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HIV pre-exposure prophylaxis use with casual partners among men who have sex with men in Switzerland: testing an extended information-motivation-behavioral skills model

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ABSTRACT

Pre-exposure prophylaxis (PrEP) is an effective medical option for HIV prevention. This study aimed to examine PrEP uptake among men having sex with men (MSM) in Switzerland and to develop and test a theoretical model explaining PrEP use. We used an anonymous self-administered online questionnaire to collect data. In 2022, we recruited a convenience sample of 743 HIV-negative MSM who had had anal sex with casual partners 12 months prior to the survey. Approximately one-third of the participants used PrEP with casual partners. We used structural equation modeling to test a theoretical model of PrEP use based on an extended information-motivation-behavioral skills model (IMB model). The dependent variable measured how often MSM used PrEP with casual partners in the past year using a 7-point Likert scale. PrEP use was positively associated with intention to use PrEP ($\beta = 0.51$) and PrEP self-efficacy ($\beta = 0.10$). The intention to use condoms ($\beta = -0.26$) and the subjective HIV risk perception ($\beta = -0.14$) were negatively associated with PrEP use. The extended IMB model appeared suitable for explaining the frequency of PrEP use with casual partners ($\chi^2(44) = 103.11$, CFI = 0.98, RMSEA = 0.04, SRMR = 0.04, $R^2 = 0.49$). The theoretical model provides valuable insights for prevention to further promote PrEP use among eligible MSM.

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Good health and well-being; Reduced inequalities; Gender equality

Introduction

In 2022, 371 people were newly infected with HIV in Switzerland (FOPH, 2023). Most of these new infections occurred among key populations, of which men who have sex with men (MSM) are among the most significant (UNAIDS, 2023). As MSM in Switzerland have an HIV prevalence of 8.0% and their number is estimated to be around 80,000 (Schmidt & Altpeter, 2019), they are a highly relevant group for HIV prevention efforts.

To achieve the global goal of ending AIDS by 2030 (UNAIDS, 2023), specific knowledge of the factors influencing HIV protection among MSM and other key groups remains highly relevant. For decades, the focus has been on condom use and regular testing. For several years, treatment as prevention has also been recognized as an effective method for HIV prevention (Cohen et al., 2012). However, more than 10 years ago, several studies showed pre-exposure prophylaxis (PrEP) as an effective and safe HIV protection strategy (Baeten et al., 2012; Choopanya et al., 2013; Estcourt et al., 2021; Grant et al., 2010). PrEP is a medication that can be administered daily (McCormack et al., 2016) or on demand (Carneiro et al., 2021; Molina et al., 2015).

In 2014, the WHO recommended PrEP as an additional prevention option for MSM and later extended this recommendation to other groups at substantial risk (WHO, 2015). The introduction of PrEP in Switzerland was relatively late compared with that in other countries. Since 2016, PrEP has been prescribed off-label by medical doctors for people at a high risk of HIV infection. In 2019, PrEP became available through the Swiss PrEPared, which is a national program for PrEP in Switzerland

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that provides counseling and medical assessments (Hovaguimian et al., 2024). Generic PrEP has been available in Switzerland since 2021, and health insurance has covered PrEP since mid-2024, making it affordable (FOPH, 2023). Studies have shown that this is key to increasing uptake (Ramanaik et al., 2023; van Dijk et al., 2021).

A recent meta-analysis by Huang et al. (2023) concludes that approximately 11.2% of all MSM and 16.4% of eligible MSM worldwide use PrEP, with even higher numbers in countries where PrEP has been approved; another meta-analysis highlights that awareness of PrEP and the willingness to use it has increased in recent years (Sun et al., 2022).

