

Predictors of Concurrent Sexual Partnerships and Association With Recent HIV Infection in a Large Population-Based Survey in Botswana

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Background: Multiple concurrent sexual partnerships (MCP) may drive new HIV infections. We investigated the association between MCP and recent or incident HIV infection in a cluster-randomized HIV prevention trial that followed a population-based HIV incidence cohort across 30 communities in Botswana.

Methods: We used structured questionnaires to evaluate MCP for prior 12 months, defined as either (1) MCP per UNAIDS definition or (2) concurrent sexual relationship per survey questions. Recent HIV infection was determined using an avidity assay-based algorithm or seroconversion within 2 years, and incident infection was determined through annual HIV testing for up to 3 years. We estimated prevalence ratios (PRs) and 95% confidence intervals (CIs) for MCP predictors using univariate and multivariable Poisson regression with log-link and fixed effects for matched pairs.

Results: We included 11,965 (94.9%) of the 12,610 participants in the Botswana Combination Prevention Project with sexual history data.

Among 9363 sexually active persons in prior 12 months, 2770 (29.6%) were engaged in MCP. Factors independently associated with MCP included male sex (aPR = 1.57; 95% CI: 1.45 to 1.71), age < 25 years (aPR = 1.25, 95% CI: 1.01 to 1.56), alcohol consumption \geq 2 times/week (aPR = 1.38, 95% CI: 1.26 to 1.51), transactional sex (aPR = 1.69, 95% CI: 1.49 to 1.92), having a partner with MCP (aPR = 1.82, 95% CI: 1.65 to 2.02), and intergenerational sex (partners 10 years younger: aPR = 1.16, 95% CI: 1.06 to 1.28 or 10 years older: aPR = 1.32, 95% CI: 1.15 to 1.51). Reporting prior MCP was associated with HIV seroconversion during follow-up (aPR = 1.28, 95% CI: 1.05 to 1.57) but not with prevalent or recent HIV infection at baseline.

Conclusions: MCP was common and associated with incident HIV infection. People reporting MCP may benefit from pre-exposure prophylaxis.

Key Words: concurrent sexual partnerships, recent HIV infection, HIV seroconversion

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INTRODUCTION

Multiple concurrent sexual partnerships (MCP) likely contribute more to HIV transmission in generalized HIV epidemics than in settings in which HIV transmission is concentrated in high-risk groups.¹⁻⁴ According to the Joint United Nations Programme on HIV/AIDS (UNAIDS) and the Southern African Development Community, the high prevalence of MCPs, combined with low rates of male circumcision and inconsistent condom use, are major drivers of the HIV epidemic in southern Africa.^{5,6} MCPs that overlap for months or years may be more common in southern Africa (in contrast to serial monogamy, casual once-off sexual encounters, or commercial sex, which may be more common in the West).^{1,7}

The high prevalence of MCP in southern Africa is driven by a complex interplay of social, cultural, economic, and individual factors.^{8,9} These factors may in turn be driven by sex inequality, high levels of mobility and unemployment, and contextual factors such as social norms, social networks, social relations, and social control that create a context for MCP.⁸⁻¹¹ Botswana has a high HIV prevalence (20.8%) in adults aged 15–64 years,¹² and MCPs are thought to be one of the key drivers of the epidemic in Botswana and the southern Africa region.^{13,14}

Botswana was one of the first countries to reach the UNAIDS 95-95-95 HIV testing, treatment, and viral suppression targets.^{12,15,16} Despite this progress and Botswana's messaging around MCP reduction, HIV incidence remains high in some Botswana communities.^{17,18} Despite extensive research on the role of MCP in HIV transmission, there has been limited investigation into how knowledge of one's HIV status influences engagement in MCP in the context of Botswana's high HIV prevalence and extensive efforts toward meeting the UNAIDS 95-95-95 targets.

