

Unprotected Anal Intercourse and Sexually Transmitted Diseases in High-Risk Heterosexual Women

Samuel M. Jenness, MPH, Elizabeth M. Begier, MD, MPH, Alan Neaigus, PhD, Christopher S. Murrill, PhD, MPH, Travis Wendel, JD, and Holly Hagan, PhD

Unprotected anal intercourse is a well-described risk factor for HIV and sexually transmitted diseases (STDs) among men who have sex with men,¹ but fewer studies have investigated its importance as a risk factor in heterosexuals. According to a recent US population estimate, one third of adults and adolescents have ever engaged in anal intercourse and few (25% of men and 16% of women) reported condom use at last anal intercourse.² Anal intercourse and unprotected anal intercourse are more common in at-risk heterosexual groups: a 1999 review found that 30% to 74% of several risk groups (sexually active injection drug users, female sex workers, and urban adolescents) had recently engaged in anal intercourse.³ Tian et al.⁴ observed that 40% of heterosexual STD clinic attendees had any anal intercourse in the past year, and 73% of those had unprotected anal intercourse. Among at-risk heterosexuals, unprotected anal intercourse often clusters with other risk behaviors, such as illicit drug and binge alcohol use,^{5,6} trading sex for money,⁷ and having multiple sex partners.⁸

Most heterosexuals engage in unprotected anal intercourse less frequently than they engage in unprotected vaginal intercourse, but unprotected anal intercourse presents a higher probability of HIV and STD infection than does unprotected vaginal intercourse, particularly for women.⁴ Biologically, the increased likelihood of mucosal disruption and trauma in the more fragile columnar epithelium that lines the rectum versus the vaginal lining's squamous epithelium, along with increased risk of trauma because of the muscular anal sphincter, are postulated reasons for this increased risk.⁹ One seroconversion study estimated the probability of HIV infection per act of receptive anal intercourse at 3.4% versus less than 0.01% per act of vaginal intercourse¹⁰ and also found a 5.1 increased odds of HIV infection from anal compared with vaginal intercourse.¹¹ Whereas no mention was made about the consistency of

condom use during anal versus vaginal intercourse, the study served as the basis of several modeling estimates of the per-act HIV transmission risk of unprotected anal intercourse.^{12–14}

Two other often-cited studies also reported increased risk of HIV infection from anal intercourse,^{15,16} but again did not report whether they measured protected or unprotected anal intercourse and used a broad timeframe (lifetime history) for these risk behaviors. Some research has found an increased risk for HIV or other STD infection for heterosexual men but not women,^{8,17} which may contradict the estimated increased infection probability for women in the modeling studies. Residual confounding could influence these findings, given the clustering of unprotected anal intercourse with other measured and unmeasured risk behaviors. Further research is needed to explore the prevalence and correlates of heterosexual unprotected anal

intercourse and its impact on HIV and STD infection in this population.

Our study investigated unprotected anal intercourse among a sample of high-risk heterosexual women in New York City by using a social-network–based sampling and recruitment method. Others have found that coerced sex and sex work influence unprotected anal intercourse and other behavioral risks.^{18,19} We therefore focused on women because of their predicted increased infection risk and because of a broader goal to explore female HIV/STD risks. In this analysis, we examined factors associated with having past-year unprotected anal intercourse and the relationship of unprotected anal intercourse to HIV infection or a past-year STD diagnosis. We sought to understand how the relationship between unprotected anal intercourse and other HIV or STD risk factors as well as the collinearity of unprotected anal intercourse with unprotected vaginal intercourse

Objectives. We examined the association between unprotected anal intercourse and sexually transmitted diseases (STDs) among heterosexual women.

Methods. In 2006 through 2007, women were recruited from high-risk areas in New York City through respondent-driven sampling as part of the National HIV Behavioral Surveillance study. We used multiple logistic regression to determine the relationship between unprotected anal intercourse and HIV infection and past-year STD diagnosis.

