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## Change in Sexual Activity 12 Months After ART Initiation Among HIV-Positive Mozambicans

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### Abstract

We assessed sexual behaviors before and 12-months after ART initiation among 277 Mozambicans attending an HIV clinic. Measured behaviors included the number of sexual partners, condom use, concurrent relationships, disclosure of HIV status, alcohol use, and partners' serostatus. Compared to before ART initiation, increases were seen 12 months after ART in the proportion of participants who were sexually active (48% vs. 64% respondents,  $P < 0.001$ ) and the proportion of participants with HIV-negative or unknown serostatus partners (45% vs. 80%,  $P < 0.001$ ). Almost all (96%) concurrent partnerships reported at 12 months formed after ART initiation. Although reported correct and consistent condom use increased, the number of unprotected sexual relationships remained the same ( $n = 45$ ). Non-disclosure of HIV-serostatus to

sexual partners was the only significant predictor of practicing unprotected sex with partners of HIV-negative or unknown serostatus. Sexual activity among HIV-positive persons on ART increased 12 months after ART initiation. Ongoing secondary transmission prevention programs addressing sexual activity with multiple partners, disclosure to partners and consistent condom use with serodiscordant partners must be incorporated throughout HIV care programs.

## Keywords

Antiretroviral therapy (ART); HIV/AIDS; Africa; Sexual behavior; Concurrency; Unprotected sex

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## Introduction

The expansion of antiretroviral therapy (ART) in low-income countries has improved the health of HIV-positive individuals and their communities [1, 2] by reducing progression to AIDS and death [3–5] and lowering infectivity by lowering viral load in plasma, semen, and vaginal fluid [6, 7]. However, for every person initiating ART in resource-limited settings it is estimated that there are four more newly-infected persons [8]. Individuals on ART feel better and live longer with HIV, both of which increase the potential for more sexual activity leading to secondary HIV transmission. A number of factors may influence secondary HIV transmission risk, including health beliefs [9], HIV treatment optimism or complacency (e.g., that non-detectable virus equates with inability to transmit HIV) [10, 11] or cultural norms regarding gender-specific sexual behaviors. Other factors may include lack of disclosure of HIV status, community stigma around HIV and alcohol and substance use that may increase unsafe sexual practices.

Though some evidence from Uganda [12, 13] and North America [14, 15], and transmission mathematical modeling [16, 17] show that increased ART coverage can reduce secondary HIV transmission, it remains postulated that behavioral disinhibition [18] and insufficient ART adherence [18] could erase the gains made by ART at the population level. In high-income countries such as the United States (US), where HIV incidence plateaued for over a decade, the number of new infections is estimated to have increased from 40,000 to 65,000 infections annually [19]. Increases in sexually transmitted infections (STIs) and sexual risk behaviors have been seen among HIV-positive men who have sex with men [20–22] including syphilis outbreaks in San Francisco [23]. Unprotected sex with discordant partners is common in Africa, with its mature and generalized HIV epidemics. In Mozambique we found that among individuals starting ART in 2004–2006, 65% of pre-ART sex acts were unprotected and only 45% disclosed their HIV status to partners [24]. Similarly, several studies from Africa have found an increase in high risk sexual behavior among persons initiating ART [25, 26]. Other studies found no increase [27–29] or a decrease in high risk sexual behavior 1 year after ART [12, 30, 31]. This study coupled with recent findings from Africa regarding the association of ART and secondary HIV transmission risk [25–27, 30, 32] will help identify patterns of high risk sexual behavior and help guide prevention with positive strategies. We therefore examined the sexual behaviors reported among 277 HIV-positive Mozambican men and women in the 3 months prior to ART initiation, and 12 months later.

## Methods

### Participants and Setting

The study was conducted between October, 2004 and May, 2006 at the HIV care clinic in the Beira Central Hospital, a large-volume public institution providing free specialized HIV care and antiretroviral medications to all affected Mozambicans in Beira and the

surrounding area. Clinic staff assessed patients' ART eligibility based on standard Mozambican norms for starting therapy ( $CD4 < 200/mm^3$  regardless of WHO stage,  $CD4 200-349/mm^3$  if in WHO stage 3 or pregnant, and WHO stage 4 regardless of CD4 count). The staff pharmacist attempted to refer all persons initiating ART to the study team. The research manager, in consultation with clinic staff, assessed the eligibility of potential participants according to the following criteria: at least 18 years of age, living near the clinic, and free of severe mental illness or dementia (as assessed by clinic staff). The study protocol was reviewed and approved by the Institutional Review Boards of the Mozambique Ministry of Health and the University of Washington. All participants provided written consent (see [24]).

