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Sexual Risk Behaviors Among HIV-Infected South African Men and Women with Their Partners in a Primary Care Program: Implications for Couples-Based Prevention

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Abstract

We studied 1163 sexually-active HIV-infected South African men and women in an urban primary care program to understand patterns of sexual behaviors and whether these behaviors differed by partner HIV status. Overall, 40% reported a HIV-positive partner and 60% a HIV-negative or status unknown partner; and 17.5% reported >2 sex acts in the last 2 weeks, 16.4% unprotected sex in the last 6 months, and 3.7% >1 sex partner in the last 6 months. Antiretroviral therapy (ART) was consistently associated with decreased sexual risk behaviors, as well as with reporting a HIV-negative or status unknown partner. The odds of sexual risk behaviors differed by sex; and were generally higher among participants reporting a HIV-positive partner, but continued among those with a HIV-negative or status unknown partner. These data support ART as a means of HIV prevention. Engaging in sexual risk behaviors primarily with HIV-positive partners was not widely practiced in this setting, emphasizing the need for couples-based prevention.

Keywords

HIV; AIDS; South Africa; Sexual risk behavior; ART

Introduction

In light of expanding access to antiretroviral therapy (ART) and increasing calls for utilizing treatment as prevention in resource-limited settings, understanding sexual risk behaviors among HIV-infected individuals and their sex partners is necessary to inform secondary prevention interventions and to better understand the potential HIV transmission implications of greater access to ART and care [1–7]. The continued high prevalence and incidence of HIV in South Africa, with 5.7 million infected individuals, an adult prevalence of 18% [8], and an estimated incidence in young women of 5.5 per 100 person-years [9], are likely driven by a range of sexual behaviors, including low levels of condom use and multiple sex partners in whom HIV discordance is reportedly frequent [10–13].

Reframing HIV prevention as a couples-centered approach could enhance prevention efforts currently underway in sub-Saharan Africa [14]. Cohabitation is common and reported condom use is low in regular partnerships in this region [13]. It is estimated that nearly half of cohabiting HIV-infected individuals are in a serodiscordant relationship, and most new HIV infections likely occur within couples who are unaware of their HIV status [15, 16]. Increasingly calls have been made to promote condom use within African HIV discordant couples [17, 18]. Beyond condom use, additional measures of sexual behavior, namely increased duration of a relationship, a higher number of sex partners, and a higher frequency of sexual contact, have been associated with HIV transmission within discordant couples [19].

Data from sub-Saharan Africa consistently suggest that ART is associated with increased condom use and reductions in the number of sex partners, but these studies have generally not examined partner HIV status [20–27]. The practice of selectively engaging in sexual risk behaviors with partners of the same HIV status has been well-documented among high risk groups, such as men who have sex with men (MSM) and injecting drug users (IDUs) in the developed world [28, 29], and it is important to understand whether differential behavioral patterns by partner HIV status occurs in the primarily heterosexual HIV epidemic of southern Africa. We conducted a cross-sectional assessment of self-reported partner HIV status and sexual risk behaviors among sexually-active HIV-infected South African men and women enrolled in an urban primary HIV care program. We assessed four outcomes: current partner HIV status, reporting >2 sex acts in the last 2 weeks, reporting unprotected sex in the last 6 months, and having >1 sex partner in the last 6 months; and conducted stratified analyses to assess whether sexual risk behaviors differed across gender (men versus women) and partner HIV status (HIV positive partner versus HIV negative or status unknown partner).

Methods

Study Setting

Starting in June 2009 through June 2010, we conducted a cross-sectional study of self-reported partner HIV status and sexual risk behaviors among a cohort of HIV-infected men and women enrolled in a primary care program at Chris Hani Baragwanath Hospital in Soweto, which is part of the Johannesburg metropolitan area. The overall prevalence of HIV is 10% in this urban region [30] and 29.0% in pregnant women [30]. Eligible participants were HIV-infected adults ≥ 18 years of age who consented to participate in this

observational study. Since not all HIV-infected participants reported being sexually active, we utilized data only from participants who reported being sexually active in the preceding 6 months. Participants were either already in care, were self-referred, or were referred from mother-to-child transmission prevention programs and HIV counseling and testing programs.