Therefore, there remains a critical need to identify persistent and emerging drivers of HIV transmission within the evolving epidemiologic landscape in Botswana, including (1) shifting demographic patterns among new infections, (2) spatial redistribution of transmission, and (3) behavioral factors influencing transmission networks. We investigated the prevalence and predictors of MCPs and the association between MCP and prevalent, recent, and incident HIV infection in a large household-based cluster-randomized HIV prevention trial (the Botswana Combination Prevention Project, or BCPP) conducted in 30 Botswana communities.

METHODS

Study Population

BCPP (also known as the “Ya Tsie” trial, NCT01965470) was a pair-matched, cluster-randomized clinical trial that aimed to test whether a combination prevention intervention package was able to reduce cumulative 3-year HIV incidence on a population level, as compared with an enhanced national standard of care.^{17,18}

The combination prevention package consisted of the following interventions that were not provided as part of the standard of care at the time of the trial: community-wide, home-based, and mobile universal HIV testing; active linkage to HIV care within 1 week of HIV diagnosis (and more rapid

ART start); widened ART eligibility that changed over time, as guidelines evolved; and enhanced male circumcision services (mobilization campaigns, mobile clinics, and peer linkage with scheduled appointments, reminders, and transportation).^{18,19} BCPP was conducted in 30 rural and periurban communities across Botswana from October 2013 to November 2018. In these 30 communities, we enrolled all consenting people aged 16–64 years who resided in a random sample of approximately 20% of households into a prospective survey cohort and followed them longitudinally for a median of 29 months.

At enrollment into the cohort, we used structured questionnaires to evaluate for multiple HIV transmission risk factors, including MCP. At each visit, we collected extensive sociodemographic and socioeconomic information, comorbid conditions/illnesses, self-reported HIV risk behavior (including number and type of partners, frequency of sexual contacts with each partner), HIV testing and treatment history, and health history (including CD4 and viral load), male circumcision, and mobility.¹⁹

MCP for the prior 12 months was defined as present if either of the following indicated MCP: (1) a standard UNAIDS-recommended method in which MCP were defined as having at least 2 active and overlapping sexual partners in the past 12 months and (2) a direct question asking whether concurrent sexual relationships existed at the same time for the prior year. Individuals without prior documented HIV infection were tested for HIV at enrollment, and plasma was stored for all participants with HIV (including those with known HIV infection). Recent HIV infection (at entry) was determined using an algorithm including the limiting-antigen avidity assay, and documented HIV seroconversion from negative to positive status within the 2 years before enrollment in BCPP.^{17,18}

All cohort participants were followed longitudinally for a median of 29 months. HIV testing was offered annually to all adults who did not have documentation of HIV-positive status (participants had a median of 2 subsequent annual study visits). Persons who were HIV negative at enrollment underwent annual HIV testing during prospective follow-up. Cohort retention and retesting were high; >95% of HIV-negative participants had at least 1 follow-up HIV test, and 88% had 2 follow-up tests.

The study received ethics committee/institutional review board approval from the Botswana Health Research Development Committee and the US Centers for Disease Control and Prevention. All participants provided written informed consent. Participants aged 16–18 years provided written assent (with parents or guardians providing written permission).

Statistical Analysis

We estimated prevalence ratios (PRs) and 95% confidence intervals (CI) for predictors of MCP reported at the enrollment visit. Poisson regression with log-link and fixed effects for matched pair. The 95% CIs were computed using robust variance, accounting for clustering at the community level. MCP was used as a predictor of prevalent, recent, or incident HIV infection, among only participants who reported

TABLE 1. Baseline Characteristics of Participants in the BCPP Household Survey Who Reported Having at Least One Sexual Partner in the Past Year