However, little is known about PrEP uptake in Switzerland and the reasons why MSM decide whether to use PrEP. In 2015, 12.9% of MSM living in Switzerland said that they would be very likely to use PrEP if it became available, and another 26.4% said they would be likely or somewhat likely to do so (Niderost et al., 2018). In 2017, 4.3% of the respondents to an online survey reported using PrEP, 49.9% intended to use PrEP in the next 6 months, and more than three-quarters said they would use PrEP in the future (Hampel et al., 2017). Results from the Swiss data collected during the European MSM Internet Survey 2017 (EMIS) showed that 30.5% of HIV-negative MSM were likely or very likely to use PrEP if available and affordable. Of the HIV-negative MSM, 4.5% reported using or having used PrEP (Weber et al., 2019). The Federal Office of Public Health estimated that at least 4'500 people used PrEP in 2018, with the majority of users being MSM (FOPH, 2023). Therefore, estimates of PrEP uptake vary widely but show that a considerable proportion of MSM appears to be interested in PrEP as a prevention option. To improve PrEP uptake in Switzerland, it is crucial to identify factors that explain PrEP use among MSM and monitor PrEP uptake among key populations such as MSM. This study focused on MSM, who had anal sex with casual partners in the 12 months prior to the survey, because of their increased risk of HIV infection and their key role in reducing the number of HIV infections in Switzerland.

Aim of the study

The study examined the following two research questions: (1) How many HIV-negative MSM in Switzerland, who have had anal sex with casual partners in the 12 months prior to the survey, are using PrEP daily or on demand? (2) What factors are relevant in explaining PrEP use with casual partners among MSM in Switzerland? Regarding the second question, our aim was to develop and test a theoretical model explaining PrEP use among MSM in Switzerland to gain further insights into HIV prevention.

Modeling PrEP use with casual partners among MSM

The explanatory model for PrEP use with casual partners among MSM is based on the information-motivation-behavioral skills model (IMB model) developed by Fisher and Fisher (1992). According to the IMB model, (1) information on HIV, (2) motivation to protect against an HIV infection, and (3) the behavioral skills to use condoms are relevant in explaining condom use among a specific group. We adapted the model to PrEP use using specific PrEP-related questions from a previous survey on PrEP acceptability among MSM in Switzerland (Niderost et al., 2018).

In the second step, we extended the original IMB model with variables focusing on personal, social, and economic resources, as well as partnership and situational variables, as suggested by Niderost et al. (2011) and Nöstlinger et al. (2010). Based on the literature review, we identified additional factors that could explain PrEP use with casual partners among MSM. This review included articles published between 2014 and 2019. In the literature, we identified several factors with a potential influence on PrEP use. For our study, the important factors were the level of disclosure of sexual orientation (Weber et al., 2019), past experiences of physical and sexual violence (Ayala et al., 2013; Braksmajer et al., 2020), experiences of discrimination (Underhill et al., 2015), and the frequency of illicit drug use (Closson et al., 2018; Frankis et al., 2016). These variables were included in the original model under the term "critical life events". This process resulted in a theoretical model to explain PrEP use with casual partners among MSM (Figure 1).