Study nurses delivered a structured questionnaire at study visits, which included socio-demographic, behavioral, and health history information. Further information about data collection can be found in earlier publications from this observational cohort [31, 32]. Patient care, delivered primarily by nurses with physician oversight, included the following HIV-related clinical services: symptom screening for sexually transmitted infections (STIs) and tuberculosis, prophylactic treatment for opportunistic infections (OIs), treatment for STIs and HIV-related OIs, annual cervical smears [33], and female family planning methods. Study personnel underwent training that involved rehearsing the survey, non-judgmental survey delivery, and instruction in prevention counseling. Six monthly CD4 cell counts were scheduled and participants were referred for ART per current South African guidelines [34]. All study participants received the above preventive and clinical care services free of charge. Participants provided informed consent at enrollment, and the Ethics Committee at the University of the Witwatersrand approved this study.

Measures

We used data from participants' most recent study visit for the current cross-sectional analysis. Information about the partners of HIV-infected participants was collected beginning in June 2009, and all participants' most recent study visit was after this date. Since many participants were enrolled in the observational cohort for a longer period of time prior to this cross-sectional study, we controlled for time enrolled in the care program and time-dependent changes in behavior and disease progression in all analyses. At each study visit (scheduled 4–7 months apart), participants were interviewed using the structured questionnaire. Self-reported partner HIV status and sexual risk behaviors were assessed at the most recent study visit. CD4 cell count and weight measurements were utilized from within 100 days of the most recent study visit. We hypothesized that sexual behaviors may vary by HIV disease stage (i.e. CD4 cell count) as well as by apparent body shape (i.e. BMI) [35, 36]. Body mass index (BMI) (kg/m^2) was categorized according to the World Health Organization (WHO) International Classification of Adult BMI [37]. The following variables, age, employment, marital status, and height, were assessed at baseline; STI symptoms, ART status, alcohol use, drug use, needing assistance in completing daily activities (as a proxy measure for quality of life) [38], and disclosure of HIV status to either family or friends was assessed at every study visit. In analyses, variables assessed at every visit were defined as a composite index of ever reporting the exposure during study follow-up (i.e. between enrollment to the most recent study visit).

Sexual Behavior Definitions

We assessed behavioral factors that may influence the concordance of HIV results within couples, which can be divided into factors that affect transmissibility of HIV per sex act (i.e. condom use) and factors that influence the number of sex acts during which exposure to HIV may occur (i.e. coital frequency, duration of the relationship) [19]. Partner HIV status was assessed by asking the participant whether his/her closest (and second-closest if reported more than 1 concurrent partnership) sex partner was currently HIV-infected with the responses of HIV positive, HIV negative, or HIV status unknown. "Sexually active" was defined as reporting having had sex in the last 6 months. Coital frequency was assessed by asking about the number of times the participant had sex with each of his/her sex partners in the last 2 weeks, and the underlying distribution (i.e. median value) was used to define the

categorical outcome of reporting >2 sex acts in the last 2 weeks. Condom use in the last 6 months was assessed using a frequency scale with categorical response options of always, occasionally, and never; unprotected sex was defined as occasionally or never using condoms in the last 6 months. Multiple sex partners was defined as reporting >1 sex partner in the last 6 months. Average duration of relationship was assessed by asking “for how many months have you been having sex with each partner?” These self-reported measures have been employed previously in this setting [31, 32].

Statistical Analysis

Multivariable logistic regression models were used to determine predictors of the four self-reported outcomes, namely currently having a HIV-negative or status unknown partner (Model I); reporting >2 sex acts in the last 2 weeks (Model II); having unprotected sex in the last 6 months (Model III); and having >1 sex partner in the last 6 months (Model IV). We present adjusted odds ratios (AORs) for these four outcomes overall, and then stratified by gender and partner HIV status. Once participants initiated ART, they were considered ART-experienced at subsequent visits. A stepwise approach was first used to identify independent risk factors. Confounding was assessed based on either a change of >10% in the beta coefficient of independent risk factors, or a priori confounders (age, gender, and ART status) based on a review of the literature. We controlled for time-dependent changes in behavior by adjusting for time since enrollment in the care program [25]. To assess whether sexual risk behaviors differed by gender and partner HIV status (i.e. effect modification or interaction) [39, 40], we present stratified multivariable models comparing men to women, and HIV positive partners to HIV negative or status unknown partners. In sensitivity analyses, we assessed the impact of CD4 cell count and BMI on the outcomes, both as confounders and effect modifiers, through examining participants with available CD4 cell count (84.0%) and BMI data (92.8%). All analyses used STATA (STATA CORP, version 10.0, College Station, TX) software.