## Procedures

During the study recruitment period, 683 people initiated ART, 433 were eligible for the study, and 350 were enrolled on the day they started ART. As part of the primary study aim, participants were randomly assigned to either a modified directly observed therapy adherence intervention or standard care, and completed a 45-min interviewer-administered questionnaire [33, 34]. As part of the secondary aim, which is reported in this paper, participants reported their sexual behaviors during the 3 months prior to the day they initiated ART and during the 3 months prior to the 12-month assessment point. Interviewers attended a 5-day training and interviews were conducted in the local language. Participants were reimbursed 25,000 meticaís (approximately US\$1) for each interview.

## Measures

Most items and all scales were selected from published and validated measures and all items were transcribed and pre-tested, and psychometric properties for validity and reliability were assessed for cultural appropriateness in Beira, Mozambique [33].

**Sexual Behavior**—We asked respondents about the number of sexual partners 12 months prior to and 12 months after initiating ART. At each assessment point, we assessed number and type of sex acts (i.e., oral, anal, or vaginal) for each of the participants' last three sexual partners in the last 3 months, and the frequency of *correct and consistent condom use* (i.e., number of times condoms were used minus breakage, slippage, or incorrect application). To assess *concurrent relationships*, participants provided the month, day, and year the relationship began and ended. Any overlap in the last 12 month with two or more partners was coded as a concurrent relationship. To validate this measure, participants were also asked "About how many other sexual partners did you have during the time you were together?" There were no discrepancies between the overlap dates and the response to this single item question. If more than three partners were reported in the 3 month assessment timeframe, summary questions were used to capture the number of partners, sex acts, and condom use per sex act for the other partners. To calculate a correct and consistent score, we set mechanical (not user-related) condom effectiveness at 0.95 to take into account product defects and then adjusted this rate by the number of times a participant reported the condom broke, slipped off, or was put on incorrectly in the prior 3 months. The 'correct & consistent condom use score' ranged from 0 (poor or non use) to 0.95 (perfect and consistent use) [24].

**Treatment Optimism (Complacency)**—This measure is defined as "minimizing, discounting, or discrediting the threat of HIV/AIDS" [11, p. 427]. Two sets of culturally adapted measures assessed prevention-related attitudes and perceptions of ART medication. Participants responded to 5 items on their attitudes about HIV/AIDS since ART treatment, including HIV/AIDS being less of a threat, less worry about transmitting HIV, believing there is now nearly a cure, HIV/AIDS is less serious than in the past, and being HIV-positive is not a big problem now that treatment is available [10, 35, 36]. The standardized

Cronbach's  $\alpha$  for this sample was 0.73. A second six-item scale captured whether participants felt it was necessary to practice safer sex after initiating ART ( $\alpha = 0.66$ ). Response to each item was made on a 4-point response scale ranging from strongly disagree to strongly agree. A score for each scale was created. The summative score was divided by the number of items over which the sum was calculated. *Treatment optimism* items were added after the study began; thus only 201 participants responded.

To capture culturally appropriate social and cultural factors that may influence individuals' perception and understanding of health risk, participants responded to 10 items about men's and women's sexual roles in Mozambique society. Items asked the participants to rate the validity of a statement in relation to both genders, such as, "a married man/woman can have one or more sexual partner(s) than the person they are married to; a single man/woman can have one or more sexual partners while dating another person; and men/women want more sex than women/men". Gender specific items included: "women having multiple male partners is an economic necessity; there are more women than men so men are expected to have multiple partners; and a man is obligated to have multiple partners." Response options were graded on a 4-point Likert scale ranging from "strongly disagree" to "strongly agree" ( $\alpha = 0.87$ ).