	Female, n (%), n = 5983	Male, n (%), n = 3380	Total, n (%), n = 9363
Age (yrs)	n = 5983	n = 3380	n = 9363
16–24	1156 (19.3)	596 (17.6)	1752 (18.7)
25–34	2060 (34.4)	1102 (32.6)	3162 (33.8)
35–44	1414 (23.6)	782 (23.1)	2196 (23.5)
45–54	878 (14.7)	521 (15.4)	1399 (14.9)
55–64	475 (7.9)	379 (11.2)	854 (9.1)
Marital status	n = 5979	n = 3379	n = 9358
Married	1192 (19.9)	687 (20.3)	1879 (20.1)
Single/never married	4592 (76.8)	2623 (77.6)	7215 (77.1)
Widowed	128 (2.1)	28 (0.8)	156 (1.7)
Divorced/separated	67 (1.1)	41 (1.2)	108 (1.2)
Education	n = 5955	n = 3345	n = 9300
Nonformal	475 (8.0)	381 (11.4)	856 (9.2)
Primary	1133 (19.0)	639 (19.1)	1772 (19.1)
Junior secondary	2335 (39.2)	1181 (35.3)	3516 (37.8)
Senior secondary	1081 (18.1)	508 (15.2)	1589 (17.1)
Tertiary	931 (15.6)	636 (19.0)	1567 (16.8)
Age at first sex (yrs)	n = 5477	n = 3014	n = 8491
< 16	353 (6.4)	202 (6.7)	555 (6.5)
≥ 16	5124 (93.6)	2812 (93.3)	7936 (93.5)
Circumcised		n = 3362	n = 3362
Yes	n/a	1038 (30.9)	1038 (30.9)
No	n/a	2324 (69.1)	2324 (69.1)
Recent HIV infection (per LAg)	n = 798	n = 1952	n = 2750
Recent infection	8 (1.0)	22 (1.1)	30 (1.1)
Long-term infection	790 (99.0)	1930 (98.9)	2720 (99.0)
Seroconverter*	n = 4005	n = 2566	n = 6571
Yes	90 (2.2)	24 (0.9)	114 (1.7)
No	3915 (97.8)	2542 (99.1)	6457 (98.3)
Employment status	n = 5977	n = 3379	n = 9356
Employed	1833 (30.7)	1469 (43.5)	3302 (35.3)
Unemployed, looking for work	2869 (48.0)	1384 (41.0)	4253 (45.5)
Unemployed, not looking for work	1275 (21.3)	526 (15.6)	1801 (19.2)
Alcohol consumption	n = 6578	n = 2764	n = 9342
Never	5047 (76.7)	1765 (63.9)	6812 (72.9)
Less once/week to once/wk	957 (14.5)	513 (18.6)	1470 (15.7)
≥ 2 times/week	574 (8.7)	486 (17.6)	1060 (11.3)
Transactional sex	n = 5953	n = 3368	n = 9321
Yes	427 (7.2)	101 (3.0)	528 (5.7)
No	5526 (92.8)	3267 (97.0)	8793 (94.3)
Age of sexual partner†	n = 6428	n = 2737	n = 9165
Same age category	3414 (53.1)	1307 (47.8)	4721 (51.5)
Younger partner	1175 (18.3)	720 (26.3)	1895 (20.7)
Older partner	1839 (28.6)	710 (25.9)	2549 (27.8)
Income (monthly, US\$)	n = 5953	n = 3346	n = 9299
None or <200	3421 (57.5)	1546 (46.2)	4967 (53.4)
200–999	1028 (17.3)	382 (11.4)	1410 (15.2)
1000–4999	1160 (19.5)	1049 (31.4)	2209 (23.8)
≥ 5000	344 (5.8)	369 (11.0)	713 (7.7)
ARV status (among people with HIV)	n = 1959	n = 802	n = 2761
ARV naive	534 (27.3)	248 (30.9)	782 (28.3)
ARV defaulters	13 (0.7)	4 (0.5)	17 (0.6)

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TABLE 1. (Continued) Baseline Characteristics of Participants in the BCPP Household Survey Who Reported Having at Least One Sexual Partner in the Past Year

