1 Top quintile of condomless vaginal sex with high-risk partner/s in the past three months

Variable	Total (N=2214)	In top quintile of high-risk vaginal sex Yes=445 No=1769	Odds ratio	
	n	%	Unadjusted	Adjusted
Characteristics of sample				
Current age				
≤25	1168	18.5	0.81 (0.66, 1.00)*	–
>25	1046	21.9	a	–
Age at first sex[1]				
≤15	1062	23.2	1.46 (1.18, 1.81)***	1.31 (1.05, 1.63)*
>15	1100	17.1	a	a
Race/ethnicity				
Black	1554	19.2	a	–
Hispanic	420	23.8	1.32 (1.02, 1.70)*	–
White	147	19.1	0.99 (0.65, 1.53)	–
Other	93	20.4	1.08 (0.64, 1.82)	–
Level of education				
High school or less	722	22.7	1.28 (1.02, 1.59)*	–
Beyond high school	1490	18.8	a	–
Has at least one child				
Yes	986	23.6	1.49 (1.21, 1.84)***	1.38 (1.10, 1.72)**
No	1227	17.2	a	a
Uses some form of contraception				
Yes	1281	15.4	0.50 (0.41, 0.62)***	0.54 (0.43, 0.67)***
No	932	26.5	a	a
Male partner characteristics				
Partner has sex with men				
Yes	438	17.1	0.79 (0.60, 1.03)	0.69 (0.52, 0.93)**
No	1776	20.8	a	a
Condomless sex with at least one high-risk partner not tested for HIV				
Yes	1051	17.9	0.77 (0.62, 0.95)**	–
No	1163	22.1	a	
Condomless sex with at least one high-risk partner not tested for HIV since together				
Yes	1396	17.3	0.64 (0.51, 0.78)***	0.66 (0.53, 0.82)***
No	818	24.8	a	a
Women's exchange sex and substance use				
Exchange sex for money/drugs/other benefits				
Yes	393	26.2	1.54 (1.20, 1.99)***	–
No	1820	18.7	a	–
Alcohol before or during sex[2]				
Never	726	16.0	a	–
Sometimes	1153	22.6	1.19 (1.04, 1.36)[2],**	–
Most times	271	18.5	1.42 (1.08, 1.85)[2],**	–
Always	63	27.0	1.69 (1.12, 2.52)[2],**	–
Drug use before or during sex[2]				
Never	1379	16.3	a	a
Sometimes	478	22.6	1.42 (1.28, 1.58)[2],***	1.42 (1.27, 1.59)[2],***
Most times	218	28.9	2.02 (1.64, 2.50)[2],***	2.02 (1.61, 2.53)[2],***
Always	138	34.8	2.86 (2.10, 3.94)[2],***	2.86 (2.05, 4.02)[2],***

Table 1 (continued)

Variable	Total (N = 2214)	In top quintile of high-risk vaginal sex Yes = 445 No = 1769	Odds ratio	
	n	%	Unadjusted	Adjusted
Uses weed before or during sex				
Yes	765	26.7	1.82 (1.48, 2.25)***	–
No	1449	16.6	a	–
Uses opioids before or during sex				
Yes	72	30.6	1.79 (1.07, 2.99)*	–
No	2142	19.8	a	–
Uses Ecstasy before or during sex				
Yes	44	40.9	2.83 (1.54, 5.20)**	–
No	2170	19.7	a	–
Uses cocaine before or during sex				
Yes	56	37.5	2.45 (1.41, 4.26)**	–
No	2158	19.7	a	–
Uses benzodiazepines before or during sex				
Yes	18	50.0	4.04 (1.59, 10.23)**	3.67 (1.38, 9.77)**
No	2196	19.9	a	a

The following variables were excluded from this table because they were found to be non-statistically significant in both the unadjusted univariate and adjusted multivariate models: recruitment method, randomization site, work outside of home, believe condoms reduce HIV risk, randomized into main study, high-risk sex category, partner has sex with other women, partner injects drugs, partner is HIV positive, had any high-risk anal sex, injected drugs in past 3 months

*$p \leq 0.05$ but > 0.01, **$p \leq 0.01$ but > 0.001, ***$p < 0.001$

[a]Baseline variable

[1]There were 52 cases missing due to programming error

[2]p-value from trend test and odds ratio from ordinal logistic regression model was coded as: never = 0, sometimes = 1, most time = 2, always = 3

– The variable was not selected in the final stepwise model

year ago (n = 442. 20.0%), with the lowest percentages having never been tested (n = 215, 9.7%). Level of education was associated with TQ-CVS-HRP in unadjusted analysis only, and work outside the home was not associated with sex risk behavior nor HIV testing frequency.

Results of participants recruited online were compared to the more limited geographic FTF recruitment to assess representativeness of the online versus FTF sample. No difference was found in sex risk behavior according to the mode of recruitment (see Tables 1, 2). With Massachusetts as the comparator, there were no differences in being in the TQ-CVS-HRP nor in CAS-HRP according to the geographic site location among those who were randomized.

Tables 1 and 2 show both percentages and unadjusted odds ratios (uOR) for TQ-CVS-HRP and CAS-HRP by important woman and partner characteristics. In addition, the adjusted odds ratios (aOR) are shown for those variables that made it into the final multivariate models. For HIV testing (see Table 3), we focus on comparison of having never been HIV tested (the worst outcome) to both, 1) having been HIV tested in the past year (the best outcome) and,

2) having been HIV tested in the past year. Several variables were not associated with either TQ-CVS-HRP, CAS-HRP nor HIV testing in unadjusted analyses and were not selected for inclusion into any of the final stepwise models and are thus not presented in Tables 1, 2 and 3.