Results. Of the 436 women studied, 38% had unprotected anal intercourse in the past year. Unprotected anal intercourse was more likely among those who were aged 30 to 39 years, were homeless, were frequent drug or binge alcohol users, had an incarcerated sexual partner, had sexual partners with whom they exchanged sex for money or drugs, or had more than 5 sexual partners in the past year. In the logistic regression, women who had unprotected anal intercourse were 2.6 times as likely as women who had only unprotected vaginal intercourse and 4.2 times as likely as women who had neither unprotected anal nor unprotected vaginal intercourse to report an STD diagnosis. We found no significant association between unprotected anal intercourse and HIV infection.

Conclusions. Increased screening for history of unprotected anal intercourse and, for those who report recent unprotected anal intercourse, counseling and testing for HIV and STDs would likely reduce STD infections. (*Am J Public Health*. 2011;101:745–750. doi:10.2105/AJPH.2009.181883)

could affect the association of unprotected anal intercourse with these disease outcomes.

METHODS

This study was part of the National HIV Behavioral Surveillance (NHBS) study conducted in New York City. The NHBS is a cross-sectional study with the objective of characterizing HIV risk and prevalence among men who have sex with men, injection drug users, and high-risk heterosexuals.²⁰ The NHBS includes a structured survey and HIV test. The present analysis is based on the study cycle among high-risk heterosexuals conducted in 2006 to 2007.

The NHBS methods for defining high-risk heterosexuals have been explained in detail elsewhere.²¹ Briefly, New York City HIV case surveillance data and Census data on household poverty were used to identify New York City zip codes where residents and members of their social networks were at highest risk for heterosexual HIV infection. Zip codes were ranked by combined standardized rates of heterosexual HIV infection and poverty. The top 30 were considered “high-risk areas.” Residing in or having a social connection to a high-risk area was a main eligibility criterion. Participants were considered to have a social connection if they were recruited into the study by a previous participant who resided in a high-risk area. Respondent-driven sampling (RDS) was used for peer recruitment.²² Study participants were given incentives to recruit others in the target population. Ethnographers selected 8 initial recruits, called seeds, through community outreach. Once the seeds completed the study, we asked them to recruit up to 3 peers, and then asked the next wave of participants to recruit, and so on until we met our target sample size. Participants who lived outside a high-risk area were not allowed to recruit others so that we could maintain the connection to high-risk areas.

Other eligibility criteria were opposite-sex vaginal or anal sex in the past year, age between 18 and 50 years, New York City residence, and English or Spanish comprehension. Participants with a history of injection drug use or same-sex partnerships were not excluded. For this analysis, we removed participants who were male or self-reported as HIV-infected. Eligible participants were paid \$20 for

completing the questionnaire, \$10 for taking the HIV test, and \$10 for each eligible participant whom they recruited.

Measures

For our analysis, we examined sociodemographics (race/ethnicity, age, poverty, homelessness, arrest history), HIV risks (drug injection history, past-year frequent noninjection drug use or past-month binge alcohol use, last sex partner ever incarcerated for 3 months or more, and exchange sex partners or more than 5 sex partners in the past year), and their associations with past-year unprotected anal intercourse, HIV seroinfection, and a past-year STD diagnosis. STD diagnoses included but were not limited to syphilis, gonorrhea, chlamydia, herpes, and HPV. Homelessness was defined as living on the street, in a shelter, or in a single-room occupancy apartment in the past year. Frequent noninjection drug use was defined as the use of noninjection drugs at least weekly during the past year. Exchange partners were defined as those with whom money or drugs were traded for sex. Because of the collinearity of unprotected anal intercourse with unprotected vaginal intercourse, we created a 3-level variable to examine the effect of unprotected anal intercourse on HIV infection and STD diagnoses: no unprotected intercourse, unprotected vaginal intercourse only, or any unprotected anal intercourse.

HIV infection was determined through blood collected by a trained phlebotomist and tested on HIV1/2 enzyme-linked immunosorbent assay and HIV1 Western blot platforms (Bio-Rad Laboratories, Hercules, CA).

Statistical Analysis

We conducted a weighted analysis using the RDS Analysis Tool (RDSAT) version 5.6 (Cornell University, Ithaca, NY). RDSAT generates weights that control for biases common with peer-referral sampling. Participants with large networks and participants who recruit others like themselves tend to be overrepresented.²² RDS weights were generated and applied for each univariate and bivariate statistic. Weighted survey data were analyzed in SAS version 9.1 (SAS Institute, Cary, NC).