	Female, n (%), n = 5983	Male, n (%), n = 3380	Total, n (%), n = 9363
Currently on ARV	1412 (72.1)	550 (68.6)	1962 (71.1)
Known living with HIV at baseline	n = 5964	n = 3368	n = 9332
No	2872 (48.2)	2128 (63.2)	5000 (53.6)
Yes	3092 (51.8)	1240 (36.8)	4332 (46.4)

Transactional sex: received or paid money in exchange for sex. Age of sexual partner: same category (sex with persons within the same age category (16–24, 25–34, 35–44, 45–54, or 55–64).

*At the 2-year follow-up, among participants who were HIV negative at baseline.

†Younger partner (>10 years younger), older partner (>10 years older).

ARV, antiretroviral; LAg, limiting antigen avidity assay.

having at least 1 sexual partner for the prior 12 months, adjusting for age, sex, and clustering by community (aPRs). All analyses were conducted using STATA version 18 (StatCorp, College Station, TX).

RESULTS

We enrolled 12,610 individuals into the survey cohort. Sexual history data at enrollment were available from 11,965 (94.9%) of 12,610 BCPP cohort participants. Among 9363 individuals who were sexually active in the past 12 months, 2770 (29.6%, 95% CI: 28.7 to 30.5) reported engaging in MCP (Table 1). The median age of persons reporting MCP was 32 years (IQR: 25, 41) compared with 34 years (IQR 26, 44) in persons not reporting MCP. Among the 20% of participants who were currently married, 29% of men and 21% of women reported MCP.

In the univariate analysis (Table 2), participants reporting MCP were more likely to be male (unadjusted PR = 1.57; 95% CI: 1.45 to 1.71); younger, PR = 1.34 (95% CI: 1.16 to 1.55) for 16–24 years, and PR = 1.33 (95% CI: 1.15 to 1.55) for 25–34 years, as compared with >54 years of age. MCP was also significantly associated with being single/never married [adjusted (PR) = 1.32; 95% CI: 1.21 to 1.44] as compared with married, having younger age at first intercourse (PR = 1.37; 95% CI: 1.20 to 1.58), reporting transactional sex (PR = 1.64, 95% CI: 1.37 to 1.97), intergenerational sex (PR = 1.37, 95% CI: 1.30 to 1.45) with a partner 10 years younger, alcohol consumption at least 2 times a week (PR = 1.77, 95% CI: 1.61 to 1.94), and being employed (PR = 1.16; 95% CI: 1.06 to 1.28). Among individuals who believed that their partners had other partners during their relationships in the past year, 45% were themselves in MCP (PR = 1.91; 95% CI: 1.75 to 2.08). Among persons with HIV, participants who knew their HIV-positive status at enrollment were less likely to report MCP (aPR = 0.9; 95%CI: 0.71 to 0.88).

In our multivariable analysis (Table 2), several demographic, behavioral, and partner-related factors were independently associated with having MCP. Men were more likely to engage in MCP than women (aPR = 1.51, 95% CI: 1.36 to 1.68), as were individuals aged <25 years (aPR = 1.25, 95% CI: 1.01 to 1.56) compared with those >54 years old. Key behavioral factors included reporting any alcohol

consumption [for instance, at least 2 times per week (aPR = 1.38, 95% CI: 1.26 to 1.51)] and engagement in transactional sex (aPR = 1.69, 95% CI: 1.49 to 1.92). Having a partner with MCP (aPR = 1.82, 95% CI: 1.65 to 2.02) and engaging in intergenerational sex with partners 10 years younger (aPR = 1.16, 95% CI: 1.06 to 1.28) or 10 years older (aPR = 1.32, 95% CI: 1.15 to 1.51) were also independently associated with MCP.