Finally, to present the most important associations in one place, Table 4 summarizes only those variables that remain independently statistically significant related to TQ-CVS-HRP, CAS-HRP, and/or HIV testing in multivariate models. We will focus our presentation on the results shown in Table 4. Some variables that were associated in unadjusted analysis but did not remain statistically significant in adjusted analysis (and thus are not in Table 4) will also be reported here because of their importance to HIV transmission dynamics.

Correlates of Condomless Vaginal sex with High-Risk Partners

The following characteristics of the woman remained independently associated with condomless vaginal sex in

Table 2 Condomless anal sex risk with high-risk partner/s in the past 3 months

Variable	Total (N = 2214)	Engaged in high-risk anal sex Yes = 463 No = 1751	Odds ratio	
	n	%	Unadjusted	Adjusted
Characteristics of sample				
Current age				
≤ 25	1168	17.7	0.66 (0.54, 0.82)***	0.75 (0.59, 0.94)**
> 25	1046	24.5	[a]	[a]
Race/ethnicity				
Black	1554	18.9	[a]	–
Hispanic	420	26.2	1.53 (1.19, 1.97)**	–
White	147	24.5	1.40 (0.94, 2.08)	–
Other	93	25.8	1.50 (0.93, 2.42)	–
Has at least one child				
Yes	986	24.4	1.46 (1.19, 1.80)***	1.38 (1.10, 1.73)**
No	1227	18.1	[a]	[a]
Believe condoms reduce HIV risk?				
Yes	1841	19.8	[a]	[a]
No	277	27.1	1.51 (1.13, 2.01)**	1.67 (1.23, 2.28)*
Don't know	95	25.3	1.37 (0.85, 2.21)	1.30 (0.79, 2.13)
Uses some form of contraception				
Yes	1281	18.4	0.70 (0.57, 0.86)***	0.71 (0.57, 0.87)***
No	932	24.4	[a]	[a]
Male partner characteristics				
High-risk sex category				
Single high-risk partner	1629	18.9	[a]	[a]
Multiple partners[1]	585	26.5	1.55 (1.24, 1.93)***	1.35 (1.06, 1.71)*
Partner has sex with men				
Yes	438	28.5	1.70 (1.34, 2.16)***	1.36 (1.04, 1.78)*
No	1776	19.0	[a]	[a]
Partner injects drugs				
Yes	405	29.4	1.77 (1.39, 2.26)***	1.64 (1.24, 2.16)***
No	1809	19.0	[a]	[a]
Partner is HIV positive				
Yes	124	29.0	1.59 (1.07, 2.38)*	–
No	2090	20.4	[a]	–
Women's exchange sex and substance use				
Exchange sex for money/drugs/other benefits				
Yes	393	27.5	1.56 (1.22, 2.01)***	–
No	1820	19.5	[a]	–
Alcohol before or during sex[2]				
Never	726	15.0	[a]	[a]
Sometimes	1153	23.0	1.36 (1.19, 1.56)[2],***	1.24 (1.08, 1.43)[2],**
Most times	271	27.7	1.85 (1.42, 2.43)[2],***	1.54 (1.17, 2.04)[2],**
Always	63	22.2	2.52 (1.69, 3.80)[2],***	1.91 (1.26, 2.92)[2],**
Drug use before or during sex[2]				
Never	1379	18.9	[a]	–
Sometimes	478	22.8	1.17 (1.05, 1.30)[2],**	–
Most times	218	28.0	1.37 (1.10, 1.69)[2],**	–
Always	138	23.2	1.60 (1.16, 2.20)[2],**	–

Table 2 (continued)

Variable	Total (N = 2214)	Engaged in high-risk anal sex Yes = 463 No = 1751	Odds ratio	
	n	%	Unadjusted	Adjusted
Uses weed before or during sex				
Yes	765	23.7	1.28 (1.04, 1.58)*	–
No	1449	19.5	a	–
Uses opioids before or during sex				
Yes	72	34.7	2.07 (1.26, 3.40)**	–
No	2142	20.5	a	–
Uses Ecstasy before or during sex				
Yes	44	36.4	2.20 (1.18, 4.11)**	–
No	2170	20.6	a	–
Uses cocaine before or during sex				
Yes	56	42.9	2.94 (1.71, 5.04)***	2.26 (1.28, 3.99)**
No	2158	20.3	a	a
Uses benzos before or during sex				
Yes	18	44.4	3.06 (1.20, 7.80)*	–
No	2196	20.7	a	–

The following variables were excluded from this table because they were found to be non-statistically significant in both the unadjusted univariate and adjusted multivariate models: Recruitment methods, randomization site, age at first sex, level of education, work outside the home, randomized into main study, partner has sex with other women, condomless sex with at least one high-risk partner not tested for HIV, condomless sex with at least one high-risk partner not tested for HIV since together, in top quintile of condomless vaginal sex, injected drugs in past 3 months

$*p \leq 0.05$ but > 0.01, $**p \leq 0.01$ but > 0.001, $***p < 0.001$

[a]Baseline variable

[1]Multiple partners is condomless sex with more than one partner up to five partners

[2]p-value from trend test and odds ratio from ordinal logistic regression model was coded as never = 0, sometimes = 1, most times = 2, always = 3

– The variable was not selected in the final stepwise model

multivariate analysis (Table 4). Age at first sexual intercourse younger than or equal to 15 was independently associated with an increased likelihood of being in the TQ-CVS-HRP in adjusted (aOR = 1.31, $p \leq 0.05$) as well as unadjusted (uOR = 1.46, $p \leq 0.001$) analyses. These and other unadjusted analyses reported for TQ-CVS-HRP are shown in Table 1. In terms of reproductive health, using some form of contraception was independently associated with a decreased likelihood of being in the TQ-CVS-HRP (aOR = 0.54, $p \leq 0.001$), whereas, having at least one child was associated with an increased likelihood of being in the TQ-CVS-HRP (aOR = 1.38, $p \leq 0.01$).