Results

Characteristics of Participants Overall and Stratified by Gender and Partner HIV Status

Among 1542 enrolled HIV-infected participants, 1163 (75.4%) were sexually active in the last 6 months and were consequently included in the current analysis (see Table 1). Most participants (78.9%) were women and the median age was 34.8 years. Almost 16% of participants were currently receiving ART at the time of the study. Almost two-thirds of participants self-reported being in an HIV discordant relationship, either with a HIV-negative (20.9%) or with a status unknown partner (39.8%). The median duration of partnerships was 3.4 years. Women were younger than men, women on average had partners who were older by 3 years and men had partners who were younger by 4 years. About 1% reported a history of same-sex partners. Almost all (98.0%) had disclosed their HIV status to a family member or friend. Most participants (60.4%) had been enrolled in care for >12 months. The median CD4 cell count at the most recent study visit was 375 cells/ μ l, median BMI was 26.2 kg/m², and 68.8% were classified as WHO clinical stage I.

In stratified analyses comparing men to women and having a HIV seronegative or status unknown partner to having a HIV positive partner, we noted significant differences in socio-demographic and behavioral characteristics, which are shown in Table 1 ($P < 0.05$).

Patterns of Sexual Activity

Overall, 17.5% of participants reported >2 coital acts in the last 2 weeks with a mean number of 1.8 coital acts for men and 1.4 for women, 16.4% reported unprotected sex in the last 6 months, and 3.7% >1 sex partner in the last 6 months. Among participants reporting

sexual risk behaviors (N = 260), there was limited overlap, with only two participants reporting all three sexual risk behavior outcomes, and 42/260 participants (16.2%) reporting two outcomes (29/260 unprotected sex and >2 coital acts, 6/260 unprotected sex and >1 sex partner, and 7/260 >2 coital acts and >1 sex partner). By gender, women were significantly more likely to report having a HIV seronegative or status unknown partner compared to men, and women reported higher rates of unprotected sex (see Table 1). Men were significantly more likely to report >2 sex acts in the last 2 weeks and to have >1 sex partner in the last 6 months. By ART status, ART-experienced participants were less likely than those who were ART-naive to report: a partner who was HIV negative or status unknown (50.8 vs. 62.5%; $P = 0.003$), >2 sex acts in the last 2 weeks (9.3 vs. 19.1%; $P = 0.001$), unprotected sex in the last 6 months (11.5 vs. 17.4%; $P = 0.049$), and >1 sex partner in the last 6 months (0.6 vs. 4.3%; $P = 0.014$). With increasing BMI, there was a higher frequency of reporting a HIV negative or status unknown partner, >2 sex acts in the last 2 weeks, and unprotected sex in the last 6 months, but a lower frequency of reporting multiple sex partners in the last 6 months ($P < 0.1$). By CD4 cell count, the frequency of the outcomes did not vary, except an increasing non-significant trend of reporting a HIV negative or status unknown partner at higher CD4 cell counts ($P = 0.068$). The frequencies of sexual risk behaviors were not significantly different by partner HIV status.

Predictors of Sexual Behaviors Overall, and Stratified by Gender and Partner HIV Status

Table 2 presents multivariable analyses of significant predictors of each of the four study outcomes overall, and then stratified by gender (women versus men) and self-reported partner HIV status (partner HIV negative or unknown status versus partner HIV positive). Overall, women were more likely to report a HIV-negative or status unknown sex partner (Model I) (AOR: 3.31; 95% CI: 2.36–4.66). Participants who were ART-experienced (AOR: 0.59; 95% CI: 0.41–0.85), as well as those who were unemployed and who were married, had a lower odds of reporting a HIV-negative or status unknown sex partner. The associations between ART, employment, and marital status with reporting a HIV-negative or status unknown sex partner varied by gender.

In regards to coital frequency (Model II), women (AOR: 0.54; 95% CI: 0.35–0.80) and those who were ART-experienced (AOR: 0.53; 95% CI: 0.30–0.93) were less likely to report >2 coital acts in the last 2 weeks. Participants who reported unprotected sex were more likely to report >2 coital acts in the last 2 weeks (AOR: 1.56; 95% CI: 1.05–2.30). Participants who were ≥ 40 years of age and who had been in care for ≤ 12 months also had a lower odds of reporting >2 coital acts in the last 2 weeks, but alcohol use was associated with a higher odds of reporting >2 coital acts in the last 2 weeks. Except alcohol use and age, these associations with coital frequency did not differ by gender. Except unprotected sex, these associations with coital frequency did not differ by partner HIV status.