We used the χ^2 test, odds ratios (ORs), and 95% confidence intervals (CIs) to determine the factors associated with unprotected anal

intercourse, HIV infection, and STD diagnoses. Multiple logistic regression models were constructed to calculate the adjusted odds ratios (AORs) and 95% CIs for the associations between unprotected anal intercourse and HIV infection and then between unprotected anal intercourse and an STD diagnosis. In the STD model, we used any unprotected anal intercourse as the reference group because of the small sample size of the lowest risk group, no unprotected anal intercourse or unprotected vaginal intercourse. The regression model was adjusted for the sociodemographic variables and behavioral risk factors associated with unprotected anal intercourse. We weighted the regression model by the RDS weight for the dependent variable, as others have done.^{23,24} However, because RDS regression modeling techniques are still developing, we conducted a sensitivity analysis of regression outcomes by comparing weighted and unweighted models.

RESULTS

Of the 850 eligible high-risk heterosexual study participants, 412 males and 2 self-reported HIV-infected women were excluded from this analysis (final $n=436$). As shown in Table 1, most women were Black (70%), aged 40 to 50 years (46%), in poverty (77%), or homeless (55%). Respondents reported high levels of behavioral risks: a history of injection drug use (23%), noninjection drug use at least weekly (58%), binge alcohol consumption in the past month (42%), having a last sex partner ever incarcerated for at least 3 months (47%), and having any past-year exchange partners (41%) or more than 5 sex partners in the past year (28%). The HIV seroprevalence in this group was 9% overall and 7% among women with no history of injection.

Anal intercourse was reported by 41% of women in the past year. Overall, 38% of women had any unprotected anal intercourse, 57% had unprotected vaginal intercourse only, and 5% had neither unprotected anal nor unprotected vaginal intercourse in the past year. Unprotected anal and unprotected vaginal intercourse were highly collinear: 98% of women who had unprotected anal intercourse also had unprotected vaginal intercourse. Unprotected anal intercourse was more likely among women who were aged 30 to 39 years

TABLE 1—Unprotected Anal Intercourse (UAI), Sociodemographics, and HIV Risks and Prevalence Among High-Risk Heterosexual Women: New York City, 2006–2007

Characteristic	Total, Weighted %	UAI in Past Year, Weighted %	P	OR (95% CI)
Overall	100.0	37.8
Race/ethnicity			.13	
Black (Ref)	70.2	36.6		1.00
Hispanic	19.2	49.8		1.72 (0.83, 3.58)
White	9.0	43.5		1.33 (0.48, 3.72)
Other	1.5	24.0		0.55 (0.11, 2.84)
Age, y			<.01	
18–29	34.4	38.3		0.36 (0.16, 0.83)
30–39 (Ref)	20.1	63.3		1.00
40–50	45.5	26.3		0.21 (0.09, 0.47)
Sociodemographics ^a				
Income < \$10 000	76.9	36.9	.98	0.99 (0.62, 1.60)
Homeless	54.7	48.4	<.01	2.92 (1.91, 4.47)
Arrested	24.6	40.4	.56	1.15 (0.73, 1.81)
Behavioral risks				
History of injection ^b	22.6	43.1	.25	1.32 (0.82, 2.10)
Noninjection drug use at least 1 time per week ^a	58.0	43.1	.01	1.71 (1.13, 2.58)
Binge alcohol use ^c	41.7	47.3	<.01	2.00 (1.34, 3.00)
Last sex partner ever incarcerated ≥ 3 mo	46.6	46.5	<.01	2.01 (1.34, 3.02)
Any sex-exchange partners ^a	41.2	53.0	<.01	3.06 (2.03, 4.62)
5 or more sex partners ^a	27.9	54.6	<.01	2.66 (1.71, 4.14)
HIV serostatus			.14	
Negative (Ref)	90.2	39.6		1.00
Positive	9.0	27.6		0.58 (0.28, 1.20)

Note. CI = confidence interval; OR = odds ratio.

^aPast year.

^bEver.

^cPast month.