Of note, race and ethnicity did not remain statistically significant in the multivariate model for TQ-CVS-HRP. When Hispanic/Latina, white, and the category of "other" were compared to the majority of the sample (Black women), being Hispanic/Latina was associated with an increased likelihood of being in the TQ-CVS-HRP in unadjusted analysis only (uOR = 1.32, $p \leq 0.05$) but again, there was no statistical difference by race or ethnicity in adjusted analyses.

Characteristics of the male partner that remained independently significant in adjusted analysis are now described. Believing one's male partner had sex with men was independently associated with a decreased likelihood of being in the TQ-CVS-HRP (aOR = 0.69, $p \leq 0.01$). However, no difference for TQ-CVS-HRP was shown according to the perception of the male partner(s)' sex with other women. Of interest, it was not statistically different to be in the top quintile of numbers of CVS-HRP acts ($p = 0.13$) for the 1629 women with a single at-risk partner as it was for the 585 who were with more than one high-risk partner. Having condomless sex with at least one high-risk partner *not HIV tested since together* was independently associated with a decreased likelihood of being in the TQ-CVS-HRP, including in adjusted analysis (aOR = 0.66, $p \leq 0.001$). No difference in being in the TQ-CVS-HRP was found in unadjusted analysis, according to believing a male partner injected drugs.

As shown in Table 1, exchanging sex for money, drugs, or other benefits was associated with increased likelihood of being in the TQ-CVS-HRP (26.2%) compared to

Table 3 HIV testing over 1 year ago and never testing compared to testing in past year

Variable	Total (N = 2214)	Percent of row variable having the column outcome			Compared to having tested in the past year			
	n	Past year or less	Greater than 1 year	Never	Tested > 1 year ago		Never tested	
					Unadjusted odd ratio	Multivariate odds ratio	Unadjusted odd ratio	Multivariate odds ratio
Characteristics of sample								
Recruitment method[b]								
Online	1942	71.3	19.7	9.0	0.79 (0.57, 1.08)	–	0.54 (0.37, 0.79)**	0.52 (0.34, 0.80)**
Face-to-face	271	63.1	22.1	14.8	a	–	a	a
Geographic randomization site[1]								
Massachusetts	412	64.1	25.2	10.7	a	a	a	a
New Jersey	181	75.1	17.7	7.2	0.60 (0.38, 0.93)*	0.65 (0.41, 1.03)	0.57 (0.30, 1.10)	0.63 (0.29, 1.35)
New York City	237	80.2	16.5	3.4	0.52 (0.35, 0.79)***	0.55 (0.36, 0.84)**	0.25 (0.12, 0.55)***	0.34 (0.15, 0.79)*
Other	49	77.6	16.3	6.1	0.53 (0.24, 1.18)	0.54 (0.24, 1.22)	0.47 (0.14, 1.60)	0.58 (0.16, 2.16)
Philadelphia	137	71.5	23.4	5.1	0.83 (0.52, 1.31)	0.92 (0.57, 1.47)	0.43 (0.19, 0.98)*	0.63 (0.25, 1.60)
Current age[b]								
≤ 25	1167	69.8	16.1	14.1	0.67 (0.55, 0.84)***	0.64 (0.52, 0.80)***	3.01 (2.16, 4.19)***	1.85 (1.26, 2.71)**
> 25	1046	70.9	24.3	4.8	a	a	a	a
Age at first sex[2]								
≤ 15	1062	73.8	19.9	6.3	0.89 (0.72, 1.10)	–	0.45 (0.33, 0.61)***	0.49 (0.35, 0.70)***
> 15	1100	67.0	20.3	12.7	a	–	a	a
Race/ethnicity[b]								
Black	1554	73.4	18.7	7.9	a	a	a	a
Hispanic	420	65.2	21.9	12.9	1.32 (1.01, 1.72)*	1.30 (0.99, 1.72)	1.83 (1.29, 2.58)**	1.57 (1.06, 2.33)*
White	147	55.8	25.9	18.4	1.82 (1.21, 2.72)**	1.68 (1.11, 2.55)*	3.05 (1.90, 4.90)***	2.36 (1.35, 4.11)**
Other	92	65.2	22.8	12.0	1.37 (0.82, 2.29)	1.36 (0.80, 2.30)	1.70 (0.87, 3.32)	1.52 (0.69, 3.34)
Has at least one child[b]								
Yes	986	75.4	20.5	4.2	1.09 (0.88, 1.33)	–	0.26 (0.18, 0.37)***	0.39 (0.26, 0.59)***
No	1227	66.3	19.6	14.2	a	–	a	a
Believe condoms reduce HIV risk[b]								
Yes	1841	70.9	20.5	8.6	a	–	a	a
No	277	68.2	18.1	13.7	0.92 (0.66, 1.28)	–	1.65 (1.12, 2.43)*	1.79 (1.13, 2.85)*
Don't know	95	65.3	15.8	19.0	0.84 (0.47, 1.49)	–	2.38 (1.38, 4.13)***	2.64 (1.41, 4.94)**
Uses some form of contraception[b]								

