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Contextual Correlates of Per Partner Unprotected Anal Intercourse Rates Among MSM in Soweto, South Africa

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Abstract

Men who have sex with men (MSM) throughout the world are at high-risk of HIV acquisition and transmission. Although individual behavior remains a central feature of HIV prevention efforts in sub-Saharan Africa and beyond, contextual factors likely influence behavioral risk. We identify contextual factors at the individual, dyadic (within the partnership), and extra-dyadic (relationships external to the focal dyad) levels that are associated with increased rates of unprotected anal intercourse with a given male partner among MSM in Soweto, South Africa. Drawing on data from The Soweto Men's Study, multilevel models were applied to 758 partnerships nested within 377 MSM respondents. Independent of overall sexual engagement, dyadic (e.g. description of partner as 'regular'), psychosocial (e.g. experiences of homonegativity), and sociocultural (e.g. income) contextual factors were significant predictors of differential 6-month rates of UAI with a given partner. By contrast, sexual partnerships outside of the focal sexual pair were not significantly related to UAI rates within the focal pair. Our findings support the need for continuing to understand and intervene on partner-level, psychosocial, and sociocultural dimensions of sexual behavior and sexual risk among MSM in Soweto.

Keywords

HIV; MSM; South Africa; Risk behavior

Introduction

Men who have sex with men (MSM) throughout the world are at high-risk of HIV acquisition and transmission. In sub-Saharan African countries where prevalence among MSM has been measured, it has been found to be as high or higher than men of similar age, and in some cases, as high, or higher than those of women [1–7]. Multiple factors are likely to contribute to the disparate HIV prevalence among MSM compared to other men in sub-Saharan Africa including biological transmission routes, behavior, and structural determinants such as stigma and discrimination, and access to HIV services [8–12]. Although individual behavior remains a central feature of HIV prevention efforts in sub-Saharan Africa and beyond, in the present article we explore contextual factors that may lend themselves to behavioral risk. Specifically, we attempt to identify contexts that may be associated with increased rates of unprotected anal intercourse with a given male partner among MSM in Soweto, South Africa. Our premise is that explicit appeal to the contexts of risk behavior will improve the overall efficacy of behavioral and biomedical HIV prevention efforts.

The probability of HIV acquisition has been described by some to follow a Bernoulli-process model [13, 14], in which each sex act with a given partner is treated as an independent event with a small probability of transmission. According to this model the likelihood of acquisition is the cumulative probability across sexual acts with a given partner, and across the total number of partners. Yet each of the factors specified in the Bernoulli-process model—number of unprotected sex acts with a given partner, infectivity of a given partner, exposure to high-prevalence sexual networks, and choices about the total number of partners—is context dependent. We will focus on contextual factors at the individual, dyadic (between paired partnerships), and extra-dyadic (relationships external to the focal dyad) levels.

Qualitative literature has identified several partner-oriented motivations for UAI. These include sexual satisfaction, love, intimacy, social support, validation, socialization, and stress relief [15–18]. We would therefore anticipate greater UAI episodes, on average, among persons considered to be a ‘regular’ partner by virtue of relationship duration and relationship status. However, there is some question as to whether concurrency (having overlapping sexual partners) is associated with reduced or increased risk behavior within a given relationship. Prior studies have shown, for example, that behaviorally bisexual MSM with concurrent male and female partners may be more likely to report always using condoms with casual partners [19], and have lower HIV prevalence than MSM whose sexual partners do not include women [4, 19]. Individual traits that are culturally or economically desirable can also influence engagement in UAI episodes. Income may be one such trait. A previous report on the Soweto MSM sample reported here demonstrated that men who purchased alcohol for their male sexual partners—and who were generally financially betteroff than their counterparts—were more than 3 times as likely to be HIV-infected than those who did not [4]. Although these findings may be an amalgam of numerous income-related mechanisms—including greater access to sex-oriented venues, cultural desirability, alcohol-induced disinhibition—we investigate the potential for differential risk aversion by economic status, which could be associated with increased episodes of UAI. Although

