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Differences between groups of pre-exposure prophylaxis (PrEP) using couples in HIV-negative/unknown relationships

Steven A. John, PhD, MPH¹, Gabriel Robles, PhD, MSW², Tyrel J. Starks, PhD^{2,3,4}, and H. Jonathon Rendina, PhD, MPH^{2,3,4,*}

¹Center for AIDS Intervention Research, Department of Psychiatry and Behavioral Medicine, Medical College of Wisconsin, Milwaukee, WI, USA

²Center for HIV/AIDS Educational Studies & Training, Hunter College of the City University of New York (CUNY), New York, NY, USA

³Health Psychology and Clinical Science Doctoral Program, The Graduate Center of the City University of New York (CUNY), New York, NY, USA

⁴Department of Psychology, Hunter College of the City University of New York (CUNY), New York, NY, USA

Abstract

Background: Epidemiology research is limited on the characteristics of HIV pre-exposure prophylaxis (PrEP) using couples.

Setting: United States nationwide sample recruited online in 2017.

Methods: HIV-negative/unknown gay, bisexual, and other men who have sex with men (GBMSM) with HIV-negative/unknown partners ($n=3140$) were asked about individual and main partner PrEP uptake. Men were coded into five groups: 1) neither participant nor partner on PrEP, 2) partner only on PrEP, 3) participant only on PrEP, 4) both on PrEP, and 5) unknown partner PrEP use. We examined associations of demographics, relationship factors, condomless anal sex (CAS) with main and casual partners, bacterial sexually transmitted infection (BSTI) diagnoses, and sexual positioning with reported dyadic PrEP use using fully-adjusted multinomial logistic regressions.

Results: PrEP use was 3.2% for the partner only, 5.7% for the participant only, and 4.9% for both participant and partner; 5.6% reported not knowing their partner's PrEP use status. Men who reported any CAS with their main partner or any CAS with male casual partners were both more likely to be classified in the dyadic PrEP use group compared to the neither on PrEP group. Compared to monogamous, men in open arrangements were more likely to be classified in each of the three PrEP groups compared to the neither on PrEP group. Six-month BSTI prevalence was 2.8%, 8.1%, 8.3%, 15.6%, and 4.0% for the five groups, respectively.

* Author to whom correspondence should be addressed; Address: 695 Park Avenue, Room N611, New York, NY 10065; Phone: 212-206-7919; Fax: 212-206-7994; hrendina@hunter.cuny.edu.

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Conclusions: PrEP use occurred during times of higher risk behavior engagement, but further efforts are needed to expand PrEP use to more partnered GBMSM.

Keywords

HIV; pre-exposure prophylaxis; sexually transmitted infections; men who have sex with men; couples

INTRODUCTION

Despite decreasing HIV incidence nationally in the United States (US),¹ HIV incidence continues to rise among gay, bisexual, and other men who have sex with men (GBMSM).² Biomedical strategies to prevent HIV transmission have the potential to influence long-term trends in HIV diagnoses among GBMSM. HIV pre-exposure prophylaxis (PrEP) is highly effective in preventing HIV seroconversion^{3–13} and approved by the US Food and Drug Administration (USFDA) for daily oral use.¹⁴ PrEP is now recommended by the Centers for Disease Control and Prevention for many GBMSM¹⁵ including adolescent GBMSM.¹⁶ Nonetheless, PrEP uptake among GBMSM in the US remains limited,^{17–19} with fewer than 60,000 males (including men who have sex with women only) prescribed PrEP during the second quarter of 2017.²⁰ Novel strategies are needed increase uptake among GBMSM.

GBMSM in relationships are an important group for biomedical HIV prevention because an estimated 35–68% of new HIV infections are transmitted through main partnerships.^{21,22} Examining relationship dynamics is important to contextualize factors associated with HIV risk among GBMSM in HIV-negative/unknown relationships. While PrEP use is an individual behavior (i.e., taking a daily or intermittent PrEP dose individually), its use by HIV-negative men in relationships has added benefits for an HIV-negative partner by reducing HIV transmission risk associated with the PrEP user's sexual behavior—assuming adequate PrEP adherence. Seroconcordant HIV-negative couples have described the benefits of PrEP use within the relationship during dyadic interviews²³ and couples HIV testing and counseling sessions,²⁴ wherein men described PrEP as a mechanism to reduce HIV-related anxiety^{23,24} and provide HIV protection should the couple change their sexual agreement or a monogamous agreement is violated.²⁴ HIV-negative GBMSM perceived PrEP use by their main partner to be important in prior research,²⁵ but epidemiology research is limited on the characteristics of actual PrEP uptake among partnered GBMSM nationwide.