Table 3 (continued)

Variable	Total (N = 2214)	Percent of row variable having the column outcome			Compared to having tested in the past year			
					Tested > 1 year ago		Never tested	
	n	Past year or less	Greater than 1 year	Never	Unadjusted odd ratio	Multivariate odds ratio	Unadjusted odd ratio	Multivariate odds ratio
Yes	1281	71.4	19.6	9.0	0.92 (0.74, 1.14)	–	0.81 (0.61, 1.07)	0.71 (0.51, 0.98)*
No	932	68.8	20.5	10.7	a	–	a	a
Male partner characteristics								
High-risk sex category[b]								
Single high-risk partner	1629	70.0	20.4	9.5	a	a	a	a
Multiple partners[3]	584	71.1	18.7	10.3	0.90 (0.71, 1.15)	0.70 (0.54, 0.91)**	1.06 (0.77, 1.46)	0.54 (0.37, 0.78)***
Partner injects drugs[b]								
Yes	404	63.4	19.6	17.1	1.11 (0.84, 1.46)	–	2.40 (1.75, 3.29)***	1.50 (1.03, 2.17)*
No	1809	71.9	20.1	8.1	a	–	a	a
Condomless sex with at-least one high-risk partner not tested for HIV[b]								
Yes	1050	61.7	21.6	16.7	1.48 (1.20, 1.83)***	–	6.13 (4.29, 8.77)***	3.06 (1.94, 4.81)***
No	1163	78.1	18.5	3.4	a	–	a	a
Condomless sex with at least one high-risk partner not tested for HIV since together[b]								
Yes	1395	63.3	22.9	13.8	1.98 (1.57, 2.49)***	2.20 (1.72, 2.81)***	6.69 (4.25, 10.51)***	3.20 (1.80, 5.67)***
No	818	82.3	15.0	2.7	a	a	a	a
Women's sexual and substance use in the past 3 months								
In top quintile of condomless vaginal sex[b]								
Yes	444	76.1	17.3	6.5	0.76 (0.58, 1.00)*	–	0.56 (0.37, 0.85)**	–
No	1769	68.9	20.6	10.5	a	–	a	–
Exchange sex for money/drugs/other benefits[b]								
Yes	393	75.6	20.1	4.3	0.92 (0.70, 1.21)	–	0.36 (0.22, 0.61)***	0.49 (0.28, 0.85)**
No	1820	69.2	20.0	10.9	a	–	a	a
Alcohol before or during sex[4,b]								
Never	726	70.1	17.2	12.7	a	–	a	–
Sometimes	1153	71.0	20.9	8.2	1.20 (1.04, 1.38)[4,**]	–	0.81 (0.66, 0.99)[4,*]	–

Table 3 (continued)

Variable	Total (N = 2214)	Percent of row variable having the column outcome			Compared to having tested in the past year			
	n	Past year or less	Greater than 1 year	Never	Tested > 1 year ago		Never tested	
					Unadjusted odd ratio	Multivariate odds ratio	Unadjusted odd ratio	Multivariate odds ratio
Most times	271	72.0	19.6	8.5	1.44 (1.08, 1.90)[4,**]	–	0.66 (0.44, 0.98)[4,*]	–
Always	63	54.0	36.5	9.5	1.73 (1.12, 2.63)[4,**]	–	0.53 (0.29, 0.97)[4,*]	–
Injected drugs in past 3 months[b]								
Yes	48	66.7	12.5	20.8	0.65 (0.27, 1.58)	–	2.32 (1.13, 4.80)*	–
No	2165	70.4	20.1	9.5	[a]	–	[a]	–

The following variables were excluded from this table because they were found to be non-statistically significant in both the unadjusted univariate and adjusted multivariate models: Level of education, work outside of home, randomized into main study, partner has sex with other women, partner has sex with men, partner is HIV positive, has condomless anal sex, non-injection drug use before or during sex: weed, opioids, Ecstasy, cocaine, and benzodiazepines

[1]Data on site of recruitment was captured for those randomized into the study only, n = 1016

[2]There were 52 cases missing due to programming error

[3]Multiple partners is condomless sex with more than one partner up to five partners

[4]p-value from trend test and odds ratio from ordinal logistic regression model was coded as: never = 0, sometimes = 1, most time = 2, always = 3

[a]Baseline variable

[b]N = 2213

*$p \leq 0.05$ but > 0.01, **$p \leq 0.01$ but > 0.001, ***$p < 0.001$

– The variable was not selected in the final stepwise model

not exchanging sex (18.7%), $p \leq 0.001$. But, in the multivariate analysis, exchange sex did not remain statistically associated with being in TQ-CVS-HRP.

Consideration of substance use yielded mixed findings. Level of alcohol use before or during sex as an ordinal category (0–3) was associated with an increased likelihood of being in the TQ-CVS-HRP only in unadjusted analysis (uOR per category = 1.19, $p \leq 0.01$), but there was no independent associated risk of being in the TQ-CVS-HRP in adjusted analysis (Table 1). As a whole, non-injection drug use before or during sex was independently associated with increased odds of being in the TQ-CVS-HRP (aOR = 1.42 per category shift from 0 to 3, $p \leq 0.001$). Thus, always using drugs before or during sex (as opposed to never using drugs) was associated with a $(1.42)^3 = 2.86$ increased likelihood of being in the TQ-CVS-HRP ($p \leq 0.001$) in both unadjusted and adjusted analyses (Table 1). For use of individual non-injection drugs before or during sex, only that of benzodiazepines remained independently associated with increased odds of being in the TQ-CVS-HRP in adjusted analysis (aOR = 3.67, $p \leq 0.01$).

