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Pre-exposure prophylaxis use, HIV knowledge, and internalized homonegativity among men who have sex with men in Brazil: A cross-sectional study

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Summary

Background—Pre-exposure prophylaxis (PrEP) use in Brazil remains low despite free national access. We explored associations of HIV knowledge and internalized homonegativity with PrEP use among PrEP-eligible men who have sex with men (MSM).

Methods—Brazilian *Hornet* users completed an online, cross-sectional survey in February–March 2020. We included cis-men 18 years old who reported recent sex with men and were PrEP-eligible per the following: condomless anal intercourse, partner(s) living with HIV, transactional sex, and/or sexually transmitted infection. Our outcome was current PrEP use, defined by the response, “I am currently taking PrEP.” Key predictors included the HIV/AIDS Knowledge Assessment (HIV-KA) and Reactions to Homosexuality Scale (RHS); higher scores indicate greater knowledge and greater internalized homonegativity, respectively. Scales were standardized for analysis. Associations with current PrEP use were estimated using adjusted odds ratios (aOR) with 95% confidence intervals (95% CI).

Findings—Among 2398 PrEP-eligible MSM, $n = 370$ (15.4%) reported current PrEP use. Increasing HIV-KA scores were associated with greater odds of PrEP use (aOR 1.70 [95% CI 1.41–2.04], $p < 0.001$), and increasing RHS scores with lower odds of PrEP use (aOR 0.83 [95% CI 0.73–0.96], $p = 0.010$). PrEP use was lower among 18–24 versus 40+-years-old MSM (aOR 0.43 [95% CI 0.27–0.69], $p = 0.005$), and in Black versus White/Asian respondents (aOR 0.51 [95% CI 0.31–0.85], $p = 0.040$).

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.lana.2021.100152.

Interpretation—Among PrEP-eligible Brazilian MSM, HIV knowledge was associated with increased PrEP use and internalized homonegativity with decreased use. Wider dissemination of HIV prevention knowledge and addressing stigma experienced by MSM could promote increased PrEP use.

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O número de usuários da profilaxia pré-exposição (PrEP) no Brasil continua baixo, apesar do acesso gratuito pelo Sistema Único de Saúde. Exploramos as associações entre conhecimento sobre HIV e homonegatividade internalizada com o uso de PrEP entre homens que fazem sexo com homens (HSH) elegíveis para PrEP.

Brasileiros usuários do Hornet completaram uma pesquisa seccional online em fevereiro-março de 2020. Foram incluídos homens cis 18 anos, que reportaram sexo recente com homens e elegíveis para PrEP. O desfecho principal foi uso de PrEP, definido por: “Estou atualmente tomando PrEP.” Os principais preditores incluíram escalas de Conhecimento em HIV/aids (HIV-KA) e de Reações à Homossexualidade (RHS); escores mais altos indicam maior conhecimento e maior homonegatividade internalizada, respectivamente. As escalas foram padronizadas para análise. Associações com uso da PrEP foram estimadas usando razões de chances ajustadas (aOR) com intervalos de confiança de 95% (IC95%).

Entre 2.398 HSH elegíveis para PrEP, 370 (15,4%) relataram o uso atual de PrEP. Maior conhecimento em HIV/AIDS foi associado a maior chance de uso de PrEP (aOR 1.70 [IC 95% 1.41–2.04], $p < 0.001$), e maior homonegatividade internalizada com menor chance de uso de PrEP (aOR 0.83 [95% IC 0.73–0.96], $p = 0.010$). Uso de PrEP foi menor entre HSH de 18–24 vs. 40+ anos (aOR 0.43 [IC95%:0.27–0.69], $p = 0.005$), e entre pretos versus brancos/asiáticos (aOR 0.51 [IC95% 0.31–0.85], $p = 0.040$).

Entre brasileiros HSH elegíveis para a PrEP, o conhecimento do HIV foi associado ao aumento do uso da PrEP e homonegatividade internalizada com a diminuição do uso.

National Institute of Mental Health, Fiocruz, Conselho Nacional de Desenvolvimento Científico e Tecnológico, Coordenação de Aperfeiçoamento, de Pessoal de Nível Superior.

Keywords

HIV prevention; Men who have sex with men; LMIC; Pre-exposure prophylaxis; Latin America & Caribbean; Public health

Introduction

Daily or event-driven pre-exposure prophylaxis (PrEP) with oral tenofovir disoproxil fumarate and emtricitabine (TDF-FTC) has been shown to be highly effective in preventing new HIV infections in men who have sex with men (MSM).¹ PrEP is endorsed by the World Health Organization as a prevention tool for those at high risk of contracting HIV,² and increasing PrEP access is a priority in Latin America, where several countries have recorded a rising HIV infection incidence, particularly among MSM.^{3,4} Although global targets for

PrEP coverage vary, UNAIDS recommends 50% coverage for MSM and transgender people at very high risk of acquiring HIV.^{4,5}

Brazil is an upper-middle-income country, and its population of over 210 million is the largest in Latin America.⁶ An estimated 930,000 people were living with HIV (PLWH) in Brazil in 2020⁷ and recent studies estimate an HIV prevalence among Brazilian MSM as high as 23.0%.⁸ Brazil was the first country in the region to provide national access to PrEP, which is freely available through the Public Health System (Sistema Único de Saúde, SUS),^{9–11} and as of 2020 had the highest rate of PrEP use per 10,000 people of any Latin American country.⁵

As of September 2021, there were 270 healthcare centres across all Brazilian states providing PrEP to approximately 23,000 individuals,⁹ with an additional 3000 or more receiving PrEP through research studies such as the Implementation PrEP Project (ImPrEP).¹² Over 80% of current PrEP users in Brazil are MSM,⁹ but this level of PrEP utilization remains well below an estimated 66,120 Brazilian MSM aged 15–64 years who were eligible for and willing to use PrEP in 2018,¹¹ a number likely to be even higher with 2021 population estimates. A 2020 survey of Brazilian MSM and transgender/non-binary individuals conducted via geosocial networking applications (GSN apps) and social media found 19.8% of respondents reported current PrEP use, though this percentage did not consider PrEP eligibility of respondents and is likely an over-estimate of PrEP use given recruitment from groups affiliated with ImPrEP.¹³ Low levels of PrEP utilization in Brazil compared to the goal of 50% coverage⁴ suggest a need for further exploration of facilitators and barriers to use among those who are eligible for PrEP.

There is growing recognition that knowledge about HIV prevention modalities facilitates their uptake.¹⁴ Research has shown that those with greater HIV knowledge are more likely to engage with prevention services,¹⁵ and lack of understanding about the efficacy and/or side effects of PrEP may lead to decreased willingness to use it.¹⁶ Another factor known to impact engagement with HIV prevention is internalized homonegativity, which refers to gay or homosexual MSM directing societal stigma, discrimination, or negative perceptions about homosexuality toward themselves.^{17,18} Internalized homonegativity has been shown to be associated with lower engagement with HIV prevention services, including PrEP.^{18,19} Various scales have been developed to measure HIV knowledge and internalized homonegativity, including the HIV/AIDS Knowledge Assessment (HIV-KA)²⁰ and the Reactions to Homosexuality Scale (RHS),²¹ both available in Brazilian Portuguese.

While several studies have explored PrEP awareness, willingness, and uptake among MSM in Brazil,^{10,16,22–25} none have explored associations with the individual's HIV knowledge or internalized homonegativity, nor have any focused specifically on PrEP use among the eligible population of MSM. This cross-sectional study explores the impact of HIV knowledge and internalized homonegativity, measured via the HIV-KA and RHS tools, as well as other sociodemographic and sexual health variables, on current PrEP use among Brazilian MSM who were eligible for PrEP in 2020.