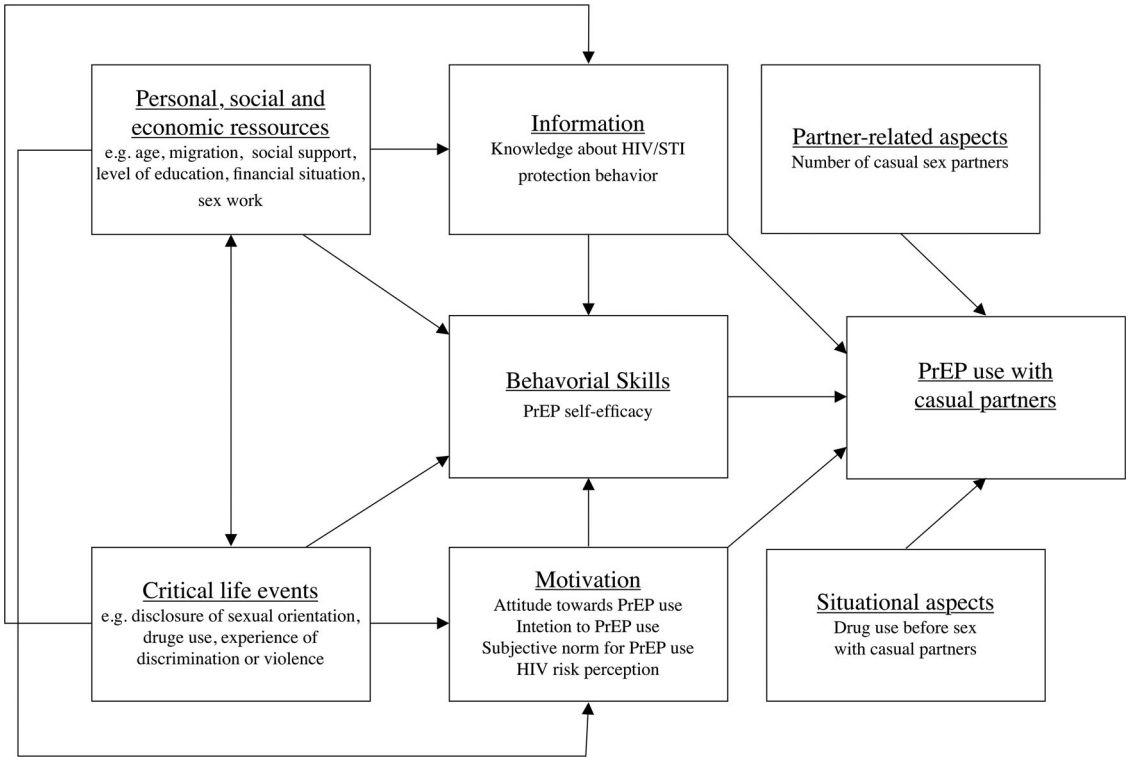

Figure 1. Extended information-motivation-behavioral skills model to explain PrEP use.

Materials and methods

Design and procedure

The "MSM dataset" analyzed for this article is a subset of a large cross-sectional survey on HIV/STI protective behavior among key populations in Switzerland. In our study, the key populations were MSM, transgender people, sex workers, and migrants from countries with a high HIV prevalence. We collected data using an anonymous, standardized, self-administered questionnaire created using software for online surveys (EFS Survey).

The questionnaire was developed in collaboration with stakeholders working in the field of HIV prevention. We pre-tested the questionnaire with 11 respondents of whom 5 were MSM. Moreover, several experts provided feedback on the initial version of the questionnaire. Afterwards, we adjusted the wording of some questions and tested the questionnaire in a second pretest with 35 respondents. After a few minor adjustments, the questionnaire was finalized and translated from German into 10 other languages (French, Italian, English, Spanish, Russian, Portuguese, Hungarian, Tigrinya, Thai, and Romanian) selected in consultation with experts in the field of HIV prevention. A second expert checked each translation to ensure adequacy.

The questionnaire was made available on the study website. Informed consent was obtained, and participation was voluntary. In accordance with the Federal Act on Research Involving Human Beings (The Federal Assembly of the Swiss Confederation, 2023), ethical approval was not required for this study. To recruit MSM, several influencers and MSM organizations promoted the survey on social media. In addition, two online advertisements were placed on the dating platform Grindr. We distributed flyers and put up posters at various parties and gay prides. Three LGBTQ magazines published articles both online and in print. To recruit MSM engaged in sex work, a team member conducted on-site visits to saunas where male sex workers were offering their sexual services and personally asked the sex workers to participate in the survey. Sex workers were also given the opportunity to complete the questionnaire with tablets provided at local drop-in centers. In case of language or other difficulties, social workers at the centers used tablets to complete the questionnaire together with sex workers in a computer-assisted personal interview format. Sex workers were reimbursed with vouchers of 40 Swiss Francs when they completed the entire questionnaire.

It took approximately 30 min to complete the survey. We gathered the convenience sample from March 2022 to November 2022. In total, 2,571 participants answered the survey, of whom 743 were HIV-negative MSM who had had anal sex with casual partners during the 12 months prior to the survey and were living in Switzerland at the time of the survey.

Measures

We measured the dependent variable with the following question: "How often were you protected by PrEP during vaginal or anal sex with casual partners in the past 12 months?" Responses were measured using a 7-point Likert scale ranging from 0 (= "never") to 6 (= "continuously"). Table 1 presents all other measures of the model variables.