relatively recent and continually expanding, the attention given to voluntary medical male circumcision (VMMC) has highlighted not only the biological nature of HIV acquisition among men, but also the cultural, psychosocial, and behavioral aspects of circumcision. Preferences for circumcised men and perceptions of potential risk compensation have been observed among heterosexual men and women in Kenya [20, 21]. The present authors' unpublished ethnographic data suggests that when engaging in receptive anal intercourse South African MSM often report a preference for circumcised insertive partners for reasons similar to those of heterosexual women, and also express similar concerns about risk compensation. The context of sexual risk behavior is also likely to be affected by individual psychosocial variables including sexual identity, homonegativity [22], HIV testing history, knowledge, and status, and perceived self-efficacy and social norms [23]. In the present study we explore correlates of UAI frequency with a given partner. There is currently no published data on per partner risk behavior in the high-prevalence MSM communities of sub-Saharan Africa that speaks to these contextual contributors.

Methods

Sample

The Soweto Men's Study was conducted in 2008 with MSM recruited via respondent driven sampling (RDS) in Soweto, a peri-urban township of 3 million people in Johannesburg, South Africa. Recruitment, sampling, questionnaire, laboratory, and analysis methods for the Soweto Men's Study have been described previously [4]. Briefly, we recruited 378 MSM who lived, worked, or socialized in the Soweto community using RDS between February and August, 2008. HIV status was determined through rapid antibody testing on blood samples collected through voluntary counseling and testing (VCT), linked to the participants' behavioral data by anonymous study identification number. After completing an interviewer-administered, paper-and-pen survey, we offered all participants VCT, for which they provided separate informed consent. Men who received a positive result were referred to clinical care within the Perinatal HIV Research Unit at Chris Hani-Baragwanath Hospital in Soweto, pending the result of CD4 testing of their blood samples. Men with CD4 cell counts less than 200 cells/mm³ were provided with antiretroviral (ARV) treatment free of charge, as was consistent with South African treatment guidelines at the time. RDS-adjusted HIV prevalence among MSM in Soweto was estimated at 13.2 %; among the subset of gay-identified MSM at highest risk of HIV infection, it was 33.9 %.

Measures

The survey asked participants how many sexual partners they had in the prior 6 months, and included a matrix of partner-by-partner sexual behavior and condom use questions for all, or up to five partners within the prior 6 months, depending on which value was smaller. For each partner, participants reported the partner's sex (and sexual identity of male partners), whether regular (e.g. husband/wife, boyfriend/ girlfriend) or casual (e.g. "one night stand"), number of times vaginal or anal sex, position in anal sex with men, and number of protected vaginal or anal sex acts. Reporting of partner-level data generally corresponded with the number of partners overall. Sixteen percent of the sample reported a total number of partners in the prior 6 months that exceeded the five available partner reports in the partner matrix.

Sixty-seven percent of respondents reported 2–5 partners in the prior 6 months. Forty-six percent of participants reported UAI with at least one male partner within the 6 months prior to their study interview. For the present analyses, data were restricted to male–male partnerships in which at least one act of anal sex (irrespective of condom use) had occurred. Thus, these analyses explore changes in the rate of UAI engagement conditional on engaging in anal intercourse. Our implicit assumption is that two distinct processes are important to UAI decision-making: a decision-making process about whether or not to have anal sex with a given partner, and a subsequent decision-making process to engage in UAI given the prior. We focus on the latter process.