Methods

Study design

A cross-sectional, internet-based survey was completed by a convenience sample of Brazilian *Hornet Gay Social Network (Hornet)* GSN app users in February–March 2020. *Hornet* is popular among gay, bisexual, and other MSM in Latin America and recruitment via this GSN app has been used in other studies in the region to reach a large population of sexually active MSM for whom PrEP may be indicated.^{16,26,27} The open survey was administered via Alchemer® (<https://www.alchemer.com/>). Requests for voluntary survey completion were sent twice to the ~1 million *Hornet* users in Brazil through the direct message inbox. Respondents did not receive compensation. The survey was in Brazilian Portuguese and contained 118 questions, with certain questions conditionally presented using branching logic. All items included a non-response option. Respondents were able to change/review answers. Usability and technical functionality were confirmed before survey administration. Respondents with incomplete surveys were excluded, as were those who incorrectly answered any of five attention questions, which requested selection of a specific response option: “This question is merely a check. Please select option A from the responses below.”²⁸ One response per internet protocol (I.P.) address was permitted.

Study population

The overall study population included adult (≥ 18 years old) *Hornet* users living in Brazil. For this analysis about PrEP use, PLWH were excluded. We focus on sexually active cis-gender men, thus excluding those who identified as transgender men, transgender women, gender non-binary, or *Travesti*, as well as those who reported no male sexual partners in the previous six months. Additionally, we limited our analysis to MSM who were eligible for PrEP in Brazil, which includes MSM who reported at least one of the following in the previous six months: condomless anal intercourse (CAI), male sexual partner living with HIV, transactional sex, or sexually transmitted infection (STI) diagnosis.

Variables

Demographic and sexual health characteristics.—Respondents were asked about sociodemographic characteristics, including age, race, gender identity, sexual orientation, education, income, region of Brazil, and living in their state capital’s metropolitan area. Family monthly income was asked in relation to the minimum monthly wage, which was BRL1039 in 2020, equivalent to \$190 USD. We grouped no salary, 1x, and 2x the minimum wage as “low income,” 2–6x as “middle income,” and >6x as “high income. Sexual behavior data included the number of male sexual partners, any male sexual partner living with HIV, passive/receptive CAI, and STI diagnosis in the past six months. Other variables included transactional sex (sex for money or gifts) and chemsex (illicit substance use before or during sex) in the previous six months, as well as binge drinking before/during sex and frequency of virtual channel (GSN app) use to seek sex. Table footnotes contain additional variable details.

Awareness and use of PrEP.—Awareness of PrEP was assessed via the question, “Have you ever heard about PrEP?” Those who responded affirmatively were then asked, “Are

you taking or have you taken PrEP?” Response options included, “No, I have never taken PrEP,” “Yes, I am currently taking PrEP,” or “Yes, I took PrEP but I stopped.” Depending on their answer, respondents were then asked about adherence to PrEP or their primary reason for stopping or never using PrEP. Free responses were re-categorized when appropriate. For analysis, those who had not heard about PrEP were considered never PrEP users.

HIV knowledge.—HIV knowledge was measured via the HIV-KA tool, which contains 12 statements about the transmission and prevention of HIV/AIDS, with response options “true,” “false,” and, “I don’t know.”²⁰ Correct responses were scored as 1 and incorrect or “I don’t know” responses as 0, with a total score range of 0–12. Higher scores indicate higher levels of HIV knowledge. As a secondary measure of HIV prevention knowledge, respondents were asked about their perceived accuracy of the following statement: “Undetectable=Untransmissible (U=U), that is, people who live with HIV and are undetectable do not transmit HIV through sex.” Response options included “completely accurate,” “somewhat accurate,” “somewhat inaccurate,” “completely inaccurate,” or “I don’t know what undetectable means.”²⁹

Internalized homonegativity.—Internalized homonegativity was measured via the RHS tool, which includes seven items measured on a 7-point Likert scale from strongly disagree to strongly agree.²¹ Total scores range from 0–42. Higher scores indicate higher internalized homonegativity. Only those who described their sexual orientation as gay/homosexual were presented with the RHS items.

Statistical analysis

Our primary outcome was current PrEP use and our primary aim was to explore factors associated with current compared to never PrEP use. Descriptive data were stratified by current, past, and never PrEP use, but past PrEP users were excluded from statistical analyzes given the small sample size and our desire to avoid combination of distinct groups. Differences between current and never PrEP users for categorical and continuous variables were estimated via Pearson’s chi-squared test and student’s t-test, respectively.

To aid in the visualization of the relationship between HIV-KA and RHS scores and PrEP use, we used restricted cubic splines with four knots within the framework of generalized additive models to fit a smooth curve with a 95% confidence interval (95% CI) showing how the probability of current PrEP use varies with HIV-KA or RHS score.

To further analyze associations with current compared to never PrEP use, we created logistic regression models to estimate odds ratios (OR) with 95% CI. A single p-value, calculated using the likelihood ratio test, is presented for each variable. Multivariable regression models were created by sequentially adding covariates by group (demographic variables in model 1, sexual behavior variables in model 2, and other variables in model 3) followed by a full adjusted model containing all covariates. Separate adjusted models were created for HIV-KA and RHS scores. Since only gay- or homosexual-identifying MSM responded to RHS items, models that include RHS scores have a smaller sample size. Full models are presented below, and data from the stepwise addition of variable groups can be found in

Supplemental Tables. Unless otherwise noted, regression results for covariates presented in the text below are from the full adjusted model for HIV-KA score.

Both the HIV-KA and RHS scores, which were the independent variables of interest, were standardised to z-scores for inclusion in regression models. Standardisation involved subtracting the mean score (μ) from each participant's score (x) and dividing the difference by the standard deviation (σ), as described by the following equation: $z = (x - \mu)/\sigma$.

Ethics

This study received approval from the human subjects ethics committee at Instituto Nacional de Infectologia Evandro Chagas of Fundação Oswaldo Cruz (#CAAE 0177791 8.0.0000.5262) and was exempt from review by the University of California, Los Angeles institutional review board. All study participants provided electronic informed consent before survey initiation. No personally identifiable information was collected, except for the I.P. address.

Role of the funding source

This project was funded by the University of California Los Angeles' (UCLA) South American Program in HIV Prevention Research (SAPHIR) NIMH grant R25MH087222 and the UCLA Center for HIV Identification, Prevention, and Treatment Services (CHIPTS) NIMH grant P30MH58107. Author P.M.L. was supported by Programa Inova FIOCRUZ, Edital Geração do Conhecimento/VPPCB, and Programa PrInt, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)/FIOCRUZ. Author T.S.T. was supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, #28/2018). Funders did not have any role in the study design, data collection, data analysis, interpretation, or writing of this report.

Results

A total of 6559 Brazilian *Hornet* GSN app users completed the survey and met the initial inclusion criteria. After exclusions (Fig. 1), 2398 sexually active, cis-gender MSM who were eligible for PrEP were included in this analysis. Among respondents, 370 (15.4%) were currently taking, 110 (4.6%) had previously taken, and 1918 (80.0%) had never taken PrEP (Table 1). The most cited reasons for never taking PrEP were not knowing where to obtain it (30.9%), satisfaction with other prevention methods (17.9%), and worry about side effects (14.1%). The most cited reasons for having stopped PrEP were difficulty accessing the health service (25.5%), worry about side effects (21.8%), and decreased perceived HIV risk (10.9%).