($P < .01$), were homeless ($P < .01$), were frequent drug users ($P = .01$), were binge alcohol users ($P < .01$), had a last sex partner who was incarcerated ($P < .01$), and had any exchange sex partners ($P < .01$) or more than 5 sex partners ($P < .01$).

The prevalence and factors associated with STD diagnoses are shown in Table 2. Overall, 33% of women had a past-year STD diagnosis. In bivariate analysis, White women were less likely than were Black or Hispanic women to have an STD ($P = .03$). STD diagnoses were also significantly associated with HIV infection ($P < .01$), exchange sex partnerships ($P < .01$), and multiple sex partnerships ($P < .01$). They were also associated with frequent drug use

($P = .08$) and binge alcohol use ($P = .07$) with marginal significance. Finally, women who had unprotected anal intercourse were more than twice as likely to have an STD than were women who only had unprotected vaginal intercourse ($P < .01$) or nearly 6 times as likely as women who had neither unprotected anal nor unprotected vaginal intercourse in the past year ($P < .01$).

In the multiple logistic regression model, women who only had unprotected vaginal intercourse were less than half as likely as were women who had unprotected anal intercourse to have an STD diagnosis (AOR = 0.39; 95% CI = 0.23, 0.67), equivalent to a 2.6 increased odds for those who had unprotected anal

intercourse. With marginal significance ($P = .06$), women who had neither unprotected anal nor unprotected vaginal intercourse were less than one quarter as likely to have an STD (AOR = 0.24; 95% CI = 0.05, 1.07), equivalent to a 4.2 increased odds for those who had unprotected anal intercourse. STDs were also significantly associated with HIV infection (AOR = 6.33; 95% CI = 2.56, 15.62) and multiple sex partnerships (AOR = 3.00; 95% CI = 1.56, 5.78).

In a separate analysis (data not shown), unprotected anal intercourse was not associated with HIV infection at either the bivariate or multivariate level. The recency of HIV infection could not be accurately determined because of prior HIV testing infrequency. In the sensitivity test using an RDS unweighted model, the main association between unprotected anal intercourse and STD diagnoses held.

DISCUSSION

Despite the estimated increased likelihood of heterosexual HIV/STD infection from unprotected anal intercourse compared with unprotected vaginal intercourse or oral sex,¹⁴ this behavioral risk has not been well described in heterosexual women. In our study of high-risk heterosexual women in New York City, we found that anal intercourse and unprotected anal intercourse were common, that unprotected anal intercourse was associated with other behavioral risk factors for HIV/STDs, and that unprotected anal intercourse was independently associated with recent STD diagnoses even after the analysis was controlled for those other risk factors.

Prevalence of Unprotected Anal Intercourse

One recent study found that heterosexual anal intercourse is relatively infrequent (33% had a lifetime history) in the US general population, yet still risky, with less than one quarter of those who had anal intercourse during their last act reporting condom use.² Similarly, only one third of New York City residents who had anal sex in the past year used condoms every time, according to a 2007 estimate.²⁵ Rates of anal intercourse and unprotected anal intercourse in at-risk heterosexual groups similar to our study population are usually higher.³

TABLE 2—Unprotected Anal Intercourse (UAI) and Past-Year STD Diagnoses Among High-Risk Heterosexual Women: New York City, 2006–2007