Among 12,610 BCPP cohort participants, 3596 (29%) were living with HIV at enrollment.¹⁸ Of those, 2750 (76%) had sexual history and recency assay data, and 30 of them (1.1%) had a recent HIV infection (limiting-antigen avidity assay). MCP were not associated with prevalent HIV infection nor with recent infection at baseline.

However, reported history of MCP was associated with HIV seroconversion during follow-up. A total of 157 participants who were HIV negative at enrollment had documented HIV seroconversion (incident HIV infection) in the 29 months of follow-up after enrollment.¹⁸ Among HIV-negative participants at baseline, reporting MCP at enrollment was associated with seroconversion to HIV positive during subsequent prospective follow-up (aPR = 1.28, 95% CI: 1.05 to 1.57; Table 2).

DISCUSSION

Our study leveraged an extensive population-based survey from the Botswana Combination Prevention Project to provide a comprehensive analysis of MCP predictors, and the association between reported history MCP and subsequent actual HIV seroconversion, offering insights not previously available at this scale. Nearly one-third of adults (30%) in rural Botswana reported having multiple concurrent sexual partnerships. Although methodologies in prior studies differ,^{7,20–22} the measured prevalence of MCP is similar to previous studies in Botswana^{13,23} that were conducted before large-scale public education campaigns to prevent MCP. Our findings are important and relevant, given the persistently high MCP rates despite many years of programmatic efforts to reduce MCP in Botswana. Because MCP remain common, biomedical interventions such as pre-exposure prophylaxis may be a particularly important tool for reducing HIV risk in people reporting MCP.

The observed association between male sex and MCP in this study has been reported previously^{24–26}; the relatively

TABLE 2. Univariate and Adjusted Predictors of Self-Reported Multiple Concurrent Sexual Partnerships in BCPP Participants Who Reported Having at Least One Sexual Partner in the Prior Year