The mean age of the overall sample was 33.6 years (standard deviation (SD) 9.7), and those who were currently taking PrEP were older than those who had never used PrEP (35.3 vs. 33.3 years, $p < 0.001$) (Table 2). Compared to those who had never taken PrEP, a greater percentage of current PrEP users reported White or Asian race (65.7% vs. 59.3%, $p = 0.026$), university or higher-level education (73.0% vs. 63.8%, $p < 0.001$), high monthly income (31.1% vs. 24.2%, $p = 0.019$), or living in their state's capital metropolitan area (82.2% vs. 67.3%, $p < 0.001$). Most of the overall sample was from the southeast region

of Brazil ($n = 1914$, 79.8%), with the state of São Paulo accounting for the majority of respondents ($n = 1244$, 51.9%). In the past six months, current PrEP users were more likely to have reported six or more male sexual partners (77.0% vs. 50.6%, $p < 0.001$), at least one male sexual partner living with HIV (41.9% vs. 16.5%, $p < 0.001$), an STI diagnosis (34.6% vs. 21.7%, $p < 0.001$), or chemsex (42.2% vs. 26.6%, $p < 0.001$) compared to those who had never taken PrEP.

The probability of current PrEP use compared to never PrEP use increased with increasing HIV-KA scores and decreased with increasing RHS scores (Fig. 2). Mean HIV-KA score was high overall (10.8, SD:1.5), but was higher among current compared to never PrEP users (11.3 vs. 10.6, $p < 0.001$) (Table 3). A higher percentage of current PrEP users correctly responded that there are medications to prevent HIV (89.7% vs. 76.7%, $p < 0.001$), that PLWH on treatment have a lower risk of HIV transmission (93.5% vs. 73.4%, $p < 0.001$), and that women living with HIV who are on treatment have a lower risk of transmitting HIV during childbirth (87.6% vs. 77.0%, $p < 0.001$). Respondents currently taking PrEP were also more likely to perceive U=U as totally accurate (78.6% vs. 49.7%, $p < 0.001$).

Mean RHS score was low overall (10.0, SD:7.4) but was lower among current versus never PrEP users (8.5 vs. 10.3, $p < 0.001$).

Participants with higher standardized HIV-KA scores had greater odds of PrEP use in unadjusted (OR 1.96 [95%CI 1.66–2.32], $p < 0.001$) and adjusted logistic regression models (aOR 1.70 [95%CI 1.41–2.04], $p < 0.001$) (Table 4). Conversely, higher standardized RHS scores were associated with lower odds of PrEP use in unadjusted (OR 0.76 [95%CI 0.67–0.87], $p < 0.001$) and adjusted analyzes (aOR 0.83 [95%CI 0.73–0.96], $p = 0.010$). For the sample that responded to the RHS items ($n = 1897$), an additional adjusted model including both key independent variables and all other co-variates found similar aORs for standardized HIV-KA (aOR 1.62 [95%CI 1.34–1.96], $p < 0.001$) and RHS (aOR 0.85 [95%CI 0.74–0.97], $p = 0.019$) scores.

Among covariates in the HIV-KA adjusted model, age 18–24 was associated with lower odds of PrEP use (aOR 0.43 [95%CI 0.27–0.69], $p = 0.005$) compared to age 40+, as was Black (aOR 0.51 [95%CI 0.31–0.85], $p = 0.040$) compared to White or Asian race. Living in a capital metropolitan area was associated with increased odds of PrEP use (aOR 2.01 [95%CI 1.48–2.73], $p < 0.001$). Reporting 31 or more male sexual partners (aOR 2.95 [95%CI 1.96–4.43], $p < 0.001$) or a male sexual partner living with HIV (aOR 3.18 [95%CI 2.40–4.20], $p < 0.001$) in the past six months had the highest odds of current PrEP use.

Discussion

This study is one of few to explore associations of HIV knowledge and internalized homonegativity with current PrEP use and is unique in its focus on MSM who were eligible for and living in a Latin American country with free national access to PrEP. Current PrEP use in this sample was slightly less than the 19.8% of GSN app users reported in April–May 2020,¹³ although that prevalence was not specific to PrEP-eligible respondents and may

have been an over-estimate due to recruitment from groups affiliated with ImPrEP, but was much higher than the 2.3% reported in 2018.¹⁶ Despite the progress in expanding PrEP use in Brazil since 2018, 15.4% of PrEP-eligible MSM currently taking PrEP falls well under the 50% recommended by UNAIDS 2021–2026 Global AIDS Strategy,^{4,5} indicating a need for continued work to decrease barriers to access.

While respondents offered various reasons for never having taken or having stopped PrEP, it is notable that approximately one-third indicated not knowing where to obtain or difficulty accessing PrEP as their main reason for never taking PrEP, and one-fourth indicated difficulty accessing the health services as their reason for stopping. Despite free national access, the availability of PrEP at SUS facilities varies across the country. According to the SUS website, two-thirds of the country's 270 facilities providing PrEP are located in the south or southeast region of the country. The state of São Paulo, for example, accounts for 100 of these facilities, while eight states in the north and northeast regions of the country have two or fewer facilities listed.⁹ Even individuals with access to a facility may encounter an overburdened system, as indicated by free-text responses about long wait times. The Federal Nursing Council in Brazil recently approved nurses to be able to prescribe PrEP in an effort to increase the number of PrEP providers in the country.³⁰ While our survey provides some insights into these structural barriers to PrEP access, future research on PrEP use in Brazil should explore this important topic in more depth.

Our sampled cohort showed high levels of HIV knowledge as measured via the HIV-KA, and we found that higher levels of HIV knowledge were associated with significantly increased odds of current PrEP use, even after adjusting for education level. Significant differences were noted between current and never PrEP users for HIV-KA items describing the existence of PrEP and HIV treatment as prevention, and a significantly greater percentage of PrEP users perceived the slogan U=U as totally accurate. Notably, a greater percentage of MSM in our study believed the U=U slogan to be accurate compared to a study conducted a year prior, though this finding could be due to our focus on PrEP-eligible respondents.²⁹ Smaller differences were also noted between current and never PrEP users for HIV-KA items describing post-exposure prophylaxis (PEP) and modes of HIV transmission. Despite higher levels of HIV knowledge among PrEP users, 10% of those currently taking PrEP incorrectly responded 'false' to the HIV-KA item 'there are medications for HIV-negative people to take to prevent HIV.' This result is surprising for a group of MSM reportedly taking PrEP. Though the exact reason for these incorrect responses is unclear, this finding indicates a need for improved counselling about the protection offered by taking PrEP, as misunderstandings could have implications for adherence.

Though we cannot determine causality with cross-sectional data, our results suggest increasing dissemination of accurate HIV prevention and PrEP information could facilitate increased use of PrEP among eligible MSM in Brazil. This is certainly true for those who had never heard of PrEP, but also for the 23% of never users who incorrectly responded to the HIV-KA item about PrEP or the 22% of never users who listed questions about PrEP's efficacy, side effects, interaction with other substances, and contribution to HIV resistance as reasons for never taking it. A recent study of PrEP awareness among GSN app users in Mexico found that the majority reported first learning about PrEP via the internet,

rather than from a doctor,²⁷ which emphasizes the importance of providing accurate, easy-to-find information about PrEP and HIV prevention online and suggests that internet-based advertising may be a promising channel for information dissemination. Ultimately, however, PrEP use and its associated follow up requires engagement with the healthcare system, again highlighting the importance of addressing structural barriers to accessing HIV prevention services in Brazil.