A 21-item stigma scale, reduced from Berger et al. 40-item scale [37], captured the social and emotional aspects of people living with HIV. This scale has been used in several studies throughout southern and eastern Africa with good validity and reliability [38, 39]. The items include social or public stigma (items relating to fear and rejection, such as what "most people think about a person with HIV" or what "most people with HIV can expect when others learn they have HIV"); negative self-image (items expressing "feelings of shame and guilt such as feeling unclean, not as good as others, or like a bad person because of HIV"); and personalized stigma (items relating to personal experiences or fears of rejection for having HIV, such as "losing friends, feeling that people were avoiding him/her, and regrets for having told some people"). Higher scores range from 21 to 84 with scores indicating higher levels of stigma. The overall scale  $\alpha = 0.90$  for this population [37].

**Soicodemographics**—Variables such as gender, age, income, employment status, and education were recorded at baseline; income and employment status were reassessed at 12 months after baseline via questionnaire.

**Clinical Measures**—Participants provided a 4–5 ml blood sample for a *CD4 cell count* as part of standard care immediately prior to ART and 4 and 10 months after initiating ART. The absolute CD4 cell count was determined through flow cytometry. A chart review was conducted to record the CD4 test result closest to but within 2 months of the assessment point. If a CD4 result was not available during this time frame, the participant was excluded from this analysis (missing at 12 months  $n = 31$ ).

**Alcohol Use**—If participants indicated alcohol or drugs use, they were asked a two-item screening for alcohol and substance abuse. In the past 12 months... "did you drink alcohol or used drugs more than you meant to" and "did you feel the need to cut down on your drinking or drug use?" [40].

**Sexual Partner Characteristics**—For each of their last three sexual partners, participants provided basic socio-demographic data, HIV status (status unknown or known to have tested positive or negative), and approximate start and end dates to capture concurrent relationships. Among those that were married, we assessed whether concurrent relationships occurred outside the marriage, to account for legal polygamous marriages.

## Statistical Methods

We assessed change in sexual activity (sexual behavior, sexual partner characteristics) from time 1 (3 months prior to ART initiation) and time 2 (3 months prior to the 12 month assessment point) and factors (disclosure of HIV status, alcohol use, and socioeconomic variables) associated with sexual behavior. To assess change in the baseline and the 12-month measures, differences in continuous variables were tested using two-sided paired *t* tests or Wilcoxon rank sum tests if the data were highly skewed. Associations between categorical data variables were assessed using the McNemar test to compare proportions. When assessing factors associated with sexual behavior 12 months after ART initiation, we used the independent *t* test and Pearson chi-square as appropriate. We examined factors associated with reported concurrent relationships and unprotected sex with partners whose serostatus was HIV-negative or unknown (assessed as separate outcomes) by fitting a logistic multivariable regression model including variables significant at the  $P = 0.05$  level in bivariate analyses. All analyses were conducted using two-sided tests and a significance level of 0.05.

## Results

### Participants

At baseline, 350 HIV-positive persons starting ART were interviewed. At the 12 month assessment point, 55 participants had died, and an additional 18 participants were lost to follow-up. Of the remaining 277 participants included in these analyses, 100% reported only heterosexual relationships, 7% any anal sex, and 8% any oral sex. Men were older than women (Median 39: IQR 21, 45 compared to Mdn = 32, IQR = 27, 37, respectively: difference 6.6 years, 95% confidence interval 4.7–8.4). Compared to the time of ART initiation, more participants at 12 months after ART were employed (71% vs. 80%,  $\chi^2 = 11.7$ ,  $P < 0.001$ ) and had disclosed their HIV status to their sexual partner (58% vs. 73%,  $\chi^2 = 3.89$ ,  $P < 0.001$ ), and less reported substance use (36% vs. 21%,  $\chi^2 = 19.1$ ,  $P < 0.001$ ; see Table 1).

### Change in Sexual Activity from Time 1 to Time 2

Of the 277 participants (see Table 1), 48% ( $n = 133$ ) reported sexual activity at time 1, while 64% ( $n = 177$ ) reported sexual activity at time 2 ( $\chi^2 = 21.0$ ,  $P < 0.001$ ). Of these, 39% ( $n = 109$ ) reported sexually active at both assessment points with no difference in the mean number of partners (1.20 at baseline vs. 1.15 at 12 months). It is important to note that although the mean is similar, the number of actual partners increased as 133 sexually active participants at time 1 reported 157 partners while 12 months later 177 sexually active participants reported 210 partners. Additionally, there was an increase in the number of respondents whose partner's HIV status was negative or unknown (45% vs. 80%,  $\chi^2 = 22.2$ ,  $P < 0.001$ ). There was no difference in sexual activity between those randomized to modified directly observed therapy or standard care.