Correlates of Condomless Anal Sex with High-Risk Partners

The following characteristics of the woman remained independently associated with CAS (Table 4) and often varied from those associated with CVS. The odds of engaging in CAS-HRP was statistically lower for women 25 or younger compared to women who were older in adjusted analysis (aOR = 0.75 $p \leq 0.01$). This and other unadjusted and adjusted analyses for CAS-HRP are shown in Table 2. Age at first sexual intercourse being younger than or equal to 15 was not statistically associated with engaging in CAS-HRP. In unadjusted analysis, Latinas showed statistically higher risk of CAS-HRP compared to Black women. But, once more, no statistical difference associated with race nor ethnicity was found in adjusted analyses. Compared to believing that condoms did reduce HIV transmission risk, believing that condoms did *not* reduce risk, was positively related to CAS-HRP in unadjusted (uOR = 1.51, $p \leq 0.01$) and adjusted analysis (aOR = 1.67, $p \leq 0.05$). Contraceptive use was independently associated with decreased likelihood of engaging in CAS-HRP (aOR = 0.71, $p \leq 0.001$).

Table 4 Table of independently significant associations

Variable	Multivariate analysis odds ratio			
	TQ-HRP-CVS	HRP-CAS	HIV-Testing	
			> 1 year	Never
Characteristics of sample				
Recruitment methods online (vs. face-to-face)	–	–	–	0.52**
Geographic site of randomization[1]				
New York City (vs. Massachusetts)	–	–	0.55**	0.34*
Current age ≤ 25 (vs. > 25)	–	0.75**	0.64***	1.85**
Age at first sex[2] ≤ 15 (vs. > 15)	1.31*	–	–	0.49***
Race/Ethnicity				
Hispanic (vs. Black)	–	–	–	1.57*
White (vs. Black)	–	–	1.68*	2.36**
Has at least one child (vs. no)	1.38**	1.38**	–	0.39***
Believe condoms reduce HIV risk?				
No (vs. yes)	–	1.67*	–	1.79*
Don't know (vs. yes)	–	–	–	2.64**
Uses some form of contraception (vs. no)	0.54***	0.71***	–	0.71*
Male partner characteristics				
High-risk sex category of multiple partners[3] (vs. single high-risk partner)	–	1.35*	0.70**	0.54***
Partner has sex with men (vs. no)	0.69**	1.36*	–	–
Partner injects drugs (vs. no)	–	1.64***	–	1.50*
Condomless sex with at least one high-risk partner not tested for HIV (vs. no)	–	–	–	3.06***
Condomless sex with at least one high-risk partner not tested for HIV since together (vs. no)	0.64***	–	2.20***	3.20***
Women's exchange sex and substance use				
Exchange sex for money/drugs/other benefits (vs. no)	–	–	–	0.49**
Alcohol before or during sex[4]				
Sometimes (vs. never)	–	1.24[4],**	–	–
Most times (vs. never)	–	1.54[4],**	–	–
Always (vs. never)	–	1.91[4],**	–	–
Drug use before or during sex[4]				
Sometimes (vs. never)	1.42[4],***	–	–	–
Most times (vs. never)	2.02[4],***	–	–	–
Always (vs. never)	2.86[4],***	–	–	–
Uses cocaine before or during sex (vs. no)	–	2.26**	–	–
Uses benzos before or during sex (vs. no)	3.67**	–	–	–

The following variables were excluded from this table because they were found to be non-statistically significant in the adjusted multivariate models: level of education, work outside the home, randomized into main study, partner has sex with other women, partner is HIV positive, uses weed, opioids, or Ecstasy before or during sex; injected drugs in past 3 months

[1]Data on site of recruitment was captured for those randomized into the study only, n = 1016

[2]There were 52 cases missing due to programming error

[3]Multiple partners is condomless sex with more than one partner up to five partners

[4]p-value from trend test and odds ratio from ordinal logistic regression model was coded as: never = 0, sometimes = 1, most time = 2, always = 3

*$p \leq 0.05$ but > 0.01, **$p \leq 0.01$ but > 0.001, ***$p < 0.001$

– The variable was not statistically significant in the final stepwise model

Having at least one child was associated with an associated independent increase in engaging in CAS-HRP (aOR = 1.38, $p \leq 0.01$).

Exchanging sex for money, drugs, or services while not independently associated with engaging in CAS-HRP, was associated in unadjusted analysis. If women had exchanged

sex for money, drugs, or other services (27.5%), they were more likely to engage in CAS-HRP than if they had not done so (19.5%), $p \leq 0.001$ (Table 2).

Consideration of male partner characteristics also yielded different associations with CAS compared to CVS. As shown in Table 2, of those with only a single high-risk partner, 308 (18.9%) had at least one CAS-HRP act versus 155 (26.5%) who had engaged in CAS-HRP with multiple high-risk partners, $p \leq 0.001$. The odds of engaging in CAS-HRP remained independently associated with an increased likelihood if women had multiple high-risk partners (aOR = 1.35, $p \leq 0.05$).

Of the 438 who perceived at least one of their male partners had sex with men, 28.5% engaged in CAS-HRP, versus only 19.0% who engaged in CAS-HRP if no partner was perceived to have sex with men, $p \leq 0.001$. Believing one's partner had sex with men was associated with an increase in the odds of engaging in CAS-HRP in unadjusted (uOR = 1.70, $p \leq 0.001$) and adjusted analysis (aOR = 1.36, $p \leq 0.05$).