Our study is also one of the first to explore the impact of internalized homonegativity on PrEP use in Brazil, a country with high levels of discrimination based on sexual orientation, sexual behavior, and HIV status.³¹ Overall RHS scores suggest low levels of internalized homonegativity among this sample of MSM, though we found that current PrEP users had significantly lower overall scores compared to never PrEP users. The reason for the inverse association between internalized homonegativity and PrEP use in Brazil is likely multifactorial, and further research, perhaps via a qualitative study, should explore this relationship in more depth. One study found that discrimination may decrease willingness to access HIV prevention services,³² though only 2.7% of respondents in our study listed discrimination as the main reason for never taking or having stopped PrEP. Another study of MSM in Brazil, Mexico, and Peru found concern about talking to healthcare providers about sex life and worry that taking PrEP may lead others to assume one has HIV as barriers to PrEP use.¹⁶ While our survey did not include those particular response options, several respondents provided a free text response indicating that they had never used PrEP because of shame or fear of others finding out. Lastly, while Brazil has been a leader in HIV prevention in Latin America, societal stigma continues to limit public health efforts to reach particular sexual and gender minority groups and the current far-right government has limited certain human rights protections that are crucial for HIV prevention efforts,^{33,34} both of which could be related to the relationship between internalized homonegativity and PrEP use.

Young MSM (YMSM) aged 18–24 years in our study had lower odds of current PrEP use compared to those aged 40+ years. Several studies have identified similar associations between age and awareness of or willingness to use PrEP.^{16,23,24,27} While we did not perform age subgroup analyzes, other research has shown that YMSM have lower levels of HIV knowledge compared to older MSM,³⁵ that perceived discrimination may be higher among YMSM,³⁶ and that homophobia and internalized homonegativity are associated with decreased HIV prevention care access among YMSM.³² HIV prevention campaigns tailored specifically to YMSM are urgent due to the rising incidence of HIV in this population in Brazil.⁸

Among other sociodemographic variables, we found that Black compared to White or Asian MSM had significantly lower odds of current PrEP use, even when controlling for income and education level. This observation is concerning, given that Brazilian national data found 64.9% of new HIV diagnoses in 2019 were accounted for by non-White males, showing an increase from 48.3% in 2007.³⁷ Black and *Pardo* MSM populations additionally face structural racism, which may increase their vulnerability to HIV infection in comparison to White MSM.^{38,39} Several previous studies exploring PrEP and HIV care in Brazil have found similar racial disparities as observed in the present study.^{10,23,24,40} The PrEP Brasil

study found Black YMSM had lower levels of protective concentrations of PrEP compared to White and *Pardo* YMSM,¹⁰ and cross-sectional data have shown a greater awareness of and willingness to use PrEP among White compared to non-White MSM in Brazil.^{23,24,40} Further research to understand the impact of intersectional stigma experienced by Black and *Pardo* MSM⁴¹ is necessary to increase PrEP use in these populations.

A larger percentage of our sample reported recent CAI,^{16,26} STI diagnosis,^{16,23} and partners living with HIV¹⁶ compared to similar studies, due to our focus on PrEP-eligible MSM. Not surprisingly, all three of these PrEP eligibility criteria were associated with increased odds of current PrEP use. An increasing number of male sexual partners was also found to be associated with increased odds of PrEP use, and MSM reporting 31 or more partners in the past six months had the highest prevalence of current PrEP use among any subgroup. Those reporting recent chemsex or daily use of GSN apps to procure sex had higher levels of current PrEP use, but the strength of these associations decreased or was lost when other demographic and sexual behavior variables were adjusted for in the full model. A similar trend was noted in a prior work exploring associations with the willingness to use PrEP.¹⁶

Our study has several limitations. As a cross-sectional survey, conclusions cannot be made regarding the causality of identified associations with current PrEP use. Additionally, all responses were self-reported, thus introducing the possibility of recall, response, or social desirability bias. Selection bias due to a survey completion percentage of 67% and the demographic characteristics of respondents may have led to an overestimation of the true prevalence of PrEP use among MSM in the country. Three-quarters of our sample were from either São Paulo or Rio de Janeiro and, given previously reported heterogeneity among Brazilian MSM²⁶ and greater access to PrEP services in the southeast region of the country,⁹ this limits the generalizability of our results. Moreover, this sample represents a highly educated, high socioeconomic status subset of Brazilian MSM with access to a device compatible with GSN apps, although cellphones and internet connection have been shown to be widely available in all socioeconomic strata in Brazil. The question used to create our outcome of current PrEP use did not include any time-frame to guide respondents as to what “currently taking PrEP” meant, though adherence data presented in Table 1 suggest most had taken PrEP four or more times in the past week. Only those identifying as gay or homosexual were included in our analysis of internalized homonegativity, which may have skewed the results by failing to capture the impact of internalized homonegativity on PrEP use for MSM who indicated other sexual orientations. Lastly, our PrEP-eligible inclusion criteria did not consider recent PEP use, which is an additional eligibility criteria in Brazil.

Conclusion

Brazil was the first Latin American country to establish free national access to PrEP for MSM at increased risk of acquiring HIV. This study is one of the first to explore PrEP use among Brazilian MSM who were eligible for it according to SUS criteria. While PrEP use has increased among Brazilian MSM in recent years, current use remains well below the 50% coverage recommended by UNAIDS, reinforcing the need to identify barriers and facilitators to PrEP uptake. Greater HIV knowledge and lower internalized homonegativity were associated with increased odds of current PrEP use. Wider dissemination of HIV

prevention knowledge and addressing stigma experienced by MSM when engaging with healthcare services could promote increased PrEP use.

Data sharing statement

Study's final de-identified dataset and dictionary will be made available with the publication upon reasonable request. A proposal should be submitted to the corresponding author's e-mail, who will evaluate and approve the request. No other additional documents will be available.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The abstract for this manuscript was presented as a poster presentation at 11th IAS Conference on HIV Science in July 2021 (abstract number A-IAS2021-00929).

Declaration of Interests

Financial support for this work is mentioned above in the 'role of funding source' section of the methods. Unrelated to this project, J.C. was involved in a recent study of adherence to oral TDF/FTC for HIV prevention which received provision of medication from Gilead Sciences, Inc.

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Research in context

Evidence before this study

We searched PubMed and Web of Science using the terms (“PrEP” OR “pre-exposure prophylaxis” OR “combination prevention”) AND (“HIV” OR “human immunodeficiency virus”) AND (“knowledge” OR “internalized homonegativity” OR “homophobia” OR “discrimination”) AND (“Brazil” OR “Latin America”) in February 2021, in addition to reviewing reference lists of relevant articles. We reviewed the literature for research pertaining to facilitators and barriers to PrEP use among men who have sex with men (MSM) in Latin America, with a particular focus on the impact of HIV knowledge and internalized homonegativity.

PrEP still has limited availability in many Latin American countries, and much of the research has come via the Implementation PrEP Project (ImPrEP) data on the feasibility and acceptability of PrEP in Brazil, Mexico, and Peru. Brazil was the first to provide free national PrEP access and is the country in which most of the research on PrEP has taken place. Recent studies on PrEP in Brazil have primarily used cross-sectional survey data to explore knowledge of or willingness to take PrEP among all MSM. Few studies have focused specifically on the subset of MSM who are eligible for PrEP, and none have explored the impact of HIV knowledge and internalized homonegativity on PrEP use in Brazil.