As compared to time 1, at time 2, respondents reported higher correct and consistent condom use (mean scores 0.36 vs. 0.77,  $t = 8.21$ ,  $P < 0.001$ ). The number of respondents reporting unprotected sex with HIV-negative or unknown status person remained unchanged (34%,  $n = 45$  vs. 25%,  $n = 45$ ,  $t = 1.71$ ) with only five respondents reporting the same behavior at time 1.

There was no significant difference in the proportion of participants who reported a concurrent relationship in the 3 months prior to each assessment point (13% vs. 15%,  $\chi^2 = 1.98$ ). However, there were more respondents reporting concurrent relationships (17–26) and all but one respondent began a new concurrent relationship after ART initiation. Those who

reported concurrent relationships (vs. those who did not) also reported more unprotected sex with their HIV-negative or unknown status partners at both time points (ART initiation: 70.6% vs. 29.2%,  $\chi^2 = 11.0$ ,  $P < 0.001$ ; 12-month assessment: 44.0%, vs. 22.5%,  $\chi^2 = 5.20$ ,  $P < 0.05$ , data not shown in table).

### Correlates of High Risk Sexual Behavior 12 Months After ART

Twelve months after ART, there were several factors associated with being in a concurrent relationship and practicing unprotected sex with a partner whose serostatus was HIV-negative or unknown (Table 2). Having a concurrent relationship in the past 12 months was associated with being male (77%, vs. 44%,  $\chi^2 = 9.80$ ,  $P < 0.001$ ), less likely to be living with a partner (50% vs. 71%,  $\chi^2 = 4.11$ ,  $P < 0.05$ ), having unprotected sex (42% vs. 23%,  $\chi^2 = 5.2$ ,  $P < 0.01$ ), less likely to disclose their HIV-serostatus (35% vs. 79%,  $\chi^2 = 22.3$ ,  $P < 0.001$ ), and belief that social and cultural factors encourages unsafe sex (27 vs. 24,  $t = 2.97$ ,  $P < 0.01$ ).

Having unprotected sex (compared to protected sex) with a partner whose status was HIV negative or unknown was associated with not living with a partner (53% vs. 72%,  $\chi^2 = 5.14$ ,  $P < 0.05$ ), higher stigma scores (57 vs. 54,  $t = 2.42$ ,  $P < 0.05$ ), lower disclosure of HIV-serostatus (51% vs. 79%,  $\chi^2 = 14.1$ ,  $P < 0.001$ ), and belief that social and cultural factors encourages unsafe sex (26 vs. 24,  $t = 2.51$ ,  $P < 0.05$ ).

Few gender differences in HIV risk behavior and beliefs were found (data not shown in tables). Specifically, men (as compared to women) were more likely to report a concurrent relationship (16% vs. 4%,  $t = 3.77$ ,  $P < 0.001$ ), and had lower scores in perceiving HIV as a threat since the availability of ART (18.6 vs. 19.2,  $t = 3.77$ ,  $P < 0.01$ ). There were no other important gender differences at 12 months after ART initiation in other sexual behavior variables.

Table 3 illustrates the results from the logistic regression analysis modeling significant associations from the bivariate analysis. For both outcomes, respondents reporting a concurrent relationship or unprotected sex with a partner who was HIV-negative or whose HIV status was unknown were less likely to disclose their HIV status to their sexual partners (OR = 0.07, SE 0.06, 95% CI = 0.01, 0.41; and OR = 0.32 SE 0.16, CI = 0.12, 0.83, respectively).