Characteristic	STD in Past Year, Weighted %	P	Crude OR (95% CI)	AOR (95% CI)
Overall	32.9
Race/ethnicity		.03		
Black (Ref)	33.3		1.00	1.00
Hispanic	39.8		1.34 (0.80, 2.20)	0.83 (0.44, 1.58)
White	14.7		0.35 (0.14, 0.89)	0.46 (0.17, 1.31)
Other	30.0		0.86 (0.16, 4.79)	1.06 (0.17, 6.80)
Age, y		.36		
18–29 (Ref)	37.4		1.00	1.00
30–39	34.2		0.87 (0.50, 1.53)	0.83 (0.42, 1.65)
40–50	30.0		0.72 (0.45, 1.13)	0.62 (0.34, 1.12)
Sociodemographics ^a				
Income < \$10 000	32.0	.32	0.78 (0.49, 1.27)	0.56 (0.30, 1.02)
Homeless	35.9	.15	1.36 (0.90, 2.05)	1.40 (0.80, 2.43)
Arrested	37.2	.28	1.29 (0.81, 2.06)	1.27 (0.70, 2.31)
HIV serostatus		<.01		
Negative (Ref)	32.3		1.00	1.00
Positive	55.3		2.59 (1.33, 5.05)	6.33 (2.56, 15.62)
UAI risks		<.01		
No UVI or UAI	12.9		0.17 (0.05, 0.64)	0.24 (0.05, 1.07)
UVI only	26.5		0.42 (0.27, 0.64)	0.39 (0.23, 0.67)
Any UAI (Ref)	46.2		1.00	1.00
Other behavioral risks				
Noninjection drug use at least 1 time/wk ^a	36.3	.08	1.45 (0.95, 2.21)	0.50 (0.27, 0.93)
Binge alcohol use ^b	37.8	.07	1.46 (0.97, 2.21)	0.90 (0.53, 1.54)
Last sex partner ever incarcerated ≥ 3 mo	32.5	.78	0.94 (0.03, 1.42)	0.82 (0.49, 1.39)
Any sex exchange partners ^a	49.3	<.01	3.64 (2.37, 5.60)	1.79 (0.90, 3.56)
5 or more sex partners ^a	55.6	<.01	3.84 (2.45, 6.01)	3.00 (1.56, 5.78)

Note. AOR = adjusted odds ratio; CI = confidence interval; OR = odds ratio; STD = sexually transmitted disease; UVI = unprotected vaginal intercourse.

^aPast year.

^bPast month.

We used a novel study design to define and sample high-risk heterosexuals based on theories of social-network level factors and geographical clustering driving HIV transmission.²⁰ Consequently, we found high levels of unrecognized HIV infection (9%) and recent STD diagnoses (33%), much higher rates than in the general New York City population.²⁶ In our study, over 40% of women had anal intercourse in the past year and over 90% of those who did had unprotected anal intercourse. These findings were similar to rates of unprotected anal intercourse among women in an STD clinic⁴ and other women at high risk for HIV infection.²⁷

Two reasons described in the literature for the high rates of unprotected anal intercourse in heterosexual risk groups are a lack of concern about pregnancy and that some do not consider anal intercourse as “sex.”³ However, we found that 98% of women who had unprotected anal intercourse also reported unprotected vaginal intercourse, which suggests that these concerns may not be common in our target population.

We found that unprotected anal intercourse was associated with 5 risk factors (frequent drug use, binge alcohol use, partnerships with incarcerated men, exchange sex partnerships, and multiple partnerships) that are often also

associated with heterosexual HIV and STD infection. The association between partnerships with incarcerated individuals and frequency of unprotected anal intercourse in particular is an under-explored topic for heterosexual HIV and STD risk. One study found that unprotected sex overall was common (68%–78%) during the last sexual encounter among young men leaving prison,²⁸ whereas another study investigated whether men who have same-sex unprotected anal intercourse in jail have higher rates of same-sex unprotected anal intercourse outside of jail.²⁹ However, the literature is sparse on opposite-sex unprotected anal intercourse for men coming out of jail. Sexual history screening for these other risks factors may provide an opportunity to assess unprotected anal intercourse, particularly for women who may be reluctant to disclose anal intercourse, as others have found.²⁷

Associations With HIV and Sexually Transmitted Diseases

Several existing studies linking HIV or STD infections to unprotected anal intercourse have been limited by some common attributes: a failure to distinguish between protected and unprotected anal intercourse in the context of unprotected vaginal intercourse, the confounding effects of clustering of unprotected anal intercourse with other HIV or STD risk factors, broad timeframe measures of unprotected anal intercourse and disease outcomes, and the potential collinearity between unprotected anal and unprotected vaginal intercourse (i.e., nearly all women who report unprotected anal intercourse also report unprotected vaginal intercourse). These do not invalidate the past research, but could overestimate the association between HIV or STD infection and unprotected anal intercourse in the context of other measured and unmeasured risk factors. Our goal in this study was to account for these limitations by examining unprotected anal intercourse specifically in a group of high-risk heterosexual women with high susceptibility to HIV and STD infection. Although we did not examine the frequency of unprotected anal intercourse relative to unprotected vaginal intercourse, we constructed a 3-way variable that accounted for the overlap of unprotected anal intercourse with

unprotected vaginal intercourse. Additionally, we used multiple logistic regression to control for the associations of unprotected anal intercourse with the 5 confounders mentioned earlier.