Some GBMSM are willing to convince their partner to go on PrEP,²⁵ and many men who use PrEP have main partners on PrEP.²⁶ However, no known published research has attempted to identify factors that differentiate concordance of biomedical prevention use among HIV-negative/unknown GBMSM. “Biomed matching” has been described by researchers as a method for GBMSM to choose sexual partners or behaviors based on biomedical HIV prevention (i.e., PrEP) and HIV treatment (i.e., treatment as prevention or undetectable = untransmittable).^{26,27} This is particularly important in the context of HIV disparities among subgroups of GBMSM and how biomed matching could decrease or exacerbate HIV-related disparities if, for instance, these prevention practices were more common in one group than another. Researchers are also concerned about the potential for

risk compensation, decreases in condom use, and associated increases in bacterial sexually transmitted infections (BSTIs).^{11–13,28–33} As such, we sought to determine the concordance of PrEP use among partnered GBMSM and characteristics of GBMSM who integrate PrEP within their relationship to inform HIV prevention priorities, implications for individual and couples HIV testing and counseling, and BSTI prevention in the US.

METHODS

Recruitment and Eligibility

GBMSM were recruited online to participate in a 10–15 minute survey between May 2017 and June 2017 using a popular geotargeted sexual networking app and social media.^{34,35} To be eligible, individuals needed to be 18+ years old, reside in the US, report same-sex sexual activity in the past year, and identify as cisgender or transgender male. Potential duplicate responses were identified by corresponding birth month and year, zip code, HIV status, and race/ethnicity; these cases were further screened by examining other demographic variables and meta-data (e.g., device and browser information) before removal consideration, as recommended previously.³⁶ For this paper, eligibility was limited to individuals who completed the survey long enough to complete the measures used in this analysis, self-reported an HIV-negative or unknown status, and reported having an HIV-negative or unknown main sexual partner. We excluded individuals with an HIV-positive main partner because our research question centered on dyadic PrEP use (as reported from the index partner who completed the survey). All procedures were approved by the Institutional Review Board of the City University of New York.

Measures

Demographics.—Individuals self-reported demographic information, including age, sexual orientation identity, gender, race/ethnicity, highest educational attainment, and geographical region of residence determined from postal codes.

Partner and relationship characteristics.—We asked each participant to report their main partner's HIV-status and gender, as well as relationship duration with this partner. Relationship agreement with individuals' main partners was assessed by self-reported relationship arrangement and behavioral characteristics. In response to our question asking how couples' handle sex outside of their relationship, we coded individuals as being in a monogamous relationship if they reported "neither of us has sex with others, we are monogamous." Men were coded as being in a monogam^{ish} relationship arrangement if they responded "both of us have sex with others together" or reported a monogamous arrangement but indicated sex together with an outside partner in the past 3 months, which has been described as an exclusive play-together arrangement in prior literature.^{25,37} Men were coded as being in an open relationship if they reported allowing external sexual partners in any form other than an exclusive play-together arrangement. Finally, men were coded as having no relationship agreement if they reported not knowing their partner's behavior ("I don't have sex with others, but I don't know about my partner" or "I have sex with others, but don't know about my partner").

Sexual HIV/STI transmission risk behavior.—Participants were asked about behaviors indicating engagement in sexual HIV/STI transmission risk behavior. Specifically, individuals were asked to report their HIV-status, engagement in condomless anal sex (CAS) with their main partner in the past 6 months, engagement in CAS with male casual sex partners in the past 6 months, and any STI diagnoses (chlamydia, gonorrhea, or syphilis) in the past 6 months, all of which were dichotomized (yes/no) for data analysis. We also asked about sexual positioning with self-identified classifications of top, versatile (including versatile/top and versatile/bottom response categories), and bottom.

PrEP use among individuals and their partners.—We asked participants to report the PrEP use for themselves and their main partner. Individual PrEP use was assessed with the following question: *Have you ever been prescribed HIV medications (e.g., Truvada) for use as PrEP (HIV pre-exposure prophylaxis)?* Individuals who responded “Yes, I am currently prescribed PrEP” were considered to be currently taking PrEP.¹⁷ Main partner PrEP use was assessed with the following question: *Is your main partner currently taking PrEP?* Response categories included “Yes,” “No,” and “I don’t know,” and those who responded “Yes” were coded as their main partner being on PrEP. Men were coded into five groups based on PrEP use among the participant and their partner: 1) neither participant nor partner on PrEP, 2) partner only on PrEP, 3) participant only on PrEP, 4) both on PrEP, and 5) unknown partner PrEP use regardless of self-PrEP use.

Statistical Analyses

Descriptive statistics were used to characterize the sample. Bivariate associations with our categorical outcome of dyadic PrEP use were conducted using Fisher’s Exact tests, chi-squared comparisons, and one-way analysis of variance. Multinomial logistic regression with a robust estimator was used for our fully-adjusted models with base referent categories of neither participant nor partner on PrEP for Model 1 and participant on PrEP as the referent for Model 2.

RESULTS

Our online recruitment methods resulted in 14,489 GBMSM who started our survey. Of those who started the survey, 12,853 completed the survey long enough to encompass the measures used for this analysis. After excluding GBMSM living with HIV ($n = 2,107$) and those who didn’t report a main partner ($n = 7,308$), the analytic sample was further reduced to 3,438 participants. Finally, we excluded another 298 participants who reported having an HIV-positive main partner, resulting in a final analytic sample of 3,140 HIV-negative or unknown status GBMSM with HIV-negative or unknown status main partners.