## Discussion

In this study we assessed change in sexual activity just prior to ART initiation and 12 months after ART initiation, and determined factors associated with changes in sexual behavior. Overall, we found an increase in correct and consistent condom use. However, there also was an increase in the proportion of participants having sex, the total number of partners, and the number of partners with HIV-negative or unknown serostatus. Given that an individual on ART has a lower viral load and thus a lower probability of transmitting HIV to their partners (by 92% in one recent cohort study) [41–45], it is not clear as to whether the changes in sexual activity in this population would lead to an increase in secondary transmissions after ART initiation [16]. Mathematical modeling has projected a slight reduction in annual HIV incidence and mortality to less than one case per 1,000 people within 10 years if all persons with HIV could be identified and treated with ART to which they remained highly adherent [16]. However, more advanced modeling would be required to investigate whether the increase in condom use coupled with ART-induced lowered transmission risk—and factoring in ART adherence patterns—would outweigh the increases in sexual activity in this population.

Risk behaviors for the subset of participants who reported concurrent relationships warrant concern. Notably, 96% of the concurrent relationships reported at the 12 month assessment were *newly* formed, i.e., after initiating ART. While more men than women reported concurrent sexual partnerships, almost half of all persons reporting concurrent sexual partners also reported unprotected sex with their HIV-negative or unknown serostatus partners, and a third were not disclosing their serostatus. This group (both men and women) believed that social and cultural factors encourage men to have multiple sexual partners. Finally, non-disclosure of serostatus was associated with concurrent relationships and having unprotected sex with HIV-negative or unknown serostatus partner.

Though some have questioned its importance [46, 47], concurrency has been shown in mathematical modeling [48] and in some observational studies [49] to propagate the endemic spread of HIV in a population [50–52]. At the individual level, the partners of the respondent who has concurrent relationships bear the increased HIV acquisition risk (i.e., one's own concurrency is a risk for HIV transmission, not acquisition) [53]. The fact that the HIV risk from concurrency is to the partners and not the already HIV-positive respondent must guide appropriate counseling. Prevention with positives messaging to reduce concurrency should focus on taking social and personal responsibility for preventing HIV transmission [54, 55] in concern for partners' and communities' well-being, the fact that HIV may still be transmitted even when on ART [56], and the self-protection value of reducing the risk of reinfection with a resistant HIV strain or an STI that may harm the person's own health [57].

A limitation of this study was the potential of socially desirable responses and under-reporting of sensitive items resulting from our reliance on self-reported behaviors and interviewer-administered questionnaires. Low literacy rates prevent the use of self-administered surveys. A preferred measure would be to adopt technologies (e.g., audio computer-assisted assessments) that may reduce bias, and also lead to more complete data particularly for sensitive questions [58]. Although these techniques do not completely ensure accurate reporting, interviewer-administered surveys would tend to err on the side of reporting fewer high risk behaviors resulting in an overly conservative representation. Since the roll-out of ART in 2004, disclosure of HIV status may have become more socially normalized in the past few years. However the continued persistence of HIV stigma even in high-HIV prevalence communities suggests this may not be the case [59], and may remain a serious impediment to more widespread PLWHA disclosure [60].

## Conclusion

Unlike some other recent studies in sub-Saharan Africa [12, 27], we found evidence of increased sexual risk behaviors among a minority of those who had been on ART for 1 year; however, we cannot conclude that risk of secondary HIV transmission has changed. Indeed, given increased condom use and the benefits of treatment on reducing infectivity and the probability of transmission, secondary transmission risk may have decreased. Nonetheless, our findings highlight the need to incorporate ongoing secondary prevention programs for HIV-positive individuals into HIV care settings. Provider-delivered 'positive prevention' counseling has been shown in RCTs [61] and meta-analyses [62] in the US to work, and might be effectively adapted for use in other cultural settings [63]. The need for such counseling in high-burden sub-Saharan African settings has been repeatedly emphasized [30, 64]. Since sexual behavior, relationships, and adaptation to HIV disease itself are dynamic processes [65], periodic counseling that individualizes specific barriers, concerns, beliefs and responsibility in regard to risk reduction would help reinforce behavior change over time. Clinics may benefit from incorporating risk behavior screening at each visit to identify those engaging in high-risk behavior and to support risk reduction strategies. For the

subset of participants in this study who reported ongoing secondary HIV transmission risk, some risk reduction messages may be more germane than others. This may include ‘loss-framed’ messages [66] that emphasize the self-protection benefits of safer sex (e.g., to avoid HIV reinfection or more commonly, other STIs that can increase viral load) [57]. There also is suggestive evidence that unsafe sex is associated with nondisclosure [67–69] and ART non-adherence [70], and conversely that disclosure can be associated with reduced sexual transmission risk behaviors [71–73].