In regards to condom use (Model III), women (AOR: 2.76; 95% CI: 1.63–4.67), those who reported >2 sex acts in the last 2 weeks (AOR: 1.55; 95% CI: 1.05–2.42), and those who reported >1 sex partner (AOR: 2.19; 95% CI: 1.00–4.79), as well as those who were married, had a higher odds of reporting unprotected sex in the last 6 months. ART-experienced participants were less likely to report unprotected sex (AOR: 0.64; 95% CI: 0.38–1.08). By partner HIV status, the protective effect of ART with unprotected sex did not hold for those participants with a HIV-positive partner. The odds of reporting >2 sex acts in the last 2 weeks and having >1 sex partner with unprotected sex were higher for those with a HIV-positive partner.

In terms of number of sex partners (Model IV), women (AOR: 0.14; 95% CI: 0.06–0.30) and ART-experienced participants (AOR: 0.11; 95% CI: 0.01–0.88), as well as those who were married, had a lower odds of reporting >1 sex partner in the last 6 months. Participants

who reported unprotected sex were more likely to have >1 sex partner (AOR: 2.26; 95% CI: 1.02–5.01). By partner HIV status, the association between unprotected sex with reporting >1 sex partner was markedly higher among those with a HIV-positive partner.

Sensitivity Analyses

To assess whether these associations were independent of two potential markers of HIV disease progression, we examined the four outcomes adjusting for CD4 cell count and BMI as confounders. These results were consistent with the multivariable analyses presented above. We also assessed effect modification of the four outcomes by strata of CD4 cell count and BMI, and differences by strata were not significant.

Discussion

In this cross sectional analysis, we found that 40% of our sample of HIV-infected South African men and women in an urban primary care program reported having sex with an HIV-positive partner, 40% with a partner of unknown HIV status, and 20% with a HIV-negative partner. Those who reported having a HIV-negative or status unknown partner were more likely to be women and ART-naïve. In stratified analyses by partner HIV status, the odds of reporting the assessed sexual risk behaviors appeared to be slightly higher among participants reporting a HIV-positive partner. However, we also noted that sexual risk behaviors persisted among those participants who reported having a HIV-negative or status unknown partner. These data suggest that selectively engaging in sexual risk behaviors by partner HIV status does not appear to be extensively practiced in this setting where most HIV transmission is heterosexual, which is different than data from the developed world among some high-risk groups [28, 29, 41]. Given the large proportion of participants who remained unaware of their partners HIV status, further interventions like partner voluntary counseling and testing (VCT) and effective counseling messages for serodiscordant couples are needed to support testing the partners of HIV-infected individuals in care [42, 43].

Increasingly prevention programs in sub-Saharan Africa have begun to emphasize the importance of HIV secondary prevention within partners in long-term relationships [17, 44]. Most sexual risk behaviors by HIV-infected individuals in sub-Saharan Africa have been reported to occur within primary partnerships [24]. HIV counseling and testing of partners have resulted in substantial increases in condom use among discordant couples in this region [43]. Condom use has been shown to substantially increase after couples receive VCT [19, 43, 45]. In the current study, participants on average had been in their relationships for a substantial period of time (median >3 years), and knowledge of partner HIV status did not vary by the duration of relationships, suggesting the need for earlier couples-based interventions. Counseling protocols need to be developed that clearly explain HIV serodiscordance, emphasize the risk for HIV transmission, and support risk reduction strategies [46, 47].

In regards to the frequency of reporting sexual risk behaviors with their partners in the current study, 17.5% of participants reported >2 sex acts in the last 2 weeks, 16.4% unprotected sex in the last 6 months, and 3.7% >1 sex partner in the last 6 months. Earlier studies conducted among HIV-infected Africans who had access to ART have generally documented higher levels of unprotected sex among those who were sexually active (>40%) compared to the current study [22–24]; recent national survey data among sexually active South Africans have also documented higher levels of inconsistent condom use and multiple sex partners compared to the current study [30]. The lower level of reporting sexual risk behaviors in the current study may be due to the fact that participants had been in the prevention and care program on average for over a year; in addition, earlier data from our

site suggest less sexual risk behaviors among urban relative to rural HIV-infected individuals [31]. When examining the frequency of sexual risk behaviors by partner HIV status, a recent study from the Cameroon examining sexual risk behaviors with one's steady partner who was HIV-negative or status unknown documented higher inconsistent condom use (35.3%) compared to the current study with partner's who were HIV-negative or status unknown (18%) [27]. It is possible that there are true differences in sexual practices between these settings; however, differing results in these regional settings highlight the complexity of measuring sexual behaviors and variations in study populations and prevention and treatment program characteristics.