Our analyses focus on contextual factors at the individual- and partner-levels. At the level of the individual, socioeconomic and demographic variables included years of schooling, income [categorized as “at or below South African Rand (ZAR) 500 per month” (less than US\$80 in 2008), or “above ZAR500”], sexual identity (“gay”, “bisexual”, or “straight”), circumcision, and age. HIV status was classified as “prior HIV negative test”, “prior HIV positive test”, “no prior test, HIV uninfected at enrollment”, “no prior test, HIV-infected at enrollment”. We use self-reported status in order to account for sexual decision-making based on perceived HIV status. This is an imperfect approximation in that some MSM may have tested subsequent to reported sexual partnerships. Psychosocial and sociocultural variables (also measured at the level of the individual) included social MSM network (i.e. number of MSM friends), and social norms for safer sex among peers of the respondent. The social norms scale was adapted from the 4-item measure developed by Kegeles [23]. We also hypothesized that experiences of homonegativity—whether due to discrimination/stigma (external) or internalized—may have an effect on partner-level risk behavior. Both internalized and enacted experiences of homonegativity were measured using scales adapted from Diaz [22]. Internalized homonegativity was initially measured on a 5-item scale of positively and negatively worded items, such as “sometimes I dislike myself for being a man who has sex with other men”. The 6-point Likert scale ranged from “strongly disagree” to “strongly agree”. Experiences of homonegativity was initially constructed as a 12-item scale related to frequency of experiences of stigma, discrimination, and violence related to sexual identity. The 4-point frequency scale ranged from “never” to “many times”. Because these measures were initially validated among ethnic minority MSM in the US, we used exploratory factor analysis (EFA) to assess the validity of each item loading onto a single unobservable factor. Items loading $<|0.3|$ were examined for exclusion. All five internalized homonegativity items demonstrated moderate or high loading, and a Cronbach’s alpha reliability of 0.85. With respect to experiences of homonegativity, four of the 15 items had poor loading through EFA and were excluded for the present sample. Cronbach’s alpha for the final 11 items was high with a value of 0.81. Additionally, we assessed self-efficacy for safer sex with a 12-itemscale on a 6-point Likert score ranging from “disagree strongly” to “agree strongly” adapted from Kegeles [23]. EFA and confirmatory factor analysis (CFA) were used to assess the potential for items to reflect a single self-efficacy score. For the present sample, two distinct factors were uncovered, which we labeled as ‘perceived’ self-efficacy (what one believes one can do), and ‘enacted’ self-efficacy (general (actual) behavior with partners). Two items loaded poorly onto either construct and were excluded. Perceived self-efficacy had an α of 0.8, and enacted self-efficacy an α of 0.6. Pearson’s r

correlation between the two constructs was low but significant ($r = 0.26, p < 0.001$). We restrict analyses of self-efficacy to perceived self-efficacy in order to avoid reverse causality —i.e., prior UAI episodes are likely to determine the ‘enacted’ self-efficacy measure. All of the above scales have a range from 0 to 1, with 1 representing high internalized homonegativity, experiences of homophobia, perceived social norms for safer sex, and perceived safer sex self-efficacy.

Partner-level factors are classified as ‘dyadic’ if they reflect traits within the focal partnership, and ‘extra-dyadic’ if they reflect sexual relationships external to the focal partnership. Dyadic variables of interest include total number of anal episodes (with or without a condom), number of UAI episodes, whether the partner is considered a regular sexual partner, number of months in which sex occurred with the partner, and difference in partner age. We hypothesize that sexual positioning within a partnership (receptive, insertive, or both) may influence the likelihood of engaging in UAI as well as the number of UAI episodes. We therefore classify partnerships by the sexual positioning of the index respondent: exclusively insertive with partner, exclusively receptive with partner, or both insertive and receptive. Three extra-dyadic variables were drawn from responses to the demographic information section of the survey. The extra-dyadic variables include total number of male and female partners in the prior 6 months, whether the respondent had a regular male partner, and whether the respondent had a regular female partner. Respondents were asked if they had a regular female partner and/or a regular male partner, where ‘regular’ was defined as “someone to whom you were married, lived with, or felt a special emotional bond to for the last 3 months or more.” These responses were classified as affirmative or negative. A fourth extra-dyadic variable was constructed from the partner matrix data. This value is the proportion of sexually active months with partner j in which the respondent also had sex with one or more other partners. We categorized the variable as no time sexually active with partner j and another partner [0], less than three-quarters of the time sexually active with other partners (0, 0.75], over three-quarters of the time sexually active with other partners (0.75, 1], and unknown. The latter was included to retain missing data when the actual month of sexual engagement was not reported. This variable reflects the *relative duration* of sexual partnership overlap. With respect to HIV risk reduction, we would hope to see reductions in episodes of UAI when a partnership is characterized by ongoing extradyadic sexual partnering (i.e. greater sexual overlap duration). This measure is akin to concurrency, but is not a direct measure of concurrency properly defined.