Secondly, perceived stigma, non-disclosure of serostatus to sexual partners, and the belief that social cultural factors promote unsafe sexual practice (as has been noted elsewhere) [74], call for a culturally appropriate social marketing campaign to help change community-level beliefs and norms. For example, the message of “zero grazing” may have been a powerful factor in reducing Uganda’s earlier HIV prevalence in the early 1990s [75]. Finally, correct and consistent condom use was seen in Uganda and provides encouraging support that clinic-delivered support can have a beneficial impact. Effective prevention with positive strategies must consider a combination of biomedical and behavioral interventions that focus on the unique characteristics of specific populations.

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Table 1

Socio-economic, clinical, sexual behavior and complacency score characteristics of the 277 HIV-positive participants at ART initiation and 12 months after ART initiation

	ART initiation N (%)	12 months after ART initiation N (%)	Test statistic
Socio-economic			
Living with spouse or partner	141 (51)	147 (53)	$\chi^2 = 1.29$
Currently employed	197 (71)	223 (80)	$\chi^2 = 11.7^{***}$
Stigma (overall scale)	53.6 (10)	54.8 (7)	$t = 1.92$
Monthly income [U.S. Dollars, mean (SD)]	54 (78)	54 (74)	$t = 0.79$
Clinical assessment			
Substance abuse (include alcohol)	101 (36)	58 (21)	$\chi^2 = 19.1^{***}$
CD4 count [ $n = 220$ , mean (SD)]	130 (5)	307 (11)	$t = 15.6^{***}$
Sexual behavior <sup>a</sup>			
Sexually active	133 (48)	177 (64)	$\chi^2 = 21.0^{***}$
Men ( $n = 121$ )	64 (53)	86 (71)	$\chi^2 = 11.0^{***}$
Women ( $n = 156$ )	69 (44)	91 (58)	$\chi^2 = 10.0^{**}$
Disclosed to sexual partner	76 (58)	128 (73)	$\chi^2 = 13.36^{***}$
Total number of partners	157	210	
Sexually active at time 1 and time 2	–	109 (39%)	
Mean (SD) number of partners	1.20 (0.05)	1.15 (0.05)	$t = 0.39$
Reported a concurrent relationship	17 (13)	26 (15)	$\chi^2 = 1.98$
Total number of concurrent partners	37	55	
Mean (SD) number of concurrent partners	2.17 (0.52)	2.11 (0.32)	$t = 0.68$
Sexual partner HIV status is negative or unknown	60 (45)	142 (80)	$\chi^2 = 22.2^{***}$
Unprotected sex: Partner HIV-/HIV? serostatus	45 (34)	45 (25)	$t = 1.71$
Correct and consistent condom score [mean (SD)]	0.36 (0.41)	0.77 (0.33)	$t = 8.21^{***}$
Complacency scales <sup>b</sup> [Mdn (IQR) range]			
HIV/AIDS less of a threat since ART	–	24 (21,27) 16–35	
Social/cultural factors that encourages unsafe sex	–	20 (18,20) 13–20	
Less need for safer sex since ART	–	13 (13,14) 9–18	

$\chi^2$ , McNemar Chi2 (1 degree of freedom) for categorical data;  $t$  two-sided paired  $t$  test for continuous data;  $T_1$  number at ART Initiation,  $T_2$  number 12 months after ART Initiation,  $SD$  standard déviation

\*\*  
 $P < 0.01$ ;

\*\*\*  
 $P < 0.001$

<sup>a</sup>Denominator for sexual behavior is reported for sexually active participants at each assessment point

<sup>b</sup>Complacency Scales were added after the baseline assessment and were available for 201 respondents

Socio-economic, clinical, sexual behavior and complacency bivariate associations with 177 sexually active participants at the 12-month assessment point