Women with partners they perceived to have injected drugs (29.4%) versus did not inject drugs (19.0%), were more likely to have engaged in CAS-HRP. Believing the partner injected drugs use remained independently associated with an increased likelihood of engaging in CAS-HRP (aOR = 1.64, $p \leq 0.001$). Of note, having at least one high-risk partner who had never tested for HIV, or having at least one high-risk partner who had not tested since being together, was not associated with engaging in CAS-HRP in unadjusted nor adjusted analysis.

In considering associations of substance use before or during sex with CAS-HRP, the findings again varied from those with CVS. Consuming alcohol before or during sex was independently associated with an increased likelihood of CAS-HRP (aOR = 1.24 per category increase, $p \leq 0.01$), meaning for each unit increase in alcohol consumption, there was an increase of 1.24 in the likelihood of engaging in CAS-HRP. For example, always (vs. never) consuming alcohol before or during sex was independently associated with an aOR of 1.91 ($= 1.24^3$). As a whole, non-injection drug use before or during sex was associated with an increased likelihood of CAS-HRP ($p \leq 0.01$) in unadjusted analysis (Table 2). Only cocaine remained independently associated with an increased likelihood of CAS-HRP in adjusted analysis (aOR = 2.26 $p \leq 0.01$). Of the entire sample of 2214, only 48 injected drugs during the previous 3 months and no statistical associations with sex behavior and injection drug use were found.

Correlates of HIV Testing Frequency: 1 Year, Never, Greater Than 1 Year

Having been recruited online was statistically associated with a lower likelihood of *never* having been tested for HIV

versus those recruited FTF, 9.0% versus 14.8%, aOR = 0.52 ($p \leq 0.01$). However, there was no statistical difference between online and FTF recruitment in the likelihood of having tested for HIV greater than 1 year ago, 19.7% vs. 22.1% (aOR = 0.79 $p > 0.50$). The comparator group for both the odds of never having HIV tested and having tested over a year ago (as described in the Methods Section) was having tested in the past year (see Table 3). From here, in general, this comparator group of having been tested in the past year, will not be restated to reduce redundancy.

Data were collected identifying the sites of recruitment among those agreeing to be randomized into the clinical trial. There were qualitative variations in HIV testing based on the site of recruitment among those randomized. Focusing on never having HIV tested, New York City (NYC) showed the lowest percent of those who were never tested (3.4%) compared to Massachusetts (MA) (10.7%), (aOR = 0.34 $p \leq 0.05$). Similarly, NYC was the single city with the lowest percent who were HIV tested > 1 year ago (16.5%) compared to 25.2% in MA (aOR = 0.55, $p \leq 0.01$) and 23.4% in Philadelphia. Still at each site, well over half the sample was HIV tested within the past year, with the lowest being 64.1% in Massachusetts.

The following characteristics of the woman remained independently associated with HIV testing frequency (Table 4). Women, aged 25 or younger, were independently more likely to have never HIV tested (14.1%) compared to women 25 to 29 years old who never tested (4.8%). This corresponded to an aOR = 1.85 ($p \leq 0.01$). However, older women were more likely to have an HIV test over a year ago. Compared to roughly one-fourth (24.3%) of women older than 25, only 16.1% of younger women (aOR = 0.64, $p \leq 0.001$) tested over a year ago. The percentages for both age groups similarly indicated high participation in testing within the past year (69.8% and 70.9% respectively) (see Table 3).

Women were independently much less likely to have *never* HIV tested if they were 15 or younger at age of first intercourse (6.3%) than if they were older at first intercourse (12.7%) corresponding to an aOR = 0.49, $p \leq 0.001$ for women younger at first intercourse. Still, there were high levels of HIV testing within the previous year for both age at first sex groups (73.8% versus 67.0% respectively, see Table 3).

Black women were least likely (7.9%) while white women were the most likely to have never HIV tested (18.4%). Among Black women, 18.7% tested over 1 year ago, compared to just over one-fifth of Latinas (21.9%) and one-fourth of white women (25.9%) who tested over a year ago. Black women were thus the most likely to have an HIV test within the past year (73.4%) compared to Latinas (65.2%) and white women (55.8%). In adjusted models with testing during the past year as a baseline, compared to Black

women, the odds for having never tested for white women were higher (aOR = 2.36, $p \leq 0.01$) and for testing over a year ago were also higher for white women than Black women (aOR = 1.68, $p \leq 0.05$). Compared to Black women, Latinas were also more likely to have never tested (aOR = 1.57, $p \leq 0.05$) and to have tested over a year ago in unadjusted analysis only (uOR = 1.32, $p \leq 0.05$).

Not believing versus believing that condom use reduces HIV risk was statistically associated with adjusted odds ratios of having never been HIV tested, $p \leq 0.05$. Compared to having tested in the past year, those who were unsure whether condoms reduce HIV risk (19.0%, aOR = 2.64) or did not believe condoms reduce HIV risk (13.7%, aOR = 1.79), were more likely to have never tested compared to those who believed that condom use reduces HIV risk (8.6%).

There was also a decreased independent likelihood of having never HIV tested associated with contraceptive use (aOR = 0.71, $p \leq 0.05$) as compared to not using some form of contraception. No association with contraception was found for last HIV testing greater than 1 year ago. Women were independently less likely to have never had an HIV test if they had at least one child (aOR = 0.39, $p \leq 0.001$).

Women who exchanged sex for money, drugs, or other benefits were less likely to have never HIV tested (4.3%) compared to those who did not exchange sex (10.9%) (uOR = 0.36, $p \leq 0.001$; aOR = 0.49, $p \leq 0.01$). There was no statistical difference by exchange of sex for money or services in testing over a year ago versus testing in the past year.