The sample was geographically diverse by US region. Nearly all (97.2%) described themselves as cisgender male, a majority (78.8%) of participants reported gay/queer sexual orientation identity, 41.3% self-reported a non-White race/ethnicity, and average age was 32.5 years old. Relationship agreements varied in the sample, with 42.6% reporting mutual monogamy, 36.8% an open arrangement, 9.6% a monogamish arrangement, and 11.1% with no agreement. PrEP use was reported as 5.7% for the participant only, 3.2% for the partner only, and 4.9% for both participant and partner; another 5.6% ($n = 177$) reported not

knowing their partner's PrEP use status, 16 (9.0%) of whom were current PrEP users. In total, current PrEP use was reported by 11.2% ($n = 350$) of participants. Recent bacterial STI diagnoses in the past 6 months were reported by 4.0%. Most (92.5%) reported having an HIV-negative status, and 9.7% reported not knowing their partner's HIV-status. See Table 1 for full sample details.

Individuals who self-identified as gay/queer were more likely to be classified in one of the three PrEP groups; 15.2% of gay/queer men were classified in a PrEP use group, compared to 8.8% of bisexual men and 3.6% of straight/other-identified men. Notably, significant differences were found by main partner gender, where GBMSM with a cisgender male partner were more likely to be classified in a PrEP use group. Of the 63 GBMSM with transgender partners, five (7.9%) reported PrEP use in the relationship. BSTI prevalence differed between the five groups. Self-reported 6-month BSTI prevalence was 2.8% for neither on PrEP, 8.1% for partner only PrEP use, 8.3% for participant PrEP use only, 15.6% for dyadic PrEP use, and 4.0% for those who did not know their partner's PrEP use status. Full bivariate results are presented in Table 1.

In our fully-adjusted multinomial logistic regressions, individuals were more likely to be classified in the individual PrEP use only group compared to the neither participant nor partner PrEP use group as age increased (see Table 2). As age increased, individuals were less likely to be classified in the groups with partner PrEP use or unknown use compared to individual PrEP group (see Table 3). Compared to gay/queer men, bisexual men were less likely to be classified in the individual or dyadic PrEP use groups, individually, compared to the neither on PrEP group. Bisexual men were also more likely to be classified in the partner PrEP only or unknown partner PrEP use groups compared to the individual PrEP use group. Similarly, straight or other identified men (as compared to gay/queer men) were less likely to be classified in the dyadic PrEP group compared to the neither on PrEP group. No differences were observed comparing cisgender to transgender male participant group classification. Compared to men with lower educational attainment, men with a Bachelor's degree or higher were more likely to be classified in the individual or dyadic PrEP use groups compared to the neither on PrEP group.

Compared to White men, Black men were more likely to be classified in the partner-only PrEP use or dyadic PrEP use groups, individually, compared to the neither on PrEP group; Latino men were less likely to be classified in the partner-only PrEP group compared to the neither on PrEP group; and other/multiracial men were more likely to be classified in the dyadic PrEP use group compared to the neither on PrEP group. Latino men compared to White men were also less likely to be classified in the partner PrEP group compared to individual PrEP use group. Finally, non-White men were more likely to report not knowing their partner's PrEP use status.

PrEP use among partnered men varied by relationship characteristics. Compared to their monogamous counterparts, men in open arrangements were more likely to be classified in each of the three PrEP groups compared to the neither on PrEP group. Also compared to monogamous men, men in monogamish arrangements were more likely to be classified in the dyadic PrEP group compared to the neither on PrEP group. Men with no relationship

agreement (compared to monogamous) were more likely to be in the partner and participant only on PrEP or unknown partner PrEP use groups compared to the neither on PrEP group. When we changed the reference category to monogamish, men who were in open relationships (compared to men in monogamish arrangements) were more likely to be classified in each of the three PrEP groups compared to the neither on PrEP group (see footnote in Table 2). Compared to men in relationships 1–5 years in duration, men in relationships less than a year were more likely to be classified in each of the three PrEP use groups and unknown partner PrEP use group compared to the neither on PrEP group. Men in relationships for less than a year were also more likely to be classified in the partner PrEP group and men in relationships longer than 5 years were more likely to be classified in the dyadic PrEP use group, as compared to the individual-only PrEP use group. Similarly, men in relationships longer than 5 years were more likely to be classified into the dyadic PrEP use group compared to neither on PrEP group.