**Table 2**

	In a concurrent relationship		Test statistics	Unprotected sex with an HIV-/HIV? partner		Test statistics
	Yes (n = 26) n (%)	No (n = 151) n (%)		Yes (n = 45) n (%)	No (n = 132) n (%)	
<b>Socio-economic</b>						
Male	20 (77)	66 (44)	$\chi^2 = 9.80^{**}$	18 (40)	66 (50)	$\chi^2 = 0.89$
Living with spouse or partner	13 (50)	106 (71)	$\chi^2 = 4.11^*$	24 (53)	94 (72)	$\chi^2 = 5.14^*$
Currently employed	24 (92)	122 (81)	$\chi^2 = 2.04$	37 (82)	108 (82)	$\chi^2 = 0.01$
Stigma [mean (SD) overall scale]	57 (1.6)	55 (0.4)	$t = 1.54$	57 (96)	54 (59)	$t = 2.42^*$
Age in years [mean (SD)]	35 (1.7)	36 (0.6)	$t = 0.43$	34 (1.5)	35 (0.7)	$t = 0.67$
<b>Clinical assessment</b>						
Substance abuse (include alcohol)	8 (31)	37 (26)	$\chi^2 = 0.46$	16 (36)	29 (22)	$\chi^2 = 3.17$
CD4 count [ $n = 220$ , mean (SD)]	317 (39)	307 (11)	$t = 0.28$	323 (33)	305 (16)	$t = 0.56$
<b>Sexual behavior<sup>a</sup></b>						
Unprotected sex: Partner HIV-/HIV? serostatus	11 (42)	34 (23)	$\chi^2 = 5.2^*$			
Correct and consistent condom score [mean (SD)]	0.8 (0.1)	0.8 (0)	$t = 0.65$	0.36 (0.1)	0.91 (0.0)	$t = 14.5^{***}$
Disclosed to sexual partner	9 (35)	119 (79)	$\chi^2 = 22.3^{***}$	23 (51)	104 (79)	$\chi^2 = 14.1^{***}$
<b>Complacency scales<sup>b</sup> [mean (SD)]</b>						
HIV/AIDS less of a threat since ART	19 (0.5)	19 (0.1)	$t = 0.42$	19 (0.3)	19 (0.2)	$t = 0.21$
Social/cultural factors that encourages unsafe sex <sup>c</sup>	27 (1.2)	24 (0.3)	$t = 2.97^{**}$	26 (0.8)	24 (0.4)	$t = 2.51^*$
Less need for safer sex since ART	13 (0.5)	13 (0.1)	$t = 0.38$	13 (0.4)	13 (0.1)	$t = 0.13$

HIV- partner with HIV negative serostatus, HIV? partner with HIV serostatus unknown,  $\chi^2$  Pearson Chi2 (1 degree of freedom) for categorical data,  $t$  two-sided  $t$  test for continuous data,  $SD$  standard deviation

\*  $P < 0.05$ ;

\*\*  $P < 0.01$ ;

\*\*\*  $P < 0.001$

<sup>a</sup>Denominator for sexual behavior is reported for sexually active participants at each assessment point

<sup>b</sup>Complacency Scales were added after the baseline assessment and were available for 201 respondents

<sup>c</sup>No gender difference

**Table 3**

Summary of logistic regression analyses for variables predicting concurrent relationships and unprotected sex with partners of HIV-negative or unknown serostatus 12 months after ART initiation

	Odds ratio	Standard error	95% CI
Reported a concurrent relationship			
Male	0.23	0.19	0.05, 1.18
Living with spouse/partner	1.78	1.65	0.29, 11.00
Disclosed to sexual partner	0.07	0.06	0.01, 0.41
Unprotected sex with an HIV- or HIV? partner	2.69	2.28	0.51, 14.21
Social/cultural factors that encourages unsafe sex	1.14	0.11	0.95, 1.37
Wald $\chi^2(5,124)$	22.84	***	
Unprotected sex with an HIV-/HIV? partner			
Living with spouse/partner	0.78	0.38	0.30, 2.01
Disclosed to sexual partner	0.32	0.16	0.12, 0.83
Stigma	1.05	0.03	0.99, 1.11
Social/cultural factors that encourages unsafe sex	1.12	0.08	0.98, 1.28
Wald $\chi^2(4, 124)$	13.94	**	

*HIV-* HIV negative serostatus, *HIV?* HIV serostatus unknown

\*\*  $P < 0.01$ ;

\*\*\*  $P < 0.001$