Added value of this study

Increasing PrEP use among eligible populations is a key UNAIDS HIV prevention priority, particularly in Latin America, where HIV incidence among MSM has risen in many countries. While Brazil has the highest rate of PrEP use of any country in the region, current PrEP use among eligible MSM remains well below the UNAIDS target of 50%. This study offers important insights into previously unexplored barriers and facilitators to PrEP use in Brazil, and is unique in its focus on MSM who are eligible for and living in a country with national access to PrEP. Higher levels of knowledge about HIV and lower levels of internalized homonegativity are associated with higher odds of PrEP use among Brazilian MSM, and can serve as targets for future interventions to improve PrEP uptake in the region.

Implications of all the available evidence

As Brazil and other countries in Latin America work to expand PrEP use among MSM in the region, it is important to ensure access to accurate HIV prevention information and to address societal stigma as well as an individual’s conscious and unconscious reactions to these negative societal attitudes toward sexual and gender minorities.

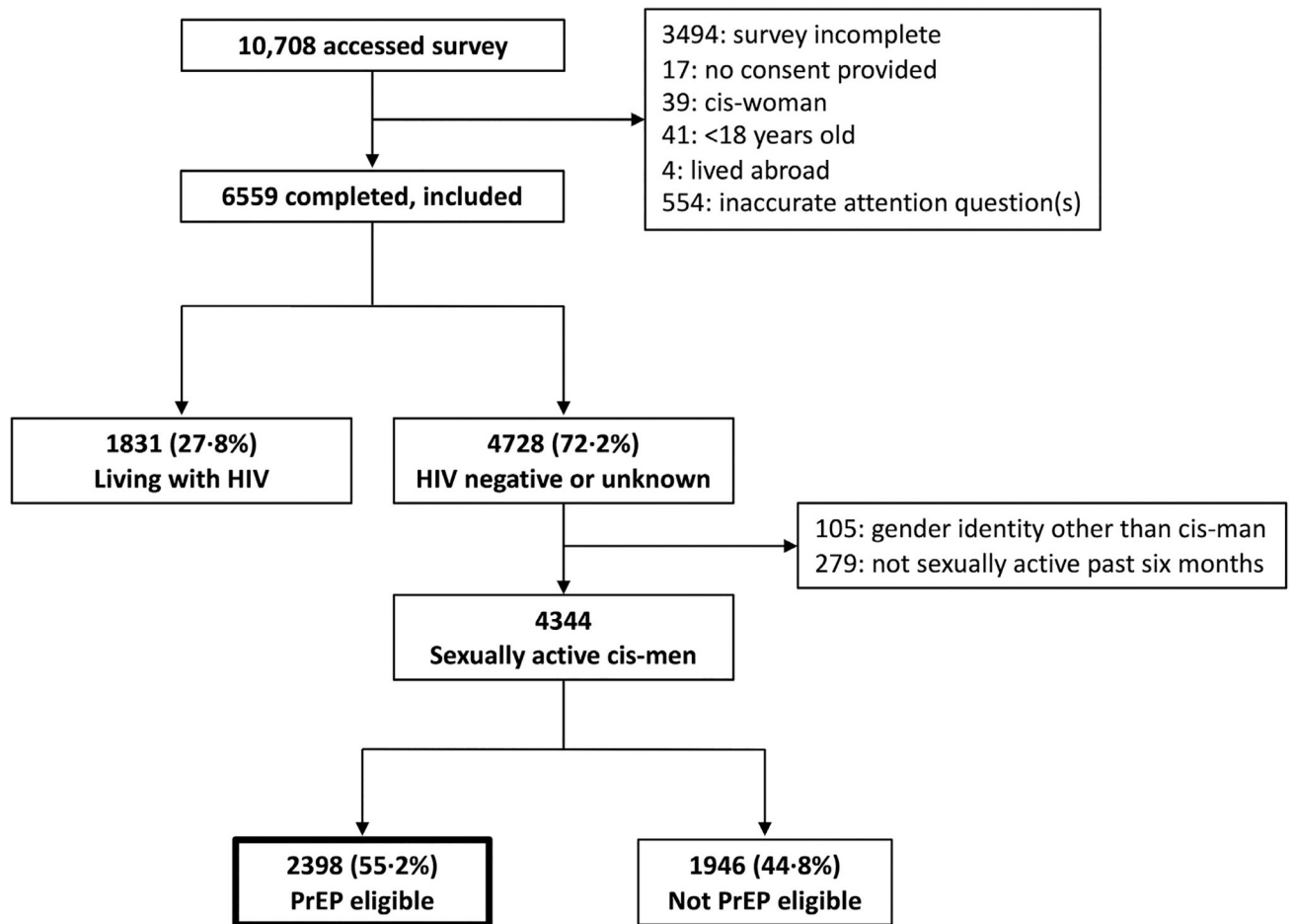


Fig. 1. Flow diagram for inclusion of Brazilian cis men who were sexually active with other men and eligible for PrEP. The bolded box indicates the 2398 respondents who met inclusion criteria for the present study.

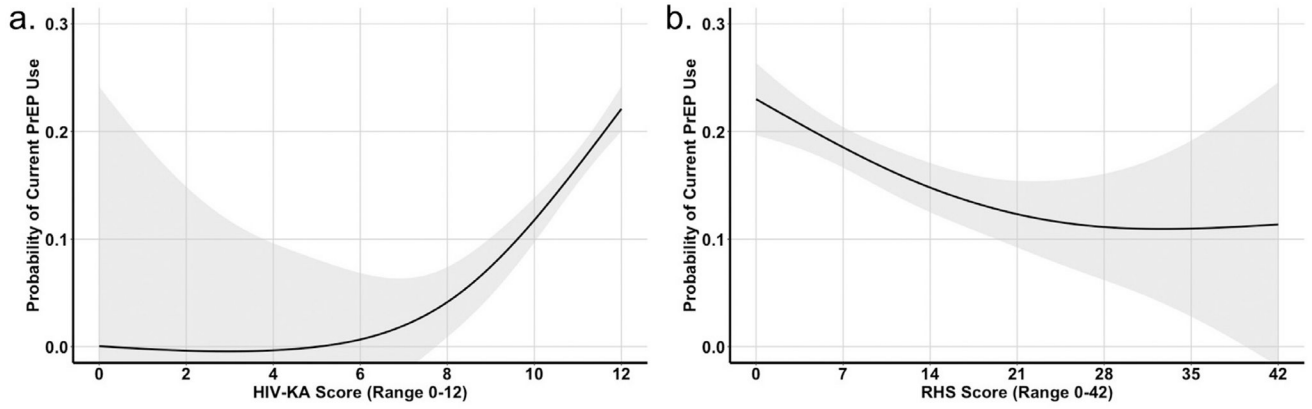


Fig. 2. Probability of current PrEP use according to (a) HIV/AIDS Knowledge Assessment (HIV-KA) score or (b) Reactions to Homosexuality Scale (RHS) score. The smoothed curve (black) with 95% confidence interval (gray region) represents the probability of current PrEP use as a function of HIV-KA score or RHS score. Increasing HIV-KA scores reflect increasing HIV knowledge, while increasing RHS scores reflect increasing internalized homonegativity. As with the logistic regression models, past PrEP users were excluded from these figures, for a sample size of (a) $n = 2288$ and (b) $n = 1897$.

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Table 1: PrEP use among a cross-sectional sample of 2398 PrEP-eligible Brazilian MSM in 2020.