Characteristics of the male partner that remained independently significant in adjusted analysis are now described. In terms of HIV testing frequency, compared to a single partner, having multiple male partners was independently associated with a decreased likelihood of having tested over a year ago (aOR = 0.70, $p \leq 0.01$) and for having never HIV tested (aOR = 0.54, $p \leq 0.001$). HIV testing did not vary statistically with the belief that a male partner had sex with men.

Being with a partner who injected drugs was associated with a greater risk of having never HIV tested (17.1%) compared to 8.1% of women who never HIV tested among those without a partner who injected drugs. Having never tested was statistically independently associated with being with a partner who was thought to have injected drugs (aOR = 1.50, $p \leq 0.05$).

Roughly half the sample (n = 1050) engaged in condomless sex with at least one high-risk partner who was never HIV tested, and women were statistically more likely to have never HIV tested if a partner had never tested, $p \leq 0.001$. Women who had condomless sex with at least one high-risk partner who was *never HIV tested,* were nearly five times as likely to have never been HIV tested (16.7%) compared to 3.4% whose partner/s had been HIV tested. This was associated with a threefold, increased odds of having never

tested in adjusted analyses (aOR = 3.06, $p \leq 0.001$), when compared to having been tested in the past year. Women engaging in condomless sex with at least one high-risk partner who had *not HIV tested since they were together* were also independently more likely to have tested over a year ago (aOR = 2.20, $p \leq 0.001$) and, also, to have never tested (aOR = 3.20, $p \leq 0.001$).

We now consider substance use before or during sex in association with HIV testing (Table 3). Consuming alcohol before or during sex was associated with a greater likelihood of HIV testing over a year ago but a lower likelihood of having never tested. For having tested over a year ago, the unadjusted odds ratio for drinking alcohol before or during sex was increased by 1.20 per category from 0 to 3 ($p \leq 0.01$). However, no statistical relationship for testing over a year ago and to having never tested was found in adjusted analyses.

There was no statistical relationship for non-injection drug use before or during sex with HIV testing. But, among the few who injected drugs in the past 3 months, 20.8% never tested compared to 9.5% who did not inject drugs (uOR = 2.32, $p \leq 0.05$) with no statistical difference remaining in adjusted analyses.

HIV testing varied with inclusion in the TQ-CVS-HRP in unadjusted analyses. Having never tested was more likely among those who were *not* in the TQ-CVS-HRP (10.5%) compared to those in the TQ (6.5%). Conversely, having tested within the year was more likely among those who were in the TQ (76.1%) versus 68.9% who were not in the TQ. But the differences between these two did not remain statistically significant in adjusted models. There were no differences in HIV testing according to whether women engaged in CAS.

Discussion

The purpose of this study was to identify demographic, behavioral, and partner characteristics that may be associated with increasing or lowering the likelihood of sex risk behavior and increasing the likelihood of annual versus less frequent or never having HIV tested in a sample of at-risk, predominately Black women in the urban Northeast. Most (87.7%) of the study sample was recruited online via Instagram or Facebook advertising. The rest (12.2%) were recruited FTF specifically targeting high HIV prevalence neighborhoods of Boston and surrounding communities. The high proportion of those online who screened in as high-risk (47.4%) suggests that the ads had selectively reached and appealed to the target population who were at-risk.

Although previous studies had investigated whether there is a difference in sex risk outcomes by mode of recruitment among young MSM, the effect of the mode of recruitment

has remained understudied in women. This study found that sex risk behavior in young adult predominately Black women, did not vary with the mode of recruitment online or FTF, a finding similar to recent studies with MSM [23, 24]. Further, sex risk behavior did not differ by the location of recruitment for those who were randomized.

In contrast, FTF recruitment was associated with higher likelihood of having never HIV tested compared to online recruitment. One plausible explanation was FTF recruitment took place in Boston and surrounding neighborhoods where there was significantly lower HIV testing, compared to NYC where testing within the past year was the highest and where recruitment occurred solely online. However, overall, the finding that most of the total sample (70.3%) was HIV tested in the past year is encouraging, notwithstanding that nearly 30% of women at-risk were not following recommendations for annual testing.

One-fifth of the sample engaged in CAS-HRP which is consistent with results reported in representative national studies [13, 17]. Disaggregating sex risk behaviors enabled us to distinguish different associations between vaginal and anal sex. For example, it was equally likely for women to be in the TQ-CVS-HRP if they had multiple partners as it was if they had a single high-risk partner. But there was a greater likelihood of CAS-HRP among women who had multiple partners compared to having a single high-risk partner. Hess et al. [17] also reported an association of engaging in anal sex with having multiple partners.

Reynolds et al. [25] asked a racially diverse group of women for their reasons of engaging in anal sex. Some reasons included that: it was enjoyable, more intimate, and reserved for special partners. But they also found this practice was associated with substance use and coercion. Additionally, other findings indicate that CAS may be considered as a means to avoid vaginal sex during menses or to avoid pregnancy [26, 27].

A substantial portion of HIV infection in heterosexuals can be attributed to CAS [16]. Yet, clinicians infrequently collect information on the type of sexual intercourse in the sexual history of the patient interview [28]. In our study, unlike results for the TQ-CVS-HRP, women engaging in CAS-HRP were more likely to report that condoms do not reduce the risk of HIV or that they were unsure, indicating that misinformation remains a concern.