Our STD analysis examined an outcome measure (STD diagnosis in the past year) with the same timeframe as the exposure measure (unprotected anal intercourse in the past year). Although other studies have examined the association between unprotected anal intercourse and STDs in heterosexual men⁸ and the correlates of anal intercourse (e.g., STDs) in heterosexual women,²⁷ our study is unique in its focus on unprotected anal intercourse and STDs in high-risk heterosexual women. Unprotected anal intercourse was associated with an increased likelihood of STD diagnoses in our study. Compared with women who had only unprotected vaginal intercourse in the past year, women who had unprotected anal intercourse were 2.6 times as likely to have an STD diagnosis. Although not directly comparable, our odds ratio was approximately half the odds of HIV infection from unprotected anal intercourse compared with unprotected vaginal intercourse found in 1 study often cited for modeling estimates.¹¹

We found no significant association between unprotected anal intercourse and HIV infection. One recent analysis did find an association between anal intercourse and HIV infection,²⁴ but they did not examine unprotected anal intercourse specifically, the overlap of anal and vaginal intercourse, or potential sexual risk confounders. One reason for no observed association between unprotected anal intercourse and HIV may be that we compared longer-term HIV infections with recent unprotected anal intercourse. In a previous analysis, we found that this population of high-risk heterosexuals test infrequently despite common encounters with HIV testing environments.²¹ Infrequent testing limits the ability to examine the factors associated with recent infection (e.g., by comparing a self-reported recent negative test with a positive HIV test in the study). Nevertheless, HIV infection was independently associated with a self-reported STD diagnosis in this analysis and prevalent herpes simplex virus type-2 infection in another recent analysis from this study (H Hagan, SM Jenness, T Wendel, et al, unpublished data, 2009), which suggests an ongoing risk of HIV infection among those with STDs.

Limitations

Our study had several limitations. We did not measure unprotected anal intercourse frequency, but others have found that unprotected anal intercourse is practiced less frequently than is unprotected vaginal intercourse.⁴ This may overestimate the attributable risk of unprotected anal intercourse for STDs in our analysis, although we minimized the effects of any differential frequency of unprotected anal and unprotected vaginal intercourse by examining the increased risk among a comparison group with no unprotected anal intercourse. Still, the collinearity of unprotected anal and unprotected vaginal intercourse presents a problem for all research attempting to determine the underlying risk of unprotected anal intercourse per se; the small sample size of women with no unprotected anal or unprotected vaginal intercourse in our study also prevented further analyses on this group.

Second, STD diagnoses are not STD infections, and many infections are not diagnosed.³⁰ Thus, we do not know whether undiagnosed STD infections were higher or lower in the group who reported unprotected anal intercourse, which may impact the associations. Third, all data except HIV serostatus were self-reported and are subject to the potential biases of survey research, including recall error and social desirability biases. Indeed, others have found that unprotected anal intercourse may be underreported because of embarrassment.²⁷

Fourth, the study design was cross-sectional and we do not know whether unprotected anal intercourse preceded an STD infection. Finally, RDS techniques for sampling and analysis are still developing, and these results are not necessarily representative of the larger target population of heterosexual women residentially or socially connected to high-risk areas in New York City.

Conclusions

Women in this high-risk heterosexual population frequently reported unprotected anal intercourse in the past year; this behavior was associated with a large increased risk of STDs, even with control for other high-risk behaviors also associated with unprotected anal intercourse. Health care providers, and specifically sexual health providers, should screen heterosexual women for unprotected anal

intercourse and counsel them on the increased STD and HIV risk of this type of intercourse, despite the lack of pregnancy risk. Additionally, the relation between unprotected anal intercourse and other risky behaviors suggests that providers should also screen for frequent drug use, exchange sex, and other HIV behavioral risk factors. This risk screening would be particularly indicated in nontraditional health care settings, such as homeless shelters, jails, and drug treatment or syringe exchange programs, and in geographical areas where at-risk heterosexuals are more likely to be encountered. Those with a history of unprotected anal intercourse since they were last screened for STDs and HIV should be screened again.