Participant Characteristics	n reporting MCP/N (%) N = 9363	Univariate Poisson Regression for Factors Associated With Concurrent Sexual Partnerships in the Past 12 mo		Multivariate Poisson Regression for Factors Associated With Concurrent Sexual Partnerships in the Past 12 mo	
		Prevalence Ratio (95% CI)	P	Adjusted Prevalence Ratio (95% CI)	Adjusted P
Age (yrs)					
16–24	582/1752 (33.2)	1.34 (1.16 to 1.55)	<0.001	1.25 (1.01 to 1.56)	0.04
25–34	1018/3162 (32.2)	1.33 (1.15 to 1.55)	<0.001	1.10 (0.93 to 1.32)	0.25
35–44	606/2196 (27.6)	1.08 (0.91 to 1.27)	0.37	0.94 (0.80 to 1.10)	0.65
45–54	355/1399 (25.4)	1.01 (0.88 to 1.16)	0.87	0.98 (0.81 to 1.19)	0.86
55–64	209/854 (24.5)	1 (ref)		1 (ref)	
Sex					
Male	1304/3380 (38.6)	1.57 (1.45 to 1.71)	<0.001	1.51 (1.36 to 1.68)	<0.001
Female	1466/5983 (24.5)	1 (ref)		1 (ref)	
Marital status					
Married	447/1879 (23.8)	1 (ref)		1 (ref)	
Single/never married	2262/7215 (31.4)	1.32 (1.02 to 1.3)	0.03	1.14 (0.99 to 1.31)	0.07
Widowed	29/156 (18.6)	0.78 (0.48 to 1.27)	0.32	1.05 (0.64 to 1.73)	0.84
Divorced/separated	31/108 (28.7)	1.21 (0.82 to 1.78)	0.35	1.04 (0.79 to 1.37)	0.78
Education					
Nonformal	212/856 (24.8)	1 (ref)		1 (ref)	
Primary	470/1772 (26.5)	1.07 (0.91 to 1.26)	0.39	1.11 (0.91 to 1.36)	0.27
Junior secondary	1045/3516 (29.7)	1.20 (1.02 to 1.40)	0.02	1.07 (0.88 to 1.32)	0.46
Senior secondary	519/1589 (32.7)	1.32 (1.14 to 1.53)	<0.001	1.17 (0.97 to 1.41)	0.10
Tertiary	500/1567 (31.9)	1.29 (1.08 to 1.54)	0.005	1.18 (0.96 to 1.45)	0.12
Age at first sex (yrs)					
< 16	221/555 (39.8)	1.3 (1.1 to 1.5)	0.001	1.17 (0.99 to 1.38)	0.07
≥ 16	2394/7936 (30.2)	1 (ref)		1 (ref)	
Circumcised (males)					
Yes	403/1038 (38.8)	1.01 (0.91 to 1.12)	<0.001	0.75 (0.51 to 1.09)	0.13
No	892/2324 (38.4)	1 (ref)		1 (ref)	
Recent HIV infection at enrollment (per LAg)					
Yes	7/30 (23.3)	0.91 (0.46 to 1.80)	0.78	—	
No	701/2720 (25.8)	1 (ref)			
HIV seroconversion during follow-up*					
Yes	43/114 (37.7)	1.21 (0.96 to 1.54)	0.11	1.28 (1.05 to 1.57)	0.02
No	2003/6457 (31.0)	1 (ref)		1 (ref)	
Suspect that partner has MCP					
Yes	858/1722 (49.8)	1.91 (1.75 to 2.08)	<0.001	1.82 (1.65 to 2.02)	<0.001
No	1043/3996 (26.1)	1 (ref)		1 (ref)	
Employed					
Yes	1074/3302 (32.5)	1.16 (1.06 to 1.28)	0.02	1.06 (0.98 to 1.15)	
No	1694/6054 (28.0)	1 (ref)		1 (ref)	
Alcohol consumption					
Never	1765/6812 (25.9)	1 (ref)		1 (ref)	
Less once/week to once/week	513/1470 (34.9)	1.35 (1.21 to 1.49)	<0.001	1.14 (1.05 to 1.25)	0.003
≥ 2 times/wk	485/1060 (45.8)	1.77 (1.61 to 1.94)	<0.001	1.38 (1.26 to 1.51)	<0.001
Transactional sex					
Yes	248/528 (47.0)	1.64 (1.37 to 1.97)	<0.001	1.69 (1.49 to 1.92)	<0.001
No	2517/8793 (28.6)	1 (ref)		1 (ref)	
Age of sexual partner†					
Same age category	1307/4721 (27.7)	1 (ref)		1 (ref)	

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TABLE 2. (Continued) Univariate and Adjusted Predictors of Self-Reported Multiple Concurrent Sexual Partnerships in BCPP Participants Who Reported Having at Least One Sexual Partner in the Prior Year

Participant Characteristics	n reporting MCP/N (%) N = 9363	Univariate Poisson Regression for Factors Associated With Concurrent Sexual Partnerships in the Past 12 mo		Multivariate Poisson Regression for Factors Associated With Concurrent Sexual Partnerships in the Past 12 mo	
		Prevalence Ratio (95% CI)	P	Adjusted Prevalence Ratio (95% CI)	Adjusted P
Younger partner	720/1895 (38.0)	1.37 (1.28 to 1.48)	<0.001	1.16 (1.06 to 1.28)	<0.001
Older partner	710/2549 (27.9)	1.01 (0.92 to 1.10)	0.89	1.32 (1.15 to 1.51)	<0.001
Income (US\$)					
None or < 200	1347/4967 (27.1)	1 (ref)		1 (ref)	
200–999	426/1410 (30.2)	1.11 (0.96 to 1.29)	0.15	1.13 (0.97 to 1.31)	0.11
1000–4999	755/2209 (34.2)	1.26 (1.13 to 1.40)	<0.001	1.14 (1.02 to 1.28)	0.02
≥ 5000	228/713 (32.0)	1.18 (0.99 to 1.41)	0.07	1.13 (0.96 to 1.32)	0.13
ARV status (among people with HIV)					
ARV naive	236/782 (30.2)	1.26 (1.10 to 1.47)	0.001	1.09 (0.89 to 1.34)	0.40
ARV defaulters	6/17 (35.3)	1.48 (0.70 to 3.14)	0.30	1.43 (0.79 to 2.61)	0.24
Currently on ARV	467/1962 (23.8)	1 (Ref)		1 (Ref)	
Known HIV status at baseline					
Known negative	636/2967 (53.6)	1		1	
Known positive	550/2270 (46.4)	0.79 (0.71 to 0.88)	<0.001	0.98 (0.91 to 1.06)	0.62