Analyses

Analyses focused on per partner episodes of UAI. We fitted generalized linear mixed models, using Penalized Quasi-Likelihood [24], applied a quasipoisson distribution function to account for overdispersion in the UAI count data [25], and specified a random intercept with partner data nested at the individual-level. We estimated the incidence rate ratio (i.e. the ratio between two groups of the number of UAI episodes per partner per 6 months) for the 377 MSM reporting one or more male anal intercourse partners using dyadic and extra-dyadic predictors (Model 1), and subsequently adding individual-level predictors after removing those variables that were non-significant in the first model (Model 2). All analyses were conducted in the R statistical software, version 2.13.2.

Results

A total of 377 men were included in this sample (Table 1). A majority (58 %) of men reported never receiving a prior HIV test result. Respondents reported a mean of 12 years of education, and 78 % were in the lowest income group (ZAR500 per month). The sample was roughly evenly split among three sexual identity categories—gay, bisexual, and straight MSM. MSM in the sample reported high levels of social norms for safer sex (0.71) and safer sex self-efficacy (0.77). A total of 758 male–male anal intercourse partnerships were reported among the 377 MSM. UAI typically accounted for 24 % of anal intercourse episodes with a given partner, at a rate of 2.5 episodes per a 6-month period. Although, on average, partner age difference was small (–0.25 years) it did exhibit substantial variation (SD 5.80). The mean duration of sexual relationships with reported partners was 2.5 months (SD 1.7) out of 6. Over one-third of male partners were considered to be “regular”. Most respondents reported being either exclusively insertive (53 %) or exclusively receptive (31 %) with a given partner. Sexual partner overlap occurred in over 57 % of partnerships, and over one-third of partnerships were characterized by a high degree of overlap (i.e. over three-fourths of months with one or more extra-dyadic (additional) sexual partners). Nearly 50 % of respondents reported having a regular female partner at the time of the survey. The mean number of (male and female) partners reported in the prior 6 months was 4.2 (SD 5.3).

Results from the quasipoisson mixed models are presented in Table 2. UAI episodes with a given partner significantly increased with the number of anal intercourse episodes, with the number of months the dyadic sexual relationship lasted, and when the partner was identified as a regular male partner (Model 1). For each additional month with a given partner the IRR of UAI episodes increased by 24 % ($p < 0.001$), and there was a 78 % increase in the rate of UAI for regular partners compared to other male partners ($p < 0.001$). In partnerships where the index respondent reported being exclusively receptive, the rate of UAI episodes declined by 46 % compared to other partnerships. Difference in partner age was not significantly associated with UAI rate. Most of the extra-dyadic variables—overlap duration and having a regular female or male partner—were not significantly associated with UAI episodes independent of dyadic factors. The one exception was the number of overall male or female partners, which yielded a small but significant IRR estimate (1.03, $p < 0.05$).