Participants who were on ART were consistently less likely to engage in the assessed sexual risk behaviors, which held even after adjusting for markers of HIV disease progression and time in care. These findings are in accordance with emerging data from sub-Saharan Africa [20–27], and provide further impetus to explore the benefits of ART as prevention [7, 48]. Why ART-experienced individuals are more likely to engage in behaviors that decrease HIV transmission requires further qualitative data. In the current study, those who were on ART were less likely to have a sex partner who was HIV negative or status unknown, and so many individuals with unsuppressed virus may be at risk of transmitting HIV to their sex partners. Recent data suggest that prompt initiation of ART can substantially decrease the risk of HIV transmission among serodiscordant couples [49], and further interventions are needed to timely initiate ART among HIV-infected individuals in serodiscordant relationships.

We did note gender-based differences in sexual behaviors. While women were more likely to report a HIV-negative or status unknown partner and unprotected sex, men were more likely to report a higher coital frequency and multiple sex partners. The association between women and having a HIV-negative or status unknown partner is different than some couples-based studies in Africa which have generally regarded men as the source of HIV infection within the partnership [17]. It is possible that unprotected sex among women may be connected to fertility choices [50], and that many women may have become aware of their HIV status through antenatal testing and then enrolled in the care program. Additionally, HIV-infected South African women may be in relationships with men where they do not have the ability to engage in discussions about his HIV status due to the risk of partner violence and power inequality [51, 52]. Further data is needed to understand contextual factors for why sexual risk behavior may differ by gender, and secondary prevention programs may need to develop gender-specific interventions.

A limitation of the current study is that HIV partner status was assessed using index participant self-report, and the accuracy of participant recall about and knowledge of his/her partner's HIV status can be imperfect [53]. As a result, it is possible we may have underestimated the proportion of sexual risk behaviors occurring with HIV-infected partners. The measures used to assess partner HIV status in relation to sexual risk behaviors were indirect, and additional data are needed to understand whether participants intentionally chose a sex partner based on HIV status. The cross-sectional nature of this study precludes establishing any casual and/or temporal associations. While we examined socio-demographic and clinical differences by partner selection, we are unable to comment on associated psychosocial factors. We cannot confirm whether participants' disclosure of HIV status was specifically to their sex partners because the measure we employed to assess disclosure included either a family member and/or a friend. Self-reported sexual behaviors are ever susceptible to social desirability and recall bias [54], especially in the context of a care program with ongoing counseling and prevention messages. Increasing studies have questioned the validity of using self-reported measures of sexual risk behaviors among HIV-infected Africans and have recommended utilizing ACASI and other biomarkers to assess

sexual behaviors [55, 56]. The lack of available plasma viral load data limits our ability to examine the potential biological risk of HIV transmission. We assessed BMI as possibly a more visible sign of HIV disease progression to sex partners relative to CD4 cell count [35, 36]; however, BMI may not be an accurate portrayal of disease progression and may be a faulty indicator of health status, given variations in muscle mass and age. It is important to note that when assessing differences in sexual risk behaviors by partner HIV status and gender (i.e. effect modification or interaction), we employed stratified multivariable models to interpret whether the adjusted odds ratios for exposure-outcome associations varied by these two variables, which is consistent with current epidemiological methods [39, 40].

This is one of the first studies (to our knowledge) to examine whether sexual risk behaviors differ by partner HIV status among heterosexual HIV-infected individuals in Africa. Our data suggest that risky sex is not limited to HIV seroconcordant partners (in this case, individuals known to also be HIV-infected). Further longitudinal data from this social setting is needed to understand whether partner selection by HIV status is occurring and possible contextual factors. Despite the positive outcomes reported by multiple couples-centered programs to HIV prevention in sub-Saharan Africa, such approaches have not become a core component of national HIV prevention and care programs in the region [47]. HIV care and treatment programs need to expand couples- and family-based VCT services so that more HIV-infected Africans know their partners' HIV status, which could have an impact on HIV transmission risk behaviors. In light of increasing debate about the HIV transmission benefits of expanding access to ART, further research will be needed to understand partner selection and sexual risk behaviors over time among HIV-infected and -uninfected Africans.