Engagement in sexual HIV/BSTI transmission risk behavior was associated with PrEP use group classification. Men who had engaged in any CAS with their main partner were more likely to be classified in the dyadic PrEP use group compared to the neither on PrEP group. Similarly, men who reported any CAS with male casual partners were more likely to be classified in the dyadic PrEP use group compared to the neither on PrEP group. Engagement in CAS with male casual partners was also associated with individual-only PrEP use classification compared to the neither on PrEP group, after similarly accounting for all other variables including relationship factors. Men who engaged in any CAS with male casual partners were also less likely to be classified in the partner PrEP use group compared to individual-only use group. Regarding sexual positioning and compared to those who identified as typically engaged in sex in the bottom position, men who identified as typically in the top position were more likely to be classified in the dyadic PrEP use group compared to men in the neither on PrEP group. Men who reported typically engaging in sex via top or versatile positions were also more likely to be classified in the dyadic compared to individual-only PrEP use group. Those who self-reported a recent BSTI were more likely to be classified in one of the three groups with PrEP use classifications compared to the neither on PrEP group. The relative risk of self-reporting a recent BSTI was also higher among men classified in the dyadic PrEP use group compared to individual-only PrEP use group. Finally, individuals who reported an HIV-unknown status compared to negative were less likely to be in the PrEP use groups compared to the neither on PrEP group. Individuals who did not know their main partner's HIV-status were also more likely to be unaware of their partner's PrEP use status.

DISCUSSION

In mid-2017, PrEP use was reported by 11.2% of the GBMSM in relationships who participated in our online survey. PrEP use was relatively uncommon when considered in the context of CDC PrEP guidelines, which indicate the benefit of PrEP for GBMSM in non-mutually monogamous relationships.¹⁵ More than half of the men in our study reported a non-monogamous relationship arrangement and more than 40% reported engaging in recent CAS with a male casual partner, indicating the need for further intervention to increase PrEP uptake among this population. The formation of relationship agreements is one mechanism

for partnered GBMSM to reduce or understand their HIV risk, which was supported by our findings that agreement formation was associated with knowing the PrEP use status of their partner. The context of these findings is supported by prior qualitative work. PrEP offers an extra level of HIV prevention beyond relationship agreements.^{23,24} PrEP barriers specific to GBMSM in relationships include concerns about perceived changes in the relationship resulting from beliefs in behavioral disinhibition and violations to these agreements.^{23,24} Enthusiasm for PrEP among partnered GBMSM was reduced because of worries about the lack of PrEP protection against BSTIs.²⁴

Our self-reported BSTI findings indicate PrEP use was occurring during times of potentially higher risk behavior engagement, supporting the need for regular BSTI screening and risk reduction counseling of GBMSM while on PrEP.^{11–13,28–33} Most notably, men who reported a recent BSTI had a five-fold greater likelihood of being in the dyadic PrEP use group, and two-fold greater likelihood of being in the individual PrEP use group, compared to the neither on PrEP group. There is rationale for incorporating partners into PrEP maintenance care because of the potential added BSTI risk of having a partner on PrEP who engages in condomless sex with outside partners. Alternatively, our BSTI findings by PrEP use group could be the result of added BSTI screening associated with PrEP maintenance care. Nonetheless, dyadic sexual health visits could offer an opportunity to promote PrEP use to partners who have not yet initiated and at least offer an opportunity for ongoing BSTI screening for the couple.

PrEP coverage is lacking for several subpopulations of GBMSM including younger men, bisexual men, Latino men, and men who have a bottom sexual position identity. Despite the disproportionate burden of HIV among young GBMSM,¹ younger men were less likely to be classified in the individual PrEP use, with the individual only PrEP users having the highest mean age. Nonetheless, average age in PrEP using couples was youngest in the partner on PrEP only group, indicating the potential to expand PrEP uptake to younger GBMSM in relationships by intervening with their partner currently on PrEP and targeting partner PrEP uptake. PrEP use could also be expanded to younger GBMSM by relationship-oriented interventions since those who didn't know their partner's PrEP use status were the youngest of all five groups. Expanding individual and dyadic PrEP uptake is particularly important for younger populations as new HIV diagnoses are skewed towards younger GBMSM and PrEP has now been USFDA approved for adolescent use.^{1,16} In particular, dyadic PrEP use could help young GBMSM overcome barriers to PrEP use through the added social support of concurrent use with their partner because of the importance of social network influences among this population.¹⁸

Bisexual men in our sample were less likely to report individual or dyadic PrEP uptake compared to their gay/queer counterparts. This finding supports prior research with preliminary indications that bisexual men are less likely to use PrEP compared to their gay identified counterparts,^{38,39} and bisexual men are also more likely to discontinue PrEP use within six months.⁴⁰ Limited PrEP use among bisexual men may result from the interacting effects related to bisexual identity disclosure difficulty and perceived PrEP stigma,^{41,42} but further investigation is needed.

No differences were observed by race/ethnicity for individual-only PrEP uptake, but we found Latino men were less likely to report partner-only PrEP use, which could exacerbate HIV disparities among this population compared to their White counterparts because of lower PrEP uptake among their partners. However, partner PrEP uptake could have a protective effect for Black GBMSM because of higher partner-only and dyadic PrEP use. Expanding discussions about PrEP use within non-White GBMSM is needed more generally to promote PrEP uptake, but also to increase their understanding of HIV risk since non-White men had the highest percentages of being in the unknown partner PrEP use group. Further epidemiological evidence is needed longitudinally to measure the effect of these PrEP uptake trends on HIV disparities.