Believing at least one partner had sex with men was associated with increased likelihood of CAS-HRP but a decreased likelihood of being in TQ-CVS-HRP. There were 438 women who considered at least one of their partners had sex with men. And of these, roughly 30% engaged in CAS with these high-risk partners. The finding of a higher incidence of CAS among women who had a partner they believed had sex with men as well as a lower likelihood of HIV testing has also been reported [17]. The association of

CAS with perceiving one's sex partner could be having sex with men presents a need for further inquiry.

Harawa et al. [29] reported an association of women having a MSMW partner with their HIV infection. Results by McKay and Mutchler [30] indicated that in general, MSMW disclosed to half of all partners and that disclosure to male and female partners was equal. However, the odds of disclosure of HIV positive status to female partners with negative or unknown HIV status has been found to be statistically lower than their disclosing their HIV positive status to male partners with negative or unknown status [30].

In the current study, there was no statistical association of HIV testing with the belief the partner had sex with men, nor the belief that one's partner injected drugs, indicating that these higher behavioral transmission risks were not associated with increased HIV testing. This is compounded by the finding here, that if a partner himself had not been HIV tested, there was greater likelihood that women did not test. Further, there was no statistically significant association of ever having HIV tested, nor testing since being together, with engaging in CAS-HRP. These findings continue to indicate that the higher transmission practice of CAS-HRP is not associated with the protective measure of HIV testing. Of interest, believing condoms do not reduce HIV risk was also associated with increased likelihood of CAS-HRP and of having never been tested. Those responding "don't know" if condoms reduce HIV risk had the highest association of well over double the likelihood of never testing.

Few in the sample injected drugs. However, 404 (18.2%) believed a partner injected drugs. The belief that the partner injected drugs although not associated with being in the TQ-CVS-HRP was associated with CAS-HRP. Consuming alcohol before or during sex was associated with increased likelihood of CAS-HRP, with always consuming associated with nearly double CAS-HRP likelihood. Hess et al. [17], also reported associations of binge drinking and non-injection drug use with CAS.

In our study, of non-injection drug use, only use of benzodiazepines was independently associated with increased odds of being in the TQ-CVS-HRP in adjusted analysis. Only cocaine was associated with an increased likelihood of CAS-HRP in adjusted analysis. Marijuana, the most commonly used before or during sex was not associated with sex risk behavior in adjusted analyses.

Although rates of HIV transmission are highest for Black women among all women, in this study of women at high-risk, there was no statistical difference in adjusted analysis by race or ethnicity in sex risk behavior. This finding is consistent with others [3, 5] who have argued that risk behaviors alone cannot explain the disparity in HIV prevalence. The results of this study showed that Black women, compared to white and Latina women, were the most likely to have had an HIV test within the past year, perhaps indicative of an understanding of

being at higher risk. This finding is also consistent with other findings that Black women demonstrated higher rates of HIV testing than white women [31].

We found that roughly half the sample (n = 1050) engaged in condomless sex with at least one high-risk partner who was never HIV tested. Such women were more than three times as likely themselves to have never tested. These findings were quite similar for condomless sex with at least one high-risk partner not tested since they were together. This is a source of concern given findings of a CDC surveillance report indicating that the highest percentage of those with undiagnosed HIV infection was among heterosexual men [2]. One in nine women with HIV infection remain unaware of her diagnosis [32].

As availability of reproductive services are increasingly compromised it is important to note the association between women availing themselves of contraception with the lower likelihood of being in the TQ-CVS-HRP, and lower likelihood of CAS-HRP. They were also more likely to have been HIV tested.

Study Limitations

The results are for women in the urban Northeast and may not generalize to women in other geographic regions. Also, the age range was limited to 18 to 29 to maintain a relative homogeneous age sample. The screening survey results were based on self-report and can be subject to memory recall bias. However, several measures were taken to increase the reliability of self-reported data. First, sex risk items were asked in the context of each relationship partner. Participants were asked to offer a pseudonym for this partner and that pseudonym was piped-into each subsequent item for each partner. Memory recall was limited to the past 3 months and calendars appeared next to the item to assist with more accurate dating. Items were posed non-judgmentally. Instead of "did you engage in…." items were posed as "how many times did you…." with the option to state never or zero [33]. The data were collected by CASI on smartphones or other web-enabled personal devices. Generally, use of CASI increases reliability of responses to items concerning sensitive behaviors [34, 35]. Another limitation is data were collected on a maximum of five partners. However, the vast majority of women in this study had one or two partners and this consideration of increasing the number of partners queried needed to be balanced with feasibility of completing the screener with minimal burden of effort.

Conclusion

Although in the United States, HIV transmission rates are highest for Black women, there was no statistical difference for this high-risk sample in sex risk behavior by race or ethnicity in adjusted analysis. We observed that engaging in CAS-HRP, the highest sexual transmission risk [36], revealed a cluster of high-risk behaviors. These included alcohol use, multiple partners, sex partner injecting drugs, and sex with men perceived to have sex with men, but there was no relationship to HIV testing. Believing condoms do not reduce HIV risk was associated with increased likelihood of CAS-HRP and of having never HIV tested. Roughly half the sample engaged in condomless sex with at least one high-risk partner who was never HIV tested. Such women were more than three times as likely themselves to have never tested.

These findings underscore the importance of addressing condom use with anal sex in public health communication [17], and particularly among those in high-risk partnerships [3, 15]. In general, approaches to effective HIV prevention strategies among heterosexual women at increased risk for HIV infection continue to be needed. Access to and use of condoms, PrEP, risk-reduction counseling, and HIV testing [13] remain the arsenal of prevention.

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