Further research is needed to investigate the differential frequency of unprotected anal and unprotected vaginal intercourse, and the effect of unprotected anal intercourse on disease outcomes, ideally including all potential confounders. HIV and STD prevention programs in high-risk heterosexual communities should incorporate messages about unprotected anal intercourse to attempt to increase condom use during unprotected anal intercourse and thus decrease heterosexual HIV and STD infections. ■

About the Authors

At the time of the study, Samuel M. Jenness, Elizabeth M. Begier, Alan Neaigus, and Christopher S. Murrill were with the New York City Department of Health and Mental Hygiene, New York, NY. Travis Wendel and Holly Hagan were with the National Development and Research Institutes, New York, NY.

Correspondence should be sent to Samuel M. Jenness, MPH, HIV Epidemiology Program, New York City Department of Health and Mental Hygiene, 346 Broadway, Suite 707D, New York, NY 10013 (e-mail: sjenness@health.nyc.gov). Reprints can be ordered at <http://www.ajph.org> by clicking the "Reprints/Eprints" link.

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Contributors

S.M. Jenness supervised the study, conceptualized and conducted the analysis, and led the writing. E.M. Begier and A. Neaigus helped to conceptualize the analysis and assisted with the writing. C.S. Murrill, T. Wendel, and H. Hagan supervised the study and assisted with the writing.

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Human Participant Protection