When variables measured at the level of the individual were added to the specification (Model 2), experiences of homonegativity, self-efficacy, income, and circumcision were significant, and the extra-dyadic measure of total partners lost significance. There was a nearly fourfold increase in the rate of UAI with a given partner among persons who reported greater experiences of homonegativity ($p < 0.05$). Perceived self-efficacy was associated with an 85 % reduction in the UAI rate with a partner ($p < 0.001$), independent of dyadic factors. Being in the lowest income group was associated with a 39 % decline in UAI rate with a given partner ($p < 0.05$). Men who were circumcised had a nearly 90 % increase in the UAI rate ($p < 0.01$). By contrast, number of MSM friends, internalized homonegativity, experiences of homonegativity, and sexual identity were not associated with UAI episodes within partnerships. There was no significant relationship between HIV testing history/status (whether self-reported known or unknown) and episodes of UAI.

Discussion

The Bernoulli-process model describes the probability of HIV acquisition as a function of partner infectivity, number of unprotected sexual acts with the partner, the overall number of partners, and the HIV prevalence within the potential sexual network pool. We sought to uncover contextual factors that may influence the number of unprotected anal intercourse episodes between two partners. Although the overall number of anal episodes (irrespective of condom use) and length (months) of sexual involvement with a partner were, as one might anticipate, significantly associated with increased rates of UAI with the partner, the partner type—viz. being a regular partner—was also significant independent of these other predictors. This latter finding is not entirely surprising, but may be an issue of concern given that none of the extra-dyadic factors (e.g. having overlapping sexual partners) were significantly associated with UAI rates. These findings may highlight the importance and urgency of discussing partnership context during sexual risk reduction counseling among MSM in Soweto. Given that extra-dyadic factors were not associated with per partner UAI rates, we suggest that the network prevalence effect on HIV acquisition probabilities may become more salient than individual infectivity, susceptibility, or UAI episodes. This is further highlighted by the significant reduction in per partner UAI rates among MSM who report being exclusively receptive with the partner. Although infectivity probabilities are generally considered higher for receptive partners compared to insertive partners, the reduction in number of UAI episodes among the former may mitigate some of the influence of this differential probability. Risk reduction counseling should openly address HIV risk within the context of partner-related motivations, especially as they relate to trust, love, and the regularity of intercourse. This approach would complement current HIV prevention efforts in South Africa that emphasize partner reduction among all populations.

Our findings also highlight the need for a renewed emphasis on psychosocial and sociocultural factors in health promotion and risk reduction activities. Previous research has highlighted social oppression as a predictor of risk among subgroups of MSM in the United States [22]. Our findings partially support this view among MSM in Soweto. Although internalized homonegativity was not associated with differences in per partner UAI rates, experiences of homonegativity were significantly and positively associated. Social oppression may influence the level of risk aversion or tolerance, the perceived dependence on sexual partners, or the power to exert agency within a partnership. These psychological, social, and structural manifestations of oppression may likely contribute to the role of UAI episodes on HIV acquisition probabilities. Perceived safer sex self-efficacy, lower income, and being uncircumcised were all associated with decreases in per partner UAI independent of dyadic factors. Based on these findings, it is plausible that self-efficacy can serve as a protective intervention factor even within regular partnerships. The association of circumcision and income with rates of UAI within partnerships may be related to cultural and social preferences in the communities. The increase in per partner UAI rates among circumcised men in the sample may suggest sexual preferences for circumcised men, or a sexual preference for condomless sex among circumcised men (as a result, for example, of decreased sensitivity). If circumcision is indeed associated with increased engagement in sexual risk behavior, the expansion of access to medical circumcision may have the

unintentional effect of increasing HIV risk among MSM in South Africa. With respect to income, our findings show that per partner UAI rates are lower among the poorest MSM. There are a number of potential explanations for this. First, this may be a result of lower sexual preference for poorer MSM, as well as reduced access to venues such as bars where persons seek partners. Second, men may view poorer MSM as potentially more risky, leading to increased vigilance on condom use with these partners. Alternatively, men of lower socioeconomic status may be more risk averse, or more aware of HIV susceptibility, thus refraining from frequent engagement in higher risk sexual activity. This is particularly likely if the burden of HIV is more readily evident among the *social* networks of lower income MSM compared to higher income MSM. A better understanding of the factors that mediate or moderate the relationship between sociocultural contexts—such as circumcision and income—and partnership risk behavior is needed in order to develop prevention messages that speak not only to behavior, but to behavior within the social context of the daily lives of MSM.