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Table 1

Socio-demographic, clinical, and behavioral characteristics of HIV-infected South African participants overall, and stratified by gender and self-reported partner HIV status (N = 1163)

Characteristic	Overall All (%) (N = 1163)	By gender ^d		By self-reported partner HIV status ^d	
		Women (%) (N = 918)	Men (%) (N = 245)	Partner HIV negative/unknown (%) (N = 706)	Partner HIV positive (%) (N = 457)
Self-reported partner HIV Status ^{a,*}					
HIV positive	39.3	32.8	63.2	–	–
HIV negative	20.9	20.8	21.2		
Unknown	39.8	46.3	15.5		
Gender					
Women	78.9	–	–	87.3	66.1
Men	21.1			12.7	33.9
ART-experienced**	15.7	15.0	18.4	13.2	24.5
Median age (IQR) (years) ^{*,**}	34.8 (20.5–39.8)	33.9 (29.7–38.2)	39.5 (35.0–44.9)	34.5 (30.0–39.2)	35.3 (31.5–40.6)
Employment ^{*,**}					
Other/student	8.3	9.0	5.7	9.9	5.9
Employed	34.5	30.2	50.6	32.4	37.6
Unemployed	57.2	60.8	43.7	57.7	56.5
Marital status ^{*,**}					
Never married	59.9	63.1	48.2	63.3	54.7
Married or living together	35.9	33.0	46.9	32.0	42.0
Divorced/separated/widowed	4.1	3.9	4.9	4.7	3.3
Needs assistance with daily activities ^b	0.4	0.4	0.4	0.4	0.4
Alcohol use ^b					
Ever used alcohol ^{*,**}	41.4	32.7	73.9	29.2	39.0
Ever consumed ≥2 drinks ^{*,**}	29.2	23.5	50.2	26.6	33.0
Used marijuana ^{b,*,**}	5.9	1.9	20.8	3.4	9.6
Disclosed HIV status ^b	98.0	97.9	98.4	97.2	99.3
STI symptoms ^{b,*,**}	24.9	28.3	12.2	27.2	21.4

Characteristic	Overall All (%) (N = 1163)	By gender ^d		By self-reported partner HIV status ^d	
		Women (%) (N = 918)	Men (%) (N = 245)	Partner HIV negative/unknown (%) (N = 706)	Partner HIV positive (%) (N = 457)
Median BMI (IQR) (kg/m ²) ^{c, **, *}	26.2 (22.7–31.1)	27.4 (23.7–32.3)	22.7 (20.5–25.6)	26.8 (23.4–31.4)	25.1 (22.0–30.5)
Median CD4 cell count (IQR) (cells/μl) ^{c, *}	375 (271–506)	384 (276–520)	335 (234–446)	385 (277–517)	352 (262–479)
WHO clinical stage ^c					
I	68.8	70.3	63.2	89.8	67.3
II	12.5	12.6	12.4	12.5	12.5
III	16.9	15.3	22.7	16.1	18.0
IV	1.8	1.9	1.7	1.6	2.2
Year enrolled in care [*]					
2002–2004	13.8	14.7	10.2	14.0	13.4
2005–2006	21.3	22.2	18.0	21.3	21.4
2006–2009	64.9	63.1	71.8	64.7	65.2
Time in care [*]					
<1 month	18.8	18.0	22.0	19.3	18.2
1–12 months	20.8	19.4	26.1	21.3	20.1
>12 months	60.4	62.6	51.8	59.5	61.7
Median duration of partnership (IQR) (years)	3.4 (2.0–5.2)	3.4 (2.0–5.3)	3.4 (2.0–5.3)	3.4 (1.9–5.2)	3.5 (2.2–5.3)
Median age of partner (IQR) (years) [*]	37 (32–42)	37 (33–42)	33 (29–39)	37 (32–42)	37 (32–42)
Sexual risk behaviors					
>2 Sex acts in the last 2 weeks [*]	17.5	15.9	23.7	16.4	19.3
Unprotected sex in the last 6 months [*]	16.4	18.4	8.9	18.0	14.0
>1 Sex partner in the last 6 months [*]	3.7	1.8	10.6	3.3	4.4
IQR interquartile range					

^{*} Significant difference between men versus women (*P*-value < 0.05)

^{**} Significant difference between participants with a HIV-positive partner versus those with a HIV-negative or status unknown partner (*P*-value < 0.05)