Data analysis

We imported the data from the EFS survey into IBM SPSS 28.0. First, we excluded all observations in which the respondents did not complete the entire questionnaire or answered the questions in less than eight minutes. Due to the length of the questionnaire, it was not possible to complete the questionnaire in less than eight minutes. Therefore, we assumed that respondents simply clicked on the survey without reading the questions. Next, descriptive and bivariate analyses were performed. As structural equation modeling requires a complete dataset, we conducted multiple imputations by fully conditional specification (FCS) with five iterations in SPSS. Table 2 shows the missing values for the model variables. We imported the pooled dataset into AMOS 28.0 and performed structural equation modeling using maximum likelihood estimates. The dependent variable was treated as continuous for all analyses, as justified by the literature (Rhemtulla et al., 2012). Variables without a significant effect ($\alpha > 0.05$) or with standardized coefficients smaller than 0.1 were stepwise removed from the model. We could not use the number of casual partners in our tested model because the sex workers' responses to this question were not reliable. We assumed that sex workers confused the number of casual partners in the previous year with the number of clients for transactional sex. Stakeholders with specific knowledge of sex work also raised this concern. Furthermore, we excluded drug use during sex from the model because it was highly correlated with regular use of illicit drugs. Since PrEP is not taken during sex, the general drug use was theoretically more applicable to our model. General health status, suicidal ideation, sexual and physical violence, discrimination, foreign passports, education, financial situation, HIV/STI knowledge, and attitudes toward PrEP were excluded from the final model because of insignificant effects or effects smaller than 0.1.

Results

Sample description

The median age of the respondents was 36.0 years (IQR = 18.8) ranging from 16 to 77 years. Almost three-quarters (72.5%, n = 539) of the MSM who have sex with causal partners reported having Swiss citizenship at the time of the survey. Table 3 shows further socio-demographic characteristics of the sample.

PrEP use among MSM who have anal sex with casual partners

Over one-third of the MSM who have sex with causal partners (36.2%, n = 269) said that they were using PrEP at the time of the survey. A further 46 (6.3%) respondents answered that they had used PrEP in the past but were not currently using it. Among PrEP users, 60.2% (n = 162) reported using PrEP daily, with the remaining 107 respondents reporting using PrEP on demand, such as on holidays, weekends, or at sex parties. A total of 269 PrEP users were asked if they intended to continue using PrEP in the future. The median was 10.0 and the mean 9.4 (SD = 1.4), showing that the PrEP users had a very high intention to continue using PrEP. Non-PrEP users were also asked whether they intended to begin using PrEP in the future. The median was 5.0 and the mean 4.7 (SD = 3.4), indicating that there is still some potential for the number of MSM PrEP users in Switzerland to increase further.

Table 1. Measures of the model variables (N = 743).

Variable	Number of items	Response Scale	Range of calculated scores	Source
PrEP Use	1	7-point Likert scale ranging from 0 = "never" to 6 = "continually"	0–6	
Self-efficacy of PrEP use e.g "How difficult is it for you to integrate the correct use of PrEP into your everyday life?"	7	Semantic differential from 0 = "not difficult at all" to 10 = "very difficult"	0–10	Nideröst et al. (2018)
Information about HIV/STI protection e.g., "HIV positive people whose medication is effective cannot pass on HIV."	8	True; False; Don't know	0–8	Carey and Schroder (2002); Nideröst et al. (2011); Shen et al. (2019)
Intention to use PrEP "How likely is it that you will continue to take PrEP?"; "How likely is it that you will take PrEP in the future?"	2	Semantic differential from 0 = "very unlikely" to 10 = "very likely"	0–10	
Intention to use condoms "How likely are you to use a condom the next time you have vaginal or anal sex with a casual partner?"		Semantic differential from 0 = "very unlikely" to 10 = "very likely"		Nöstlinger et al. (2010)
Attitudes toward condoms e.g., "Condoms prevent the feeling of being close to my casual partner."	12	Semantic differential from 0 = "not at all applicable" to 10 = "fully applicable"	0–10	Nideröst et al. (2011); Nöstlinger et al. (2010)
Attitudes toward PrEP e.g., "If I take PrEP I can live out my sexuality in a less complicated way."	10	Semantic differential from 0 = "not at all applicable" to 10 = "fully applicable"	0–10	Nideröst et al. (2018)
HIV risk perception "To what extent do you feel you might become infected with HIV in the future?"	1	Semantic differential from 0 = "very unlikely" to 10 = "very likely"	0–10	Gredig et al. (2007)
Social norm PrEP e.g., "People who influence my behavior would advise me to take PrEP."	2	Semantic differential from 0 = "not at all applicable" to 10 = "fully applicable"	0–10	Nideröst et al. (2018)
Social norm condoms e.g., "People whose opinions I value would advise me to use condoms."	2	Semantic differential from 0 = "not at all applicable" to 10 = "fully applicable"	0–10	Nideröst et al. (2018)
STI diagnosed "Have you been diagnosed with any sexually transmitted disease other than HIV in the past 12 months? (e.g., syphilis, chlamydia, gonorrhea, hepatitis, HPV)?"	1	0: No 1: Yes	0; 1	EMIS-2017
Psychosocial well-being e.g., "How often have you felt so depressed or upset over the past four weeks that nothing has been able to cheer you up?"	5	0: Never 1: Rarely 2: Sometimes 3: Usually 4: Always	0–4	Bullinger et al. (1995)
Self-esteem e.g., "I feel that I have a number of good qualities."	10	Semantic differential from 0 = "not at all applicable" to 10 = "fully applicable"	0–10	von Collani and Herzberg (2003)
Social support e.g., "There are people I can depend on to help me if I really need it."	8	Semantic differential from 0 = "not at all applicable" to 10 = "fully applicable"		Cutrona and Russell (1983)
Age in years	1		15–77	
Sex work	1	0: No 1: Yes	0; 1	
Disclosure of sexual orientation	1	0: No 1: Yes	0; 1	
Frequency of illicit drug use	1	0: Never in the past 12 months 1: 1–2 times a year 2: 3–6 times a year 3: 7–11 times a year 4: 1–3 times a month 5: 1–2 times a week 6: 3–4 times a week 7: 5–6 times a week 8: Once a day 9: Twice or more times a day	0–9	
General Health status	1	0 = Very bad 1 = Bad 2 = Moderate 3 = Good 4 = Very good	0–4	