Sexual positioning is related to HIV transmission risk,⁴³ yet we found men who identify with the position of greatest risk (i.e., bottom) to be less likely to report dyadic PrEP use (compared to no PrEP use) when compared to men who identify as a top. Based on findings from our second regression, men currently taking PrEP in less risky sexual positions (i.e., top and versatile) were more likely to report their partner was also on PrEP. This indicates men could be combining biomedical prevention with positioning as an added safety measure, but PrEP use could also be an attempt to mitigate HIV risk for their partner (i.e., partner protection beliefs). Further research is needed to compare the effects of individual and partner protection beliefs as potential motivational factors for PrEP use and other HIV risk reduction strategies.

Sexual health services tailored for partnered GBMSM could be effective in promoting PrEP for this population. Couples HIV testing and counseling—a dyadic intervention designed for GBMSM to engage in HIV testing with their cisgender male partner⁴⁴—offers a unique opportunity for further adaptation to support PrEP uptake discussions for partnered GBMSM. While some men were willing to have these discussions with their cisgender male partners,²⁴ further work is needed to expand couples HIV testing and counseling to more dyads given low reported uptake among cisgender men partnered with transgender women.⁴⁵ Within these dyadic interventions, couples could then decide if, and for whom in the relationship, PrEP could benefit. These types of sexual risk reduction discussions often incorporate negotiations of sexual agreements of how the couple will handle sex with others outside of the relationship,^{37,46,47} which could be a relevant PrEP uptake motivational factor for GBMSM in non-monogamous agreements. One noteworthy finding of our data was that men in monogamous relationships were more likely to report dyadic PrEP use compared to their monogamous counterparts, likely resulting from the formation of these agreements. Couples HIV testing and counseling sessions offer an opportunity to develop or reconcile any discrepancies in agreement and rules regarding sex with extra-dyadic partners,^{48,49} in addition to potentially promoting PrEP as an HIV prevention tool.

Limitations

Our research is not without limitation. First, our survey had gay and queer sexual identities in a single response category, which did not allow us to test for differences between these groups. Second, we relied on self-reported diagnoses of BSTIs subject to underreporting from undiagnosed asymptomatic or unrecognized infections. Third, we excluded couples

with an HIV-positive member because of differential HIV transmission risk; thus, these findings are restricted to HIV-negative/unknown GBMSM who believe their partner is HIV-negative or unknown status. Finally, our sample only included one member of the relationship recruited online, limiting generalizability, but this likely resulted in a wider range of partnered GBMSM compared to a dyadic recruitment strategy that can bias the sample towards high functioning couples.⁵⁰

Conclusion

PrEP coverage was modest among our online sample of GBMSM in relationships, and coverage remains low considering more than half of the sample reported a non-monogamous relationship arrangement with their main partner. Further efforts are needed to expand PrEP use to GBMSM in relationships, perhaps through existing HIV prevention interventions including couples HIV testing and counseling. BSTI screening remains an important component of ongoing PrEP maintenance care based on our findings of elevated BSTI risk among GBMSM who reported individual and/or partner PrEP use.

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Table 1
Demographics, relationship characteristics, and sexual behavior and their bivariate associations with concordant use of pre-exposure prophylaxis (PrEP; n = 3140)

Categorical Variables	Neither Participant nor Partner on PrEP (n = 2530)		Partner on PrEP Only (n = 99)		Participant on PrEP Only (n = 180)		Both Participant and Partner on PrEP (n = 154)		Unknown Partner PrEP Use (n = 177)		Fisher's Exact (FE) χ^2 statistic / p-value		
	n	Col. %	n	Row %	n	Row %	n	Row %	n	Row %			
Sexual orientation identity													
Gay or queer (A)	2474	78.8	1970	79.6	75	3.0	158	6.4	144	5.8	127	5.1	FE p-values: A vs B < 0.001
Bisexual (B)	611	19.5	512	83.8	23	3.8	21	3.4	10	1.6	45	7.4	A vs C = 0.099
Straight/other (C)	55	1.8	48	87.3	1	1.8	1	1.8	0	0.0	5	9.1	B vs C = 0.901
Gender													
Cisgender male	3052	97.2	2456	80.5	98	3.2	176	5.8	152	5.0	170	5.6	FE p = 0.544
Transgender male	88	2.8	74	84.1	1	1.1	4	4.6	2	2.3	7	8.0	
Main partner gender /													
Cisgender male (A)	2845	90.6	2268	79.7	96	3.4	169	5.9	152	5.3	160	5.6	FE p-values: A vs B < 0.001
Cisgender female (B)	232	7.4	211	91.0	1	0.4	10	4.3	0	0.0	10	4.3	A vs D = 0.083
Transgender male (C)	43	1.4	37	86.1	1	2.3	1	2.3	1	2.3	3	7.0	B vs C = 0.103
Transgender female (D)	20	0.6	14	70.0	1	5.0	0	0.0	1	5.0	4	20.0	B vs D = 0.001
Race/ethnicity													
Black	193	6.2	141	70.1	14	7.3	7	3.6	12	6.2	19	9.8	C vs D = 0.309
Latino	660	21.0	521	78.9	12	1.8	41	6.2	31	4.7	55	8.3	$\chi^2 = 53.0^{***}$
White	1845	58.8	1531	83.0	58	3.1	104	5.6	83	4.5	69	3.7	
Other/multiracial	442	14.1	337	76.2	15	3.4	28	6.3	28	6.3	34	7.7	
Education													
Less than Bachelor's degree	2008	64.0	1665	82.9	61	3.0	80	4.0	65	3.2	137	6.8	$\chi^2 = 79.2^{***}$
Bachelor's degree or higher	1132	36.1	865	76.4	38	3.4	100	8.8	89	7.9	40	3.5	
Region													
													χ^2 (A, B, C, D) = 33.8^{**}