^a 25 participants (2.1%) also reported an HIV status for a secondary partner. If the HIV status of the primary partner was unknown and the HIV status of a secondary partner was known to be positive or negative, the HIV status of the secondary partners was utilized

^b Variables were assessed as ever reporting exposure from enrollment to current study visit

^c Measurement taken from within 3 months of current study visit

^d Categorical variables were compared using chi squared statistics and continuous variables were compared using Student *t* tests

Table 2

Multivariable analyses of significant predictors of currently having a HIV negative or unknown status sex partner (Model I), reporting >2 sex acts in the last 2 weeks (Model II), reporting unprotected sex in the last 6 months (Model III), and having >1 sex partner in the last 6 months (Model IV) overall, and stratified by gender and self-reported partner HIV status (N = 1163)

Characteristic	Overall All (N= 1163) AOR (95% CI); P-value	By gender		By self-reported partner HIV status	
		Women (N = 918) AOR (95% CI); P-value	Men (N = 245) AOR (95% CI); P-value	Partner HIV negative or unknown status (N = 706) AOR (95% CI); P-value	Partner HIV positive (N = 457) AOR (95% CI); P-value
Model I: Predictors of reporting a HIV negative or unknown status sex partner					
Gender					
Women	3.31 (2.36–4.66); <0.0001	–	–	–	–
Men	1.00				
ART status					
Yes	0.59 (0.41–0.85); 0.004	0.50 (0.33–0.75); 0.001	1.01 (0.45–2.25); 0.968	–	–
No	1.00	1.00	1.00		
Employment					
Unemployed	0.60 (0.36–0.98); 0.043	0.52 (0.30–0.92); 0.026	0.95 (0.28–3.21); 0.937	–	–
Employed	0.60 (0.36–1.01); 0.056	0.54 (0.30–0.98); 0.046	0.90 (0.26–3.07); 0.873		
Other/student	1.00	1.00	1.00		
Marital status					
Divorced/separated/ widowed	1.56 (0.79–3.06); 0.193	1.55 (0.69–3.49); 0.283	1.94 (0.56–6.72); 0.292	–	–
Married/living together	0.71 (0.54–0.93); 0.014	0.64 (0.47–0.87); 0.005	0.95 (0.54–1.67); 0.867		
Never married	1.00	1.00	1.00		
Model II: Predictors of reporting >2 coital acts in the last 2 weeks					
Gender					
Women	0.54 (0.35–0.80); 0.003	–	–	0.63 (0.33–1.21); 0.171	0.50 (0.28–0.88); 0.018
Men	1.00			1.00	1.00
ART status					
Yes	0.53 (0.30–0.93); 0.027	0.53 (0.27–1.05); 0.069	0.59 (0.21–1.68); 0.329	0.42 (0.17–1.02); 0.057	0.59 (0.28–1.26); 0.177
No	1.00	1.00	1.00	1.00	1.00
Unprotected sex					
Yes	1.56 (1.05–2.30); 0.025	1.58 (1.03–2.43); 0.033	1.66 (0.57–484); 0.350	1.34 (0.80–2.23); 0.254	1.89 (1.01–3.54); 0.046