(*Continued*)

Table 1. Continued.

Variable	Number of items	Response Scale	Range of calculated scores	Source
Suicidal ideation	1	0: No 1: Yes	0; 1	
Migrant from HIV high prevalence country	1	0: No 1: Yes	0; 1	
Level of education	1	0: no qualification / compulsory education 1: Upper-secondary level 2: Tertiary level B 3: Tertiary level A	0–3	
Financial situation "How do you manage financially with this total income until the end of the month? (In other words, how well are you able to pay the necessary monthly expenses?)"	1	Semantic differential from 0 = "very poorly" to 10 = "very well"	0–10	

Table 2. Missing data by model variables (N = 743).

Variable	Missing values (n)	Missing values (%)	Valid values (n)
STI diagnosed	0	0.0	743
Age	11	1.5	732
Social support	0	0.0	743
Psychological wellbeing	1	0.1	742
Self-esteem	1	0.1	742
Sex work	0	0.0	743
Frequency drug use	1	0.1	742
Disclosure of sexual orientation	1	0.1	742
Intention to use condoms	0	0.0	743
Intention to use PrEP	0	0.0	743
Attitudes towards condoms	0	0.0	743
HIV risk perception	1	0.1	742
PrEP self-efficacy	2	0.3	741
PrEP use	0	0.0	743

Table 3. Socio-demographic characteristics of participants (N = 743).

Variable	Descriptor	n	%	N
Educational level				743
	No/compulsory education	50	6.7	
	Secondary education	233	31.4	
	Tertiary education B	141	19.0	
	Tertiary education A	319	42.9	
Sex work				743
	Yes	82	11.0	
	No	661	89.0	
Relationship status				743
	Single	356	47.9	
	In Relationship(s)	387	52.1	
Country of birth				743
	Switzerland	494	66.5	
	HIV high prevalence country	41	5.5	
	Other Country	208	28.0	
STI (without HIV) in last 12 months				743
	Yes	188	25.3	
	No	555	74.7	

Test of the IMB model

Four variables had a significant impact on the frequency of PrEP use when having sex with casual partners. Self-efficacy toward PrEP ($\beta = 0.10$, $p < 0.01$) and the intention to use PrEP ($\beta = 0.51$, $p < 0.01$) had a positive effect on PrEP use, as assumed in the theoretical model. Intention to use condoms ($\beta = -0.26$, $p < 0.01$) and the subjective HIV risk perception ($\beta = -0.14$, $p < 0.01$) both had a negative effect on the frequency of PrEP

use with casual partners in the last 12 months. This indicates that MSM with higher self-efficacy regarding PrEP and a higher intention to use PrEP were more likely to be protected against HIV by using PrEP when having sex with casual partners. In contrast, a low intention to use condoms and a low subjective perception of HIV risk were associated with a higher likelihood of using PrEP. Intention to use PrEP was the strongest predictor of PrEP use with casual partners.