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Categorical Variables	Neither Participant nor Partner on PrEP (n= 2530)		Partner on PrEP Only (n = 99)		Participant on PrEP Only (n = 180)		Both Participant and Partner on PrEP (n = 154)		Unknown Partner PrEP Use (n = 177)		Fisher's Exact (FE) χ^2 statistic / p-value	
	n	Col. %	n	Row %	n	Row %	n	Row %	n	Row %		
Northeast (A)	617	19.7	473	76.7	19	3.1	47	7.6	44	7.1	34	5.5
Midwest (B)	625	19.9	514	82.2	19	3.0	29	4.6	31	5.0	32	5.1
South (C)	1036	33.0	871	84.1	32	3.1	37	3.6	39	3.8	57	5.5
West (D)	838	26.7	655	78.2	29	4.5	65	7.8	37	4.4	52	6.2
Other (e.g., US possession, military overseas) (E)	24	0.8	17	70.8	0	0.0	2	8.3	3	12.5	2	8.3
Relationship agreement with main partner												
Monogamous	1338	42.6	1184	88.5	29	2.2	27	2.0	22	1.6	76	5.7
Monogamish	301	9.6	260	86.4	6	2.0	13	4.3	16	5.3	6	2.0
Open	1154	36.8	841	72.9	52	4.5	115	10.0	108	9.4	38	3.3
No agreement	347	11.1	245	70.6	12	3.5	25	7.2	8	2.3	57	16.4
Relationship duration with main partner												
Less than 1 year	868	27.6	607	69.9	52	6.0	51	5.9	45	5.2	113	13.0
1-5 years	1332	42.4	1143	85.8	28	2.1	72	5.4	46	3.5	43	3.2
More than 5 years	940	29.9	780	83.0	19	2.0	57	6.1	63	6.7	21	2.2
Any condomless anal sex with main partner (past 6 months)												
No	1032	32.9	835	80.9	26	2.5	56	5.4	23	2.2	92	8.9
Yes	2108	67.1	1695	80.4	73	3.5	124	5.9	131	6.2	85	4.0
Any condomless anal sex with male casual sex partners (past 6 months)												
No	1782	56.8	1559	87.5	47	2.6	45	2.5	43	2.4	88	4.9
Yes	1358	43.3	971	71.5	52	3.8	135	9.9	111	8.2	89	6.6
Sexual position identity												
Top	509	16.2	418	82.1	15	3.0	27	5.3	31	6.1	18	3.5
Versatile	2185	69.6	1753	80.2	73	3.3	118	5.4	108	4.9	133	6.1
Bottom	446	14.2	359	80.5	11	2.5	35	7.9	15	3.4	26	5.8

$\chi^2 = 277.8$ ****

$\chi^2 = 177.5$ ****

$\chi^2 = 54.0$ ****

$\chi^2 = 157.6$ ****

$\chi^2 = 13.7$

Categorical Variables	Neither Participant nor Partner on PrEP (n = 2530)		Partner on PrEP Only (n = 99)		Participant on PrEP Only (n = 180)		Both Participant and Partner on PrEP (n = 154)		Unknown Partner PrEP Use (n = 177)		Fisher's Exact (FE) χ^2 statistic / p-value		
	n	Col. %	n	Row %	n	Row %	n	Row %	n	Row %			
Any STI diagnosis (past 6 months) ²											$\chi^2 = 77.9^{***}$		
No	3016	96.1	2460	81.6	91	3.0	165	5.5	130	4.3	170	5.6	
Yes	124	4.0	70	56.5	8	6.5	15	12.1	24	19.4	7	5.7	
HIV-status												FE p < 0.001	
HIV-negative	2904	92.5	2331	80.3	93	3.2	180	6.2	154	5.3	146	5.0	
Unknown	236	7.5	199	84.3	6	2.5	0	0.0	0	0.0	31	13.1	
Main partner HIV-status												FE p < 0.001	
HIV-negative	2836	90.3	2300	81.1	99	3.5	165	5.8	154	5.4	118	4.2	
Unknown	304	9.7	230	75.7	0	0.0	15	4.9	0	0.0	59	19.4	
Continuous Variable	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	ANOVA
Age (range: 18-80 years)	32.5	11.9	32.4	12.0	30.6	11.1	36.3	12.5	34.4	10.1	28.6	10.3	F(4, 3135) = 11.2 ^{***}

Note: Percentages may not add up to 100 because of rounding.

* p < 0.05;

** p < 0.01;

*** p < 0.001.

¹ Main partner gender was not included in the multivariable models due to small cell sizes.