Limitations of the RDS sampling method and analysis in the Soweto Men's Study have been described previously [4]. Our RDS sample may not be fully generalizable to MSM in Soweto or South Africa. For the current analysis, the use of interviewer-administered surveys may have led to underreporting of sensitive behaviors, such as UAI. Thus our results may be a conservative estimate of the extent of this risk behavior in the MSM population. Future studies may find it advantageous to use computerized self-administered survey technology to collect sensitive behavioral risk data. In addition, similar to other MSM RDS samples [5], our sample was disproportionately young: 64 % of our sample was under the age of 25, with a median age of 23. Additional efforts may be needed to recruit older MSM into future integrated biological and behavioral surveillance studies. Our proxy for concurrency (months focal relationship overlaps with external relationships) is crude at best. More accurate approaches to measuring concurrency are warranted. Another limitation of the data is that it lacks key dyadic and extra-dyadic psychosocial variables—such as motivations for sexual engagement with the partner—which likely better account for behaviors compared to the blunt surrogates included in our analyses. Additionally, we caution against extrapolating these findings to all Soweto MSM. Importantly, as stated earlier, our findings are relevant only to the contexts in which one makes decisions about UAI engagement conditional on a prior decision to engage in anal intercourse. Roughly 32 % of reported male–male sexual partnerships did not engage in anal intercourse. Understanding the contexts associated with these choices is also important to HIV prevention efforts.

Our findings support the need for continuing to understand and intervene on partner-level, psychosocial, and sociocultural dimensions of sexual behavior and sexual risk. The relatively short duration of sexual partnerships, low uptake of regular testing, lack of influence of 'concurrency' on per partner UAI rates, and heightened UAI rates among those who experience social oppression are indicative of the complex array of HIV risk factors prevalent in the social environment of South African MSM, and provide substantial opportunity for HIV acquisition and onward transmission. Interventions with the ability to target individual, dyadic, and other social dimensions of MSM risk behavior, and promote

greater health enabling behaviors, including regular uptake of HIV testing and appropriate HIV prevention counseling, are urgently needed.

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Table 1

Partner-level and individual-level characteristics of respondents with male partners in the Soweto Men's Study

	<i>N (%)</i>	<i>M (SD)</i>
<i>Total male-male partnerships (partner-level)</i>	758	
Dyadic measures		
Anal episodes		10.28 (20.65)
UAI episodes		2.51 (12.39)
Partner age difference (years)		-0.25 (5.80)
Number of months sexual ^a		2.49 (1.71)
Sexual positioning		
Exclusively receptive	235 (31.0)	
Both receptive and insertive	119 (15.7)	
Exclusively insertive	404 (53.3)	
Is a regular sexual partner	284 (37.5)	
Extra-dyadic measures		
Proportion of sexually active months concurrent with other sexual partners		
None	299 (39.4)	
(0, 0.75]	169 (22.2)	
(0.75, 1]	262 (34.6)	
Unknown	28 (3.7)	
<i>Total respondents (respondent level)</i>	377	
Extra-dyadic measures		
Total partners prior 6 months (all sexes)		4.22 (5.29)
Has a regular female partner	188 (49.9)	
Has a regular male partner	275 (72.8)	
Individual measures		
MSM friend network size		134.02 (642.94)
Internalized homonegativity ^b		0.37 (0.32)
Experiences of homonegativity ^b		0.15 (0.15)
Years of schooling		12.01 (1.97)
Age		24.24 (6.03)
Social norms ^b		0.71 (0.24)
Self-efficacy ^b		0.77 (0.25)
HIV status at enrollment		
Prior negative	140 (37.1)	
Prior positive	18 (4.7)	
Never tested, negative	139 (36.9)	
Never tested, positive	30 (8.0)	
No HIV test	50 (13.3)	
Income ZAR500/month	293 (77.7)	
Sexual identity		