There are several factors associated with self-efficacy regarding PrEP. The variables age ($\beta = 0.14$, $p < 0.01$), intention to use PrEP ($\beta = 0.22$, $p < 0.01$), social support ($\beta = 0.24$, $p < 0.01$), attitudes toward condoms ($\beta = 0.12$, $p < 0.01$) and disclosure of sexual orientation ($\beta = 0.15$, $p < 0.01$) had a positive effect on PrEP self-efficacy. This suggests that older MSM, MSM with a higher intention to use PrEP and higher social support, MSM with positive attitudes toward condoms, and MSM whose family and friends know about their sexual orientation report higher self-efficacy regarding PrEP use. Some variables were also associated with lower PrEP self-efficacy. The intention to use condoms ($\beta = -0.14$, $p < 0.01$), the HIV risk perception ($\beta = -0.11$, $p < 0.01$) and the social norm regarding PrEP ($\beta = -0.13$, $p < 0.01$) had a negative effect in the model. Thus, a higher intention to use condoms, a higher perceived risk of HIV infection, and a more positive social norm regarding PrEP use were associated with lower PrEP self-efficacy. Interestingly, social support is the strongest predictor of self-efficacy.

The analysis revealed that two variables predicted the intention to use condoms. MSM who had been diagnosed with STI 12 months prior to the survey had a lower intention to use condoms ($\beta = -0.15$, $p < 0.01$). Furthermore, a higher frequency of illicit drug use was also associated with a lower intention to use condoms ($\beta = -0.15$, $p < 0.01$). Both predictors were equally strong in this model.

The intention to use PrEP with casual partners was predicted by the following variables: STI diagnosed ($\beta = 0.20$, $p < 0.01$) and sex work ($\beta = 0.12$, $p < 0.01$). MSM who were diagnosed with an STI in the last 12 months prior to the survey and those who engaged in sex work reported higher intentions to use PrEP. The effect of the variable STI diagnosed was slightly stronger than that of sex work.

Attitudes toward condoms were predicted by social support ($\beta = 0.15$, $p < 0.01$) and the frequency of illicit drug use ($\beta = -0.10$, $p < 0.01$). Better social support led to a more positive attitude towards condoms, whereas a higher frequency of illicit drug use was associated with a more negative attitude.

In the model, two variables predicted HIV risk perceptions among MSM. Higher social support ($\beta = -0.18$, $p < 0.01$) and better psychological well-being ($\beta = -0.18$, $p < 0.01$) were associated with a lower subjective risk of being infected with HIV in the future. Both predictors were equally strong in the tested model.

Finally, the social norm to use PrEP was explained by self-esteem ($\beta = -0.12$, $p < 0.01$), social support ($\beta = 0.11$, $p = 0.01$), and sex work ($\beta = 0.14$, $p < 0.01$). The model showed that better social support and being engaged in sex work were associated with more positive social norms for using PrEP. However, MSM with lower self-esteem ($\beta = -0.12$, $p < 0.01$) had a more negative social norm to use PrEP.

The tested model explained 49% of the variance in PrEP use with casual partners among MSM. Figure 2 shows the path diagram of the final model explaining PrEP use with casual partners among MSM in Switzerland, and several key indices indicating a good model fit. Table 4 lists all the standardized and unstandardized effects of the explanatory model.

Discussion

The results show that PrEP is widely accepted among eligible MSM who have sex with causal partners in Switzerland. Approximately one-third of the MSM respondents who had sex with casual partners in the year prior to the survey used PrEP. This is close to the number of potential PrEP users estimated when PrEP was not available, affordable, or approved in Switzerland (Hampel et al., 2017; Nideröst et al., 2018; Weber et al., 2019). MSM using PrEP with casual partners in Switzerland appear to feel confident about this HIV prevention method and intend to continue using PrEP in the future. The proportion of daily PrEP users was higher than that of the on-demand users. From an HIV prevention perspective, it is important to be aware that there are still MSM who have sex with causal partners in Switzerland who intend to use PrEP in the future but are not currently using it. To shed light on the possible reasons for this issue, structural equation modeling was used to identify the relevant factors influencing PrEP use with casual partners among MSM in Switzerland.