Variable	n (%)
Are you taking or have you taken PrEP? ^a	
Current PrEP use	370 (15.4)
Past PrEP use	110 (4.6)
Never PrEP use	1918 (80.0)
Percent adherence in past 30 days ^b	
Mean (SD)	94.1 (17.4)
Days of adherence in past week ^b	
Everyday	328 (88.7)
Four to Six Days	30 (8.1)
Three or Fewer Days	12 (3.2)
Main reason for nevertaking PrEP, n = 1918	
I do not know where to obtain PrEP	593 (30.9)
I am satisfied with the prevention methods I use	344 (17.9)
I worry about the side effects of PrEP	271 (14.1)
I have not heard of PrEP ^c	182 (9.5)
Because PrEP does not protect against other STIs	117 (6.1)
I have doubts if PrEP works	92 (4.8)
I am afraid of being discriminated against	52 (2.7)
I have no risk of getting HIV	47 (2.5)
Because I use other substances (medications, hormones, alcohol, drugs, etc.)	44 (2.3)
Difficult to access ^{d,e}	40 (2.1)
Unavailable in my city ^d	24 (1.3)
Provider didn't recommend / prescribe ^d	19 (1.0)
In the process or intend to start ^{d,e}	17 (0.9)
Do not care enough or do not want to start PrEP ^d	14 (0.7)
I am afraid of developing HIV resistance	13 (0.7)

Variable	n (%)
Do not qualify for PrEP / infrequent sex ^d	11 (0.6)
I do not trust the pharmaceutical industry	10 (0.5)
Other ^f	28 (1.4)
Main reason for having stopped taking PrEP, n = 110	
It was very difficult to access the health service	28 (25.5)
I worry about the possible side effects of PrEP	24 (21.8)
I believed that my risk of contracting HIV had decreased	12 (10.9)
I was no longer in the mood to use PrEP	11 (10.0)
I did not take PrEP correctly	6 (5.5)
Completed finite course of PrEP / research study ended ^d	6 (5.5)
I felt discriminated against	3 (2.7)
I have doubts if PrEP works	3 (2.7)
I'm afraid PrEP won't work because I use hormones, alcohol, or drugs	3 (2.7)
New city, don't know where to access ^d	2 (1.8)
Infrequent sex ^d	2 (1.8)
Provider decision ^d	2 (1.8)
Stopped following up ^d	2 (1.8)
I had no support from my partner	1 (0.9)
Other	5 (4.6)

^aResponse options included "yes, I am currently taking PrEP;" "yes, I took PrEP but I stopped," or "no, I never took PrEP."

^bCurrent PrEP users (n = 370) were asked to indicate their percentage daily adherence over the previous 30 days using a slide bar to indicate percentage from 0% to 100%, and over the past week, using number of days PrEP was taken.

^cThe 182 who responded that they had not heard of PrEP were grouped with never PrEP users but were not presented with the question about why they had never taken PrEP

^dResponse categories created based on post hoc categorization of free responses to the "Other" option

^eA total of 12 respondents specifically mentioned long wait times to access PrEP, and 5 used the word "bureaucracy" when describing the difficulty in accessing PrEP.

^fOther includes needing more information (n = 5), having a steady partner (n = 5), shame or fear that others will find out (n = 5), fear of HIV testing (n = 4), difficulty adhering to the treatment and follow up (n = 3), and other (n = 6).

Abbreviations: pre-exposure prophylaxis (PrEP), standard deviation (SD), sexually transmitted infection (STI), human immunodeficiency virus (HIV)

Table 2: Demographic and sexual health characteristics of a cross-sectional sample of PrEP-eligible Brazilian MSM in 2020.

Variable	Total N = 2398	Current PrEP Use n = 370 (15.4%)	Past PrEP Use n = 110 (4.6%)	Never PrEP Use n = 1918 (80.0%)	p value ^a
Age (years)					
Mean (SD)	33.6 (9.7)	35.3 (9.1)	33.1 (8.5)	33.3 (9.9)	<0.001
18–24	409 (17.0)	33 (8.9)	16 (14.6)	360 (18.8)	<0.001
25–29	544 (22.7)	81 (21.9)	23 (20.9)	440 (22.9)	
30–39	875 (36.5)	149 (40.3)	48 (43.6)	678 (35.4)	
40+	570 (23.8)	107 (28.9)	23 (20.9)	440 (22.9)	
Race, n (%)^b					
White or Asian	1449 (60.4)	243 (65.7)	69 (62.7)	1137 (59.3)	0.026
Pardo or Native	662 (27.6)	93 (25.1)	29 (26.4)	540 (28.2)	
Black	229 (9.6)	23 (6.2)	8 (7.3)	198 (10.3)	
Unanswered	58 (2.4)	11 (3.0)	4 (3.6)	43 (2.2)	
Sexual orientation, n (%)					
Gay or homosexual	2069 (86.3)	335 (90.5)	100 (90.9)	1634 (85.2)	0.007
Other ^c	329 (13.7)	35 (9.5)	10 (9.1)	284 (14.8)	
Education level, n (%)^d					
University or higher	1574 (65.6)	270 (73.0)	81 (73.6)	1223 (63.8)	<0.001
Secondary or less	781 (32.6)	90 (24.3)	28 (25.5)	663 (34.6)	
Unanswered	43 (1.8)	10 (2.7)	1 (0.9)	32 (1.6)	
Income level, n (%)^e					
High	614 (25.6)	115 (31.1)	35 (31.8)	464 (24.2)	0.019
Middle	1093 (45.6)	159 (43.0)	48 (43.6)	886 (46.2)	
Low	691 (28.8)	96 (25.9)	27 (24.6)	568 (29.6)	
Brazilian region, n (%)^f					
Southeast	1914 (79.8)	303 (81.9)	89 (80.9)	1522 (79.4)	0.266
Other	484 (20.2)	67 (18.1)	21 (19.1)	396 (20.6)	
Live in state's capital metropolitan area, n (%)					
					<0.001

Variable	Total N = 2398	Current PrEP Use n = 370 (15.4%)	Past PrEP Use n = 110 (4.6%)	Never PrEP Use n = 1918 (80.0%)	p value ^a
Yes	1675 (69.8)	304 (82.2)	80 (72.7)	1291 (67.3)	
No	723 (30.2)	66 (17.8)	30 (27.3)	627 (32.7)	<0.001
Timing of last HIV test, n (%)					
< 6 months	1415 (59.0)	355 (95.9)	84 (76.4)	976 (50.9)	
6 months	729 (30.4)	5 (1.4)	23 (20.9)	701 (36.5)	
Never tested	212 (8.8)	4 (1.1)	3 (2.7)	205 (10.7)	
Unanswered	42 (1.8)	6 (1.6)	0 (0.0)	36 (1.9)	
Number male sex partners, n (%)^g					
1 to 5	1077 (44.9)	85 (23.0)	45 (40.9)	947 (49.4)	
6 to 10	544 (22.7)	80 (21.6)	17 (15.4)	447 (23.3)	
11 to 30	499 (20.8)	117 (31.6)	28 (25.5)	354 (18.5)	
31+	278 (11.6)	88 (23.8)	20 (18.2)	170 (8.9)	
Male sexual partner living with HIV, n (%)^g					
Yes	501 (20.9)	155 (41.9)	29 (26.4)	317 (16.5)	
No	1897 (79.1)	215 (58.1)	81 (73.6)	1601 (83.5)	0.464
Condomless anal intercourse, n (%)^g					
Yes	1852 (77.2)	294 (79.5)	67 (60.9)	1491 (77.7)	
No	546 (22.8)	76 (20.5)	43 (39.1)	427 (22.3)	
STI diagnosis, n (%)^{g,h}					
Yes	580 (24.2)	128 (34.6)	35 (31.8)	417 (21.7)	
No or unanswered	1818 (75.8)	242 (65.4)	75 (68.2)	1501 (78.3)	0.130
Transactional sex, n (%)^{g,i}					
Yes	275 (11.5)	33 (8.9)	19 (17.3)	223 (11.6)	
No	2123 (88.5)	337 (91.1)	91 (82.7)	1695 (88.4)	<0.001
Chemsex, n (%)^{g,j}					
Yes	710 (29.6)	156 (42.2)	43 (39.1)	511 (26.6)	
No	1688 (70.4)	214 (57.8)	67 (60.9)	1407 (73.4)	0.143
Binge drinking sex, n (%)^k					
Yes	848 (35.4)	142 (38.4)	46 (41.8)	660 (34.4)	