² Sexually transmitted infection diagnoses included chlamydia, gonorrhea, and syphilis.

Table 2

Results of the fully-adjusted multinomial regression model predicting concordant use of pre-exposure prophylaxis (PrEP) with neither participant nor partner on PrEP as the reference category (n = 3140)

Variables	Partner on PrEP Only		Participant on PrEP Only		Both Participant and Partner on PrEP		Unknown Partner PrEP Use	
	RRR ⁺	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Age	0.99	0.97–1.02	1.03***	1.01–1.04	1.00	0.99–1.02	1.00	0.98–1.02
Sexual orientation identity (Ref: gay/queer)								
Bisexual	0.95	0.57–1.59	0.46**	0.28–0.75	0.21***	0.11–0.41	1.29	0.87–1.92
Straight/other	0.35	0.04–3.26	0.35	0.04–2.72	0.00***	0.00–0.00	1.40	0.42–4.63
Gender (Ref: cisgender male)								
Transgender male	0.37	0.05–3.04	1.65	0.57–4.81	1.55	0.30–7.96	1.02	0.39–2.66
Race/ethnicity (Ref: White)								
Black	2.56**	1.28–5.10	1.13	0.49–2.62	3.18**	1.55–6.51	2.01*	1.10–3.67
Latino	0.50*	0.25–1.00	1.34	0.87–2.07	1.28	0.79–2.06	1.88**	1.24–2.84
Other/multiracial	1.02	0.55–1.89	1.17	0.73–1.86	1.93*	1.17–3.18	1.85*	1.14–2.99
Education (Ref: less than Bachelor's degree)								
Bachelor's degree or higher	1.26	0.81–1.96	2.12***	1.49–3.03	2.26***	1.54–3.33	0.81	0.54–1.21
Region (Ref: South)								
Northeast	0.94	0.52–1.69	1.99**	1.25–3.16	1.70*	1.04–2.78	1.21	0.75–1.97
Midwest	1.02	0.55–1.88	1.43	0.85–2.41	1.41	0.84–2.36	1.15	0.70–1.90
West	1.33	0.76–2.30	2.21***	1.42–3.43	1.11	0.68–1.81	1.30	0.84–2.00
Other (e.g., US possession, military overseas)	0.00***	0.00–0.00	2.94	0.52–16.52	4.92*	1.40–17.29	2.48	0.61–10.02
Relationship arrangement with main partner (Ref: monogamous [†])								
Monogamish	1.41	0.57–3.51	1.88	0.95–3.75	3.03**	1.48–6.20	0.64	0.27–1.51
Open	4.19***	2.54–6.91	4.33***	2.75–6.79	6.83***	4.02–11.60	0.79	0.49–1.28
No agreement	2.30*	1.10–4.84	2.96***	1.61–5.46	1.46	0.61–3.50	2.92***	1.91–4.46
Relationship duration with main partner (Ref: 1–5 years)								
Less than 1 year	4.58***	2.80–7.51	1.86**	1.25–2.77	2.72***	1.70–4.37	3.79***	2.51–5.73
More than 5 years	0.89	0.48–1.66	0.71	0.47–1.06	1.78*	1.12–2.85	0.73	0.41–1.30
Any condomless anal sex with main partner (past 6 months; Ref: no)								
Yes	1.29	0.78–2.11	0.96	0.66–1.38	2.45**	1.47–4.10	0.46***	0.32–0.65
Any condomless anal sex with male casual sex partners (past 6 months; Ref: no)								
Yes	1.04	0.67–1.61	3.66***	2.46–5.42	2.39***	1.59–3.59	1.40	0.98–2.00

Variables	Partner on PrEP Only		Participant on PrEP Only		Both Participant and Partner on PrEP		Unknown Partner PrEP Use	
	<i>RRR</i> ⁺	95% <i>CI</i>	<i>RRR</i>	95% <i>CI</i>	<i>RRR</i>	95% <i>CI</i>	<i>RRR</i>	95% <i>CI</i>
Sexual position identity (Ref: bottom)								
Top	1.11	0.49–2.51	0.58	0.33–1.03	2.09*	1.01–4.31	0.60	0.31–1.18
Versatile	1.20	0.61–2.35	0.60*	0.40–0.91	1.42	0.76–2.67	1.01	0.63–1.63
Any STI diagnosis (past 6 months; Ref: no) ²								
Yes	2.46*	1.08–5.64	2.27**	1.24–4.14	5.20***	2.94–9.17	1.16	0.48–2.82
HIV-status (Ref: HIV-negative)								
Unknown	1.25	0.51–3.06	0.00***	0.00–0.00	0.00***	0.00–0.00	1.21	0.72–2.03
Main partner HIV-status (Ref: HIV-negative)								
Unknown	0.00***	0.00–0.00	1.24	0.68–2.26	0.00***	0.00–0.00	3.01***	1.95–4.66

Note: Values with 0.00 are non-zero, rounded numbers.

* $p < 0.05$;

** $p < 0.01$;

*** $p < 0.001$.

⁺RRR = relative risk ratio; this is the multinomial logistic regression coefficient exponentiated (i.e., e^b).