Characteristic	Overall All (N = 1163) AOR (95% CI); P-value	By gender		By self-reported partner HIV status	
		Women (N = 918) AOR (95% CI); P-value	Men (N = 245) AOR (95% CI); P-value	Partner HIV negative or unknown status (N = 706) AOR (95% CI); P-value	Partner HIV positive (N = 457) AOR (95% CI); P-value
No	1.00	1.00	1.00	1.00	1.00
Age (years)					
≥40	0.49 (0.29–0.84); 0.010	0.48 (0.25–0.91); 0.027	1.16 (0.30–4.35); 0.825	0.47 (0.23–0.96); 0.040	0.49 (0.21–1.13); 0.096
30–40	1.03 (0.69–1.52); 0.874	0.91 (0.60–1.40); 0.692	3.00 (0.83–10.90); 0.094	1.09 (0.66–1.78); 0.728	0.94 (0.49–1.83); 0.875
≤30	1.00	1.00	1.00	1.00	1.00
Had ≥2 alcoholic drinks					
Yes	1.45 (1.03–2.05); 0.031	1.08 (0.70–1.67); 0.706	2.94 (1.48–5.82); 0.002	1.41 (0.89–2.22); 0.137	1.46 (0.85–2.49); 0.165
No	1.00	1.00	1.00	1.00	1.00
Time in care					
<1 month	0.66 (0.44–1.00); 0.052	0.71 (0.44–1.14); 0.161	0.57 (0.25–1.31); 0.192	0.72 (0.41–1.23); 0.234	0.59 (0.31–1.11); 0.107
1–12 months	0.61 (0.38–0.98); 0.044	0.70 (0.43–1.12); 0.145	0.42 (0.16–1.07); 0.072	0.84 (0.46–1.53); 0.591	0.36 (0.16–0.78); 0.011
>12 months	1.00	1.00	1.00	1.00	1.00
Model III: Predictors of reporting unprotected sex in the last 6 months					
Gender					
Women	2.76 (1.63–4.67); <0.0001	–	–	5.13 (1.91–13.75); 0.001	1.75 (0.88–3.50); 0.110
Men	1.00			1.00	1.00
ART status					
Yes	0.64 (0.38–1.08); 0.097	0.65 (0.37–1.12); 0.128	0.55 (0.10–3.00); 0.496	0.51 (0.24–1.06); 0.074	1.00 (0.46–2.16); 0.993
No	1.00	1.00	1.00	1.00	1.00
>2 Sex acts in last 2 weeks					
Yes	1.55 (1.05–2.29); 0.027	1.58 (1.03–2.42); 0.034	1.68 (0.57–4.88); 0.339	1.33 (0.80–2.21); 0.268	1.87 (0.99–3.50); 0.051
No	1.00	1.00	1.00	1.00	1.00
>1 Sex partner					
Yes	2.19 (1.00–4.79); 0.048	1.85 (0.63–5.48); 0.261	2.71 (0.82–8.92); 0.101	1.93 (0.64–5.81); 0.241	3.16 (0.98–10.17); 0.053
No	1.00	1.00	1.00	1.00	1.00
Marital status					
Divorced/separated/ widowed	1.67 (0.78–3.58); 0.186	1.51 (0.65–3.53); 0.334	2.67 (0.40–17.58); 0.305	1.97 (0.81–4.78); 0.132	1.03 (0.20–5.21); 0.966
Married/living together	1.42 (1.01–1.99); 0.041	1.34 (0.93–1.93); 0.109	1.96 (0.70–5.45); 0.196	1.47 (0.96–2.25); 0.074	1.47 (0.82–2.61); 0.187

Characteristic	Overall	By gender		By self-reported partner HIV status	
	All (N=1163) AOR (95% CI); P-value	Women (N = 918) AOR (95% CI); P-value	Men (N = 245) AOR (95% CI); P-value	Partner HIV negative or unknown status (N = 706) AOR (95% CI); P-value	Partner HIV positive (N = 457) AOR (95% CI); P-value
Never married	1.00	1.00		1.00	1.00
Model IV: Predictors of having >1 sex partner in the last 6 months					
Gender					
Women	0.14 (0.06–0.30); <0.0001	–	–	0.09 (0.03–0.29); <0.0001	0.20 (0.06–0.66); 0.008
Men	1.00			1.00	1.00
ART status					
Yes	0.11 (0.01–0.89); 0.039	0.40 (0.04–3.29); 0.397	– ^a	– ^a	0.24(0.02–2.11); 0.200
No	1.00	1.00	– ^a	– ^a	1.00
Unprotected sex					
Yes	2.26 (1.02–5.01); 0.044	1.83 (0.62–5.41); 0.270	3.05 (0.93–9.96); 0.063	2.45 (0.79–7.60); 0.119	3.53 (1.01–12.28); 0.047
No	1.00	1.00	1.00	1.00	1.00
Marital status					
Divorced/separated/ widowed	2.41 (0.70–8.30); 0.161	– ^a	1.95 (0.33–11.26); 0.452	1.41 (0.25–7.91); 0.694	4.42 (0.66–29.59); 0.125
Married/living together	0.35 (0.15–0.78); 0.010		0.57 (0.22–1.45); 0.244	0.34(0.10–1.11); 0.074	0.35 (0.11–1.14); 0.084
Never married	1.00		1.00	1.00	1.00

Only statistically significant covariates ($P < 0.05$) in the overall models are presented in the table above. All four models adjusted for gender, age, employment, treatment, alcohol use, STI symptoms, marital status, and time in care. Model I was also adjusted for >2 coital acts, unprotected sex, and >1 sex partner. Model II also adjusted for unprotected sex and >1 sex partner. Model III also adjusted for >2 coital acts and >1 sex partner. Model IV also adjusted for >2 coital acts and unprotected sex

^aNo participants reported the exposure