*During a median of 29 months of prospective follow-up with annual HIV testing, among participants who were HIV negative at baseline.

†Younger partner (>10 years younger), older partner (>10 years older).

LAg, limiting antigen avidity assay; MCP, multiple concurrent partnerships.

lower prevalence of self-reported MCP among females than among males could also be a result of underreporting because of social desirability bias.^{27,28} Several other factors that we found to be associated with MCP have also been described previously, especially early sexual debut,^{29,30} being employed, transactional sex, intergenerational sex, and alcohol consumption.^{31,32} Transactional sex has been described as a way of ensuring social and financial security and can lead to MCP.^{33–35} High alcohol consumption may be associated with a greater number of sexual partners because of sexual disinhibition.^{36,37} The observed association between self-reported MCP and suspected partner's concurrency was also described by Nunn et al.³⁸

We did not find an association between self-reported concurrency and recent HIV infection, at study entry (using limiting antigen avidity assay tests). However, MCP reported at baseline (enrollment) was associated with incident HIV (actual HIV seroconversion) during >2 years of prospective follow-up of this large cohort, consistent with some of the studies in Africa,^{25,39} while others did not observe this association.^{40,41} Others have endorsed straightforward and unambiguous messaging targeted at reducing multiple sexual partnerships, regardless of whether those partnerships overlap in time.⁴¹

We found that participants living with HIV who were aware of their positive HIV status, particularly those on ART, were less likely to report MCP. This might be the result of counseling persons living with HIV (particularly persons on ART) to reduce sexual risk behavior and also taking protective actions to avoid possible transmission of HIV to others.⁴² It is also possible that persons who are tested for HIV and take ART have lower sexual risk behavior in

general, compared with people with HIV who do not engage in HIV testing or care.

The primary strength of this study is its comprehensive assessment of the MCP in a large cluster-randomized trial with a representative population-based and well-characterized nationwide cohort of adults in Botswana. In contrast to prior studies, which were relatively small and focused on the association between MCP and HIV prevalence,^{10,43,44} we performed a robust assessment of the association between MCP and both recent and incident HIV infections. We also identified a strong association between reduced MCP and knowledge of individuals' HIV-positive status and ART use.

The study's limitations include a primary focus on rural communities, excluding individuals residing in urban areas, a lack of migration data, and a lack of detailed data on coresidence in multiple households. There is possibility of social desirability or recall bias because most of our variables were self-reported. We cannot exclude the possibility of unmeasured confounding in our adjusted analysis.

CONCLUSIONS

Despite consistent health education campaigns for decades aimed at reducing MCP, nearly 1 in 3 adults self-reported being engaged in MCP in a large population-based sample of adults from across Botswana. MCP was a significant predictor of subsequent HIV seroconversion for 29 months of follow-up period. Knowledge of one's HIV-positive status was associated with lower MCP prevalence among people with HIV, highlighting the potentially important role of counseling, enhanced HIV testing, and treatment

services. Structural and sociobehavioral factors likely contribute to the high level of concurrency, calling for ongoing efforts aimed at reducing MCP, and making pre-exposure prophylaxis available to people reporting MCP.

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