Variable	Total N = 2398	Current PrEP Use n = 370 (15.4%)	Past PrEP Use n = 110 (4.6%)	Never PrEP Use n = 1918 (80.0%)	p value ^a
No	1550 (64.6)	228 (61.6)	64 (58.2)	1258 (65.6)	<0.001
GSN apps to seek sex. n (%)^f					
Never or rarely	294 (12.3)	30 (8.1)	15 (13.6)	249 (13.0)	
Sometimes or only on weekends	955 (39.8)	116 (31.4)	37 (33.6)	802 (41.8)	
Daily	1149 (47.9)	224 (60.5)	58 (52.7)	867 (45.2)	

^aStatistical tests of association were performed between current PrEP users (n = 370) and never PrEP users (n = 1918) using Pearson's chi-squared test and student's t-test for categorical and continuous variables, respectively.

^bResponses for race included White, Black, *Pardo* (mixed race), Native/Indigenous, Asian (Japanese, Chinese, Korean, among others), or prefer not to respond. For analysis, the 28 Asian respondents were grouped with White, among whom 8 were currently taking PrEP, and the 16 Native respondents were grouped with *Pardo*, among whom none were currently taking PrEP.

^c"Other" includes responses of heterosexual, bisexual, pansexual, asexual, and other

^dEducation levels of college and post-graduate were combined into "university or higher;" and secondary, primary, or less than primary were combined into "secondary or less."

^eFamily monthly income was asked in relation to the minimum monthly wage, which was BRL1039 in 2020, equivalent to \$190 USD. We grouped no salary, 1x, and 2x the minimum wage as "low income," 2-6x as "middle income," and >6x as "high income."

^fRespondents indicated in which Brazilian state they lived, which were then grouped by region. São Paulo (n = 1,244 respondents) and Rio de Janeiro (n = 538 respondents), both in the southeast region, were the two states with the greatest number of respondents.

^gIn the previous six months

^hSyphilis, urethral or rectal gonorrhea, urethral or rectal chlamydia

ⁱ"In the last six months, have you had sex for money or some other good (gifts, housing, etc.)?"

^jUse of any of the following substances before or during sex: cocaine; crack, basic paste, or oxy; marijuana, hashish, or skank; ecstasy or MD; methamphetamines (crystal or speed); GHB or GBL; poppers; other inhalants; mephedrone; hallucinogens (LSD, mushroom tea, others); or others

^k"Have you at some time consumed six or more alcoholic drinks before or during sex?"

^lRespondents were asked how frequently they used "virtual channels (e.g. Grindr, Hornet or others) to procure sex." Options included "never," "rarely," "sometimes," "only on weekends," or "daily."

Abbreviations: pre-exposure prophylaxis (PrEP), standard deviation (SD), human immunodeficiency virus (HIV), sexually transmitted infection (STI)

Table 3: HIV/AIDS Knowledge Assessment (HIV-KA) and Reactions to Homosexuality Scale (RHS) Scores by PrEP Use.

Scale questions	Current PrEP Use n = 370	Past PrEP Use n = 110	Never PrEP Use n = 1918	p value ^a
HIV/AIDS Knowledge Assessment (HIV-KA)^b				
Overall Score, mean (SD)	11.3 (0.9)	10.8 (1.7)	10.6 (1.6)	<0.001
1. There are medications for HIV-negative people to take to prevent HIV; True, n (%)	332 (89.7)	81 (73.6)	1472 (76.7)	<0.001
2. An HIV-infected person who is taking AIDS medication has a lower risk of transmitting the virus; True, n (%)	346 (93.5)	91 (82.7)	1407 (73.4)	<0.001
3. An HIV-infected pregnant woman receiving AIDS medication prenatally and at childbirth will have a lower chance of transmitting the virus to the baby; True, n (%)	324 (87.6)	92 (83.6)	1476 (77.0)	<0.001
4. There are medicines for HIV/AIDS to be used after a situation of risk of infection; True, n (%)	363 (98.1)	106 (96.4)	1758 (91.7)	<0.001
5. People can be infected with HIV if they share cutlery, cups, or meals; False, n (%)	365 (98.6)	103 (93.6)	1819 (94.8)	0.001
6. People can be infected with HIV if they use public toilets; False, n (%)	365 (98.6)	105 (95.5)	1770 (92.3)	<0.001
7. People can be infected with HIV if they are bitten by mosquitoes; False, n (%)	358 (96.8)	99 (90.0)	1729 (90.1)	<0.001
8. When having intercourse with only one faithful partner, not infected with HIV, the risk of contracting the virus is lower; True, n (%)	299 (80.8)	87 (79.1)	1604 (83.6)	0.185
9. There is a cure for HIV (virus of AIDS); False, n (%)	347 (93.8)	98 (89.1)	1746 (91.0)	0.083
10. A healthy-looking person may be infected with HIV; True, n (%)	366 (98.9)	107 (97.3)	1878 (97.9)	0.198
11. People can contract HIV (virus of AIDS) if they share with other people instruments for the use of drugs such as syringes, needles, etc.; True, n (%)	355 (95.9)	109 (99.1)	1853 (96.6)	0.524
12. People can contract HIV if they do not use condoms in sexual intercourse; True, n (%)	367 (99.2)	107 (97.3)	1891 (98.6)	0.355
Perceived accuracy of Undetectable = Untransmittable (U=U)				
Totally accurate, n (%)	291 (78.6)	72 (65.5)	953 (49.7)	<0.001
Somewhat accurate, n (%)	46 (12.4)	17 (15.5)	383 (20.0)	
Somewhat inaccurate, n (%)	11 (3.0)	6 (5.5)	147 (7.7)	
Totally inaccurate, n (%)	15 (4.1)	11 (10.0)	308 (16.1)	
Unsure what undetectable means, n (%)	7 (1.9)	4 (3.6)	127 (6.6)	
Reactions to Homosexuality Scale (RHS)^{c,d}				
Overall score, mean (SD)	8.5 (7.1)	9.8 (7.3)	10.3 (7.5)	<0.001
1. I feel comfortable in gay bars	1.2 (1.3)	1.5 (1.5)	1.5 (1.5)	<0.001
2. Social situations with gay men make me feel uncomfortable	1.4 (1.7)	1.6 (1.6)	1.7 (1.7)	0.005
3. I feel comfortable being seen in public with an obviously gay person	1.5 (1.7)	1.8 (1.9)	1.8 (1.8)	0.006
4. I feel comfortable discussing homosexuality in public	1.4 (1.6)	1.5 (1.6)	1.6 (1.6)	0.072

Scale questions	Current PrEP Use n = 370	Past PrEP Use n = 110	Never PrEP Use n = 1918	p value ^a
5. I feel comfortable being homosexual	1.1 (1.4)	1.1 (1.4)	1.4 (1.6)	<0.001
6. Homosexuality is as natural as heterosexuality	0.8 (1.5)	0.7 (1.3)	0.9 (1.6)	0.078
7. Even if it were possible, I would not change my sexual orientation	1.1 (1.7)	1.5 (2.1)	1.4 (1.8)	0.011

^aStatistical tests of association were performed between current PrEP users (n = 370) and never PrEP users (n = 1918) using Pearson’s chi-squared test and student’s t-test for categorical and continuous variables, respectively.