	<i>N</i> (%)	<i>M</i> (<i>SD</i>)
Gay/MSM	140 (37.1)	
Bisexual/“down-low”/other	117 (31.0)	
Straight	120 (31.8)	

^a Out of a minimum of 1 and a maximum of 6 months

^b Range is 0–1, with 1 representing high internalized homonegativity, experiences of homophobia, perceived social norms for safer sex, and perceived safer sex self-efficacy

Table 2

Stepwise quasipoisson mixed-effects incident risk ratios (IRR) estimates of 6-month unprotected anal intercourse (UAI) episodes within male-male partnerships

	Model 1			Model 2		
	IRR	(95 % CI)	p	IRR	(95 % CI)	p
(Intercept)	0.23	(0.12, 0.44)	0.000	0.85	(0.13, 5.14)	0.857
Dyadic						
Anal episodes	1.02	(1.02, 1.03)	0.000	1.02	(1.02, 1.02)	0.000
Partner is a 'regular' partner	1.78	(1.41, 2.24)	0.000	1.81	(1.43, 2.28)	0.000
Number of months sexual	1.24	(1.15, 1.33)	0.000	1.23	(1.14, 1.33)	0.000
Partner age difference	1.01	(0.99, 1.03)	0.210			
Sexual positioning (ref = both)						
Receptive	0.54	(0.33, 0.88)	0.015	0.51	(0.31, 0.84)	0.009
Insertive	0.97	(0.63, 1.50)	0.898	0.89	(0.58, 1.37)	0.597
Extra-dyadic						
Proportion of months concurrent with other partners (ref = 0)						
(0, 0.75]	1.28	(0.91, 1.81)	0.155			
(0.75, 1]	1.04	(0.74, 1.44)	0.835			
Unknown	1.03	(0.33, 3.17)	0.959			
Has a regular female partner	0.88	(0.56, 1.37)	0.562			
Has a regular male partner	1.40	(0.83, 2.36)	0.562			
Total male and female partners (6 months)	1.03	(1.00, 1.06)	0.037	1.02	(0.99, 1.05)	0.156
Individual						
Number of close MSM friends				1.00	(1.00, 1.00)	0.291
Internalized homonegativity				1.18	(0.59, 2.37)	0.635
Experiences of homonegativity				3.98	(1.04, 15.26)	0.044
Sexual identity (ref = gay)						
Bisexual/down-low				0.84	(0.49, 1.45)	0.540
Straight				0.69	(0.36, 1.31)	0.254
Social norms				0.96	(0.44, 2.09)	0.926
Safer sex self-efficacy				0.15	(0.07, 0.29)	0.000

	Model 1			Model 2		
	IRR	(95 % CI)	p	IRR	(95 % CI)	p
Years of schooling				0.99	(0.90, 1.09)	0.790
Income ZAR500/month				0.61	(0.40, 0.93)	0.021
Age				1.02	(0.98, 1.06)	0.318
Circumcised (ref. not circumcised)				1.86	(1.27, 2.73)	0.002
HIV status at enrollment (ref. prior negative)						
Prior positive				0.82	(0.37, 1.80)	0.620
Never tested, negative				1.19	(0.74, 1.92)	0.476
Never tested, positive				1.14	(0.59, 2.21)	0.698
No HIV test				1.04	(0.56, 1.95)	0.894
var (intercept)		1.547			1.055	
var (residual)		2.439			1.699	
IQR (standardized within-individual residual)		(−0.49, −0.05)			(−0.47, −0.04)	