¹When the referent group is monogamish, *RRRs* comparing open to monogamish are 2.97 (1.22–7.24, 95%*CI*) for partner on PrEP only, 2.30 (1.24–4.26, 95%*CI*) for participant on PrEP only, and 2.25 (1.24–4.09, 95%*CI*) for both participant and partner on PrEP.

²Sexually transmitted infection diagnoses included chlamydia, gonorrhea, and syphilis.

Table 3

Results of the fully-adjusted multinomial regression model predicting concordant use of pre-exposure prophylaxis (PrEP) with participant on PrEP only as the reference category (n = 3140)

Variables	Partner on PrEP Only		Both Participant and Partner on PrEP		Unknown Partner PrEP Use	
	RRR ⁺	95% CI	RRR	95% CI	RRR	95% CI
Age	0.97*	0.94–1.00	0.98*	0.96–1.00	0.98*	0.95–1.00
Sexual orientation identity (Ref: non-bisexual)						
Bisexual	2.08*	1.05–4.13	0.46	0.20–1.03	2.83**	1.55–5.18
Straight/other	1.02	0.06–18.31	0.00***	0.00–0.00	4.05	0.39–41.98
Gender (Ref: cisgender male)						
Transgender male	0.23	0.02–2.57	0.94	0.16–5.66	0.62	1.16–2.47
Race/ethnicity (Ref: White)						
Black	2.26	0.79–6.50	2.81	0.98–8.08	1.78	0.67–4.70
Latino	0.37*	0.17–0.82	0.95	0.52–1.72	1.40	0.79–2.51
Other/multiracial	0.87	0.42–1.82	1.65	0.88–3.08	1.58	0.83–3.00
Education (Ref: less than Bachelor's degree)						
Bachelor's degree or higher	0.59	0.34–1.02	1.07	0.65–1.74	0.38***	0.23–0.67
Region (Ref: South)						
Northeast	0.47*	0.23–0.98	0.85	0.46–1.60	0.61	0.32–1.16
Midwest	0.71	0.33–1.55	0.98	0.49–1.98	0.81	0.40–1.63
West	0.60	0.30–1.19	0.50*	0.27–0.93	0.59	0.32–1.07
Other (e.g., US possession, military overseas)	0.00***	0.00–0.00	1.68	0.24–11.80	0.85	0.09–7.63
Relationship agreement with main partner (Ref: monogamous)						
Monogamish	0.75	0.24–2.34	1.61	0.62–4.20	0.34	0.12–1.01
Open	0.97	0.50–1.87	1.58	0.81–3.09	0.18***	0.10–0.35
No agreement	0.78	0.30–1.98	0.49	0.18–1.37	0.98	0.48–2.01
Relationship duration with main partner (Ref: 1–5 years)						
Less than 1 year	2.46**	1.34–4.52	1.46	0.83–2.60	2.04*	1.17–3.54
More than 5 years	1.26	0.61–2.60	2.52**	1.41–4.51	1.03	0.51–2.06
Any condomless anal sex with main partner (past 6 months; Ref: no)						
Yes	1.34	0.74–2.45	2.56**	1.41–4.66	0.48**	0.29–0.78
Any condomless anal sex with male casual sex partners (past 6 months; Ref: no)						
Yes	0.29***	0.16–0.51	0.65	0.38–1.12	0.38***	0.23–0.64
Sexual position identity (Ref: top)						
Top	1.90	0.73–4.94	3.55**	1.51–8.34	1.03	0.44–2.41
Versatile	1.99	0.93–4.27	2.37*	1.17–4.80	1.69	0.92–3.10

Variables	Partner on PrEP Only		Both Participant and Partner on PrEP		Unknown Partner PrEP Use	
	RRR ⁺	95% CI	RRR	95% CI	RRR	95% CI
Any STI diagnosis (past 6 months; Ref: no) ^I						
Yes	1.09	0.42–2.78	2.29 [*]	1.13–4.62	0.51	0.19–1.42
HIV-status (Ref: HIV-negative)						
Unknown	4×10 ⁷ ^{***}	NR ⁺⁺	--	--	4×10 ⁷ ^{***}	NR
Main partner HIV-status (Ref: HIV-negative)						
Unknown	0.00 ^{***}	0.00–0.00	0.00 ^{***}	0.00–0.00	2.43 [*]	1.22–4.84

Notes: Neither participant nor partner on PrEP category is shown because of redundancy with Table 2. Values with 0.00 are non-zero, rounded numbers.

^{*} $p < 0.05$;

^{**} $p < 0.01$;

^{***} $p < 0.001$.

⁺ RRR = relative risk ratio; this is the multinomial logistic regression coefficient exponentiated (i.e., e^b).

⁺⁺ NR = not reported due to large values.

⁻⁻ Values are not reported because of concern of a spurious finding since zero individuals fall within this category (i.e., $RRR = 3.46^{***}$, 2.16–5.56 95% CI).

^I Sexually transmitted infection diagnoses included chlamydia, gonorrhea, and syphilis.