^bHIV/AIDS Knowledge Assessment contains 12 true/false statements, with a total score range of 0 to 12. Correct responses are scored as 1 and incorrect or “I don’t know” responses are scored as 0. Higher scores indicate higher levels of knowledge. The n (%) for individual items presented above corresponds to the number who correctly responded true or false, with the correct response listed next to each statement. The correct response to items 1–4, 8, and 10–12 is true. The correct response to items 5–7 and 9 is false.

^cReactions to Homosexuality Scale (RHS) contains seven Likert-scale questions, scored 0 to 6, with a total score range of 0 to 42. For statements 1 and 3–7, a score of 0 corresponds to Strongly Agree and a score of 6 corresponds to Strongly Disagree. For statement 2, a score of 0 corresponds to Strongly Disagree and a score of 6 to Strongly Agree. Higher scores indicate higher levels of internalized homonegativity.

^dOnly the 1990 respondents who selected gay or homosexual as their sexual orientation were presented the RHS statements. Of note, this excludes 79 respondents who listed gay or homosexual as a free-text response to the sexual orientation question. Among the 1990 presented with RHS items, 330 (16.6%) were current PrEP users, 93 (4.7%) were past PrEP users, and 1,567 (78.7%) were never PrEP users.

Abbreviations: pre-exposure prophylaxis (PrEP), standard deviation (SD), human immunodeficiency virus (HIV), acquired immunodeficiency syndrome (AIDS).

Multivariable logistic regression models for standardized HIV/AIDS knowledge assessment (HIV-KA) and reactions to homosexuality scale (RHS) scores predicting current compared to never PrEP use among PrEP-eligible Brazilian MSM in 2020

Table 4:

Variable	Unadjusted Models <i>n</i> = 2288		Adjusted Model – HIV-KA <i>n</i> = 2288		Adjusted Model – RHS <i>n</i> = 1897 ^{c,d}	
	OR [95% CI]	p value ^a	aOR [95% CI]	p value ^a	aOR [95% CI]	p value ^a
HIV/AIDS Knowledge Assessment ^b	1.96 [1.66–2.32]	<0.001	1.70 [1.41–2.04]	<0.001	-	-
Reactions to Homosexuality Scale ^{b,c}	0.76 [0.67–0.87]	<0.001	-	-	0.83 [0.73–0.96]	0.010
Age		<0.001		0.005		0.008
18–24	0.38 [0.25–0.57]		0.43 [0.27–0.69]		0.43 [0.26–0.72]	
25–29	0.76 [0.55–1.04]		0.77 [0.54–1.11]		0.72 [0.49–1.06]	
30–39	0.90 [0.69–1.19]		0.78 [0.57–1.06]		0.86 [0.62–1.20]	
40+	Ref.		Ref.		Ref.	
Race		0.020		0.040		0.042
White or Asian	Ref.		Ref.		Ref.	
Pardo or Native	0.81 [0.62–1.05]		0.81 [0.60–1.09]		0.84 [0.61–1.15]	
Black	0.54 [0.35–0.86]		0.51 [0.31–0.85]		0.50 [0.29–0.85]	
Unanswered	1.20 [0.61–2.35]		0.72 [0.28–1.88]		0.57 [0.20–1.63]	
Sexual orientation		0.005		0.621		
Gay or homosexual	1.66 [1.15–2.41]		1.11 [0.74–1.65]		-	-
Other	Ref.		Ref.		-	-
Education level		<0.001		0.284		0.113
University or higher	Ref.		Ref.		Ref.	
Secondary or less	0.61 [0.48–0.79]		0.96 [0.70–1.32]		0.90 [0.64–1.27]	
Unanswered	1.42 [0.69–2.91]		2.30 [0.81–6.51]		3.08 [1.01–9.41]	
Income level		0.021		0.093		0.334
High	Ref.		Ref.		Ref.	
Middle	0.72 [0.56–0.94]		1.05 [0.78–1.42]		0.95 [0.70–1.31]	
Low	0.68 [0.51–0.92]		1.46 [1.00–2.13]		1.24 [0.83–1.85]	
Live in capital or metropolitan area	2.24 [1.69–2.97]	<0.001	2.01 [1.48–2.73]	<0.001	1.88 [1.35–2.60]	<0.001
Brazilian region		0.261		0.800		0.843

Variable	Unadjusted Models <i>n</i> = 2288		Adjusted Model – HIV-KA <i>n</i> = 2288		Adjusted Model – RHS <i>n</i> = 1897 ^{c,d}	
	OR [95% CI]	p value ^a	aOR [95% CI]	p value ^a	aOR [95% CI]	p value ^a
Southeast	Ref.		Ref.		Ref.	
Other	0.85 [0.64–1.13]		0.96 [0.70–1.32]		1.03 [0.74–1.44]	
Number male sexual partners^e		<0.001		<0.001		<0.001
1 to 5	Ref.		Ref.		Ref.	
6 to 10	1.99 [1.44–2.76]		1.74 [1.22–2.48]		1.88 [1.29–2.73]	
11 to 30	3.68 [2.71–4.99]		2.58 [1.83–3.65]		2.57 [1.78–3.70]	
31+	5.77 [4.11–8.10]		2.95 [1.96–4.43]		3.12 [2.03–4.80]	
Male sexual partner living with HIV^e	3.64 [2.87–4.62]	<0.001	3.18 [2.40–4.20]	<0.001	3.19 [2.38–4.27]	<0.001
Condomless anal intercourse^e	1.11 [0.84–1.46]	0.461	2.18 [1.57–3.03]	<0.001	2.01 [1.42–2.85]	<0.001
STI diagnosis^e	1.90 [1.50–2.42]	<0.001	1.69 [1.28–2.22]	<0.001	1.71 [1.28–2.29]	<0.001
Transactional sex^e	0.74 [0.51–1.09]	0.120	1.02 [0.65–1.59]	0.943	0.88 [0.54–1.45]	0.621
Chemsex^e	2.01 [1.60–2.53]	<0.001	1.39 [1.05–1.83]	0.021	1.40 [1.05–1.88]	0.024
Binge drinking sex	1.19 [0.94–1.49]	0.145	0.83 [0.64–1.09]	0.180	0.78 [0.59–1.04]	0.092
GSN apps to seek sex		<0.001		0.140		0.281
Never or rarely	Ref.		Ref.		Ref.	
Sometimes or only on weekends	1.20 [0.78–1.84]		0.91 [0.57–1.45]		0.99 [0.60–1.62]	
Daily	2.14 [1.43–3.22]		1.20 [0.76–1.91]		1.24 [0.76–2.04]	

^a Likelihood ratio test p-value

^b Higher HIV-KA and RHS scores correspond to higher levels of HIV/AIDS knowledge and internalized homonegativity, respectively.

^c Logistic regression models for standardized RHS scores have a sample of *n* = 1897, which includes 330 current PrEP users compared against 1,567 never PrEP users. This is due to the fact that only the respondents who selected gay or homosexual as their sexual identity, excluding those who did so via free-text response, were presented the RHS statements.

^d Additional adjusted model including both HIV-KA and RHS scores and all other co-variables found similar aORs for standardized HIV-KA (aOR 1.62 [95%CI 1.34–1.96], *p* < 0.001) and RHS (aOR 0.85 [95%CI 0.74–0.97], *p* = 0.019) scores. The only difference from the RHS adjusted model is that chemsex is no longer significant (aOR 1.33 [95%CI 0.99–1.78], *p* = 0.060).

^e In the previous six months