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References

- Sanchez T, Finlayson T, Drake A, et al. Human immunodeficiency virus (HIV) risk, prevention, and testing behaviors—United States, National HIV Behavioral Surveillance System: men who have sex with men, November 2003–April 2005. *MMWR Surveill Summ*. 2006;55(6):1–16.
- Leichliter JS, Chandra A, Liddon N, Fenton KA, Aral SO. Prevalence and correlates of heterosexual anal and oral sex in adolescents and adults in the United States. *J Infect Dis*. 2007;196(12):1852–1859.
- Halperin DT. Heterosexual anal intercourse: prevalence, cultural factors, and HIV infection and other health risks, Part I. *AIDS Patient Care STDS*. 1999;13(12):717–730.
- Tian LH, Peterman TA, Tao G, et al. Heterosexual anal sex activity in the year after an STD clinic visit. *Sex Transm Dis*. 2008;35(11):905–909.
- Erickson PI, Bastani R, Maxwell AE, Marcus AC, Capell FJ, Yan KX. Prevalence of anal sex among heterosexuals in California and its relationship to other AIDS risk behaviors. *AIDS Educ Prev*. 1995;7(6):477–493.
- Decker MR, Raj A, Gupta J, Silverman JG. Sex purchasing and associations with HIV/STI among a clinic-based sample of US men. *J Acquir Immune Defic Syndr*. 2008;48(3):355–359.
- Reynolds GL, Latimore AD, Fisher DG. Heterosexual anal sex among female drug users: U.S. national compared to local Long Beach, California data. *AIDS Behav*. 2008;12(5):796–805.
- Bogart LM, Kral AH, Scott A, et al. Sexual risk among injection drug users recruited from syringe exchange programs in California. *Sex Transm Dis*. 2005;32(1):27–34.
- Cohen MS, Miller WC. Sexually transmitted diseases and human immunodeficiency virus infection: cause, effect, or both? *Int J Infect Dis*. 1998;3(1):1–4.
- Leynaert B, Downs AM, de Vincenzi I. Heterosexual transmission of human immunodeficiency virus: variability of infectivity throughout the course of infection. European Study Group on Heterosexual Transmission of HIV. *Am J Epidemiol*. 1998;148(1):88–96.
- European Study Group on Heterosexual Transmission of HIV. Comparison of female to male and male to female transmission of HIV in 563 stable couples. *BMJ*. 1992;304(6830):809–813.
- Boily MC, Baggaley RF, Wang L, et al. Heterosexual risk of HIV-1 infection per sexual act: systematic review and meta-analysis of observational studies. *Lancet Infect Dis*. 2009;9(2):118–129.
- Powers KA, Poole C, Pettifor AE, Cohen MS. Rethinking the heterosexual infectivity of HIV-1: a systematic review and meta-analysis. *Lancet Infect Dis*. 2008;8(9):553–563.
- Varghese B, Maher JE, Peterman TA, Branson BM, Steketee RW. Reducing the risk of sexual HIV transmission: quantifying the per-act risk for HIV on the basis of choice of partner, sex act, and condom use. *Sex Transm Dis*. 2002;29(1):38–43.
- Padian N, Marquis L, Francis DP, et al. Male-to-female transmission of human immunodeficiency virus. *JAMA*. 1987;258(6):788–790.
- Seidlin M, Vogler M, Lee E, Lee YS, Dubin N. Heterosexual transmission of HIV in a cohort of couples in New York City. *AIDS*. 1993;7(9):1247–1254.
- Lane T, Pettifor A, Pascoe S, Fiamma A, Rees H. Heterosexual anal intercourse increases risk of HIV infection among young South African men. *AIDS*. 2006;20(1):123–125.
- Friedman SR, Flom PL, Kottiri BJ, et al. Prevalence and correlates of anal sex with men among young adult women in an inner city minority neighborhood. *AIDS*. 2001;15(15):2057–2060.
- Lescano CM, Houck CD, Brown LK, Doherty G, Diclemente RJ, Fernandez MI, et al. Correlates of heterosexual anal intercourse among at-risk adolescents and young adults. *Am J Public Health*. 2009;99(6):1131–1136.
- Gallagher KM, Sullivan PS, Lansky A, Onorato IM. Behavioral surveillance among people at risk for HIV infection in the U.S.: the National HIV Behavioral Surveillance System. *Public Health Rep*. 2007;122(suppl 1):32–38.
- Jenness SM, Murrill CS, Liu KL, Wendel T, Begier E, Hagan H. Missed opportunities for HIV testing among high-risk heterosexuals. *Sex Transm Dis*. 2009;36(11):704–710.
- Heckathorn D. Extensions of respondent-driven sampling: analyzing continuous variables and controlling for differential recruitment. *Sociol Methodol*. 2007;37(1):151–207.
- Johnston L, O'Bra H, Chopra M, et al. The associations of voluntary counseling and testing acceptance and the perceived likelihood of being HIV-infected among men with multiple sex partners in a South African township. *AIDS Behav*. 2008 Feb 13 [Epub ahead of print].
- Risser JM, Padgett P, Wolverson M, Risser WL. Relationship between heterosexual anal sex, injection drug use and HIV infection among black men and women. *Int J STD AIDS*. 2009;20(5):310–314.
- New York City Department of Health and Mental Hygiene. Epiquery: NYC Interactive Health Data System. 2007. Available at: <http://nyc.gov/health/epiquery>. Accessed April 28, 2010.
- Nguyen TQ, Gwynn RC, Kellerman SE, et al. Population prevalence of reported and unreported HIV and related behaviors among the household adult population in New York City, 2004. *AIDS*. 2008;22(2):281–287.
- Gross M, Holte SE, Marmor M, Mwatha A, Koblin BA, Mayer KH. Anal sex among HIV-seronegative women at high risk of HIV exposure. The HIVNET Vaccine Preparedness Study 2 Protocol Team. *J Acquir Immune Defic Syndr*. 2000;24(4):393–398.
- Wolitski RJ. Relative efficacy of a multisession sexual risk-reduction intervention for young men released from prisons in 4 states. *Am J Public Health*. 2006;96(10):1854–1861.
- Wohl AR, Johnson D, Jordan W, et al. High-risk behaviors during incarceration in African-American men treated for HIV at three Los Angeles public medical centers. *J Acquir Immune Defic Syndr*. 2000;24(4):386–392.
- Workowski KA, Berman SM. Sexually transmitted diseases treatment guidelines, 2006. *MMWR Recomm Rep*. 2006;55(RR-11):1–94.