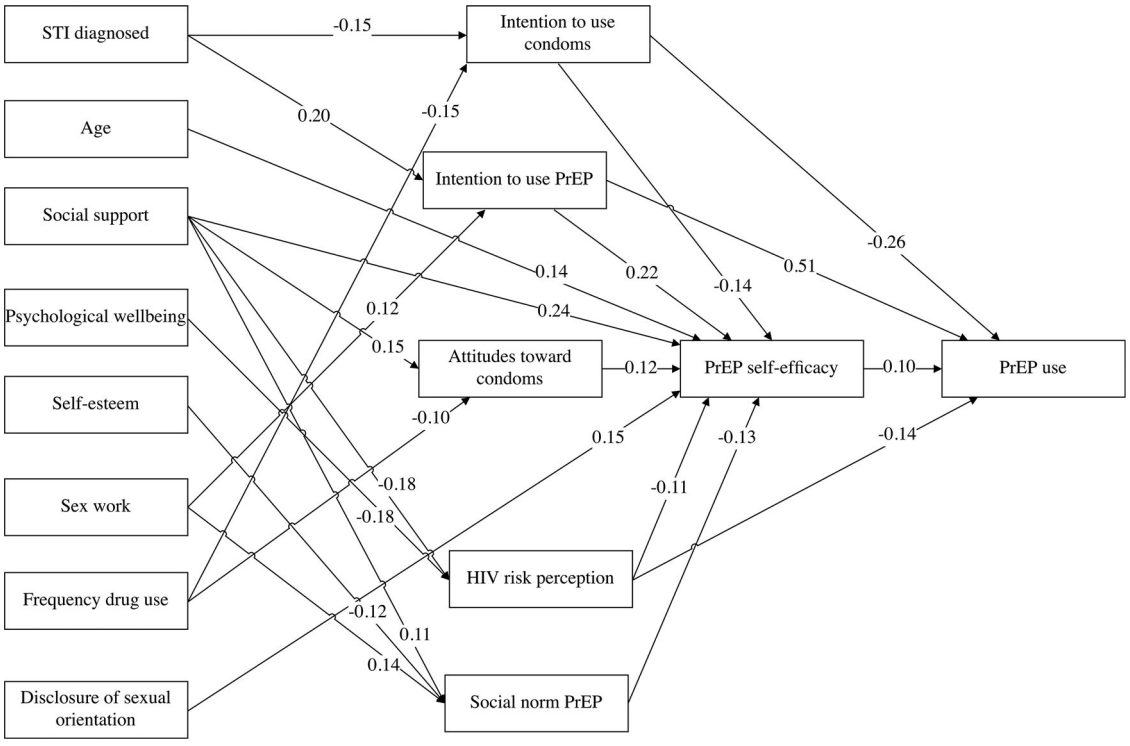

Figure 2. Tested model to explain PrEP use with casual partners among MSM (N = 743).

In the tested model, four factors had a direct impact on PrEP use with casual partners: self-efficacy, intention to use condoms, intention to use PrEP, and HIV risk perception. Self-efficacy had a positive impact on PrEP use as predicted by the IMB model. Several aspects of self-efficacy, such as the ability to bear the costs of PrEP, have been identified as important in other studies (Sudarto et al., 2022; Voglino et al., 2021). Another aspect of PrEP self-efficacy is the interaction with the PrEP provider, which has been shown to have a critical impact in a qualitative study (Devarajan et al., 2020). The intention to use condoms had a negative effect on PrEP use. This result is in accordance with multiple studies showing that PrEP is

Table 4. Unstandardized, Standardized, and Significance Levels for Model in Figure 2 (Standard Errors in Parentheses; N = 743).

Parameter estimate	Unstandardized	Standardized	*p*
PrEP self-efficacy → PrEP use	0.111 (0.03)	0.102	<0.001
Intention to use condoms → Prep use	−0.194 (0.02)	−0.263	0.005
Intention to use PrEP → Prep use	0.371 (0.02)	0.506	<0.001
HIV risk perception → Prep use	−0.164 (0.03)	−0.143	<0.001
Intention to use condoms → PrEP self-efficacy	−0.098 (0.03)	−0.144	<0.001
Age → PrEP self-efficacy	0.027 (0.01)	0.139	<0.001
Social support → PrEP self-efficacy	0.305 (0.04)	0.239	<0.001
Disclosure of sexual orientation → PrEP self-efficacy	0.845 (0.19)	0.151	<0.001
Intention to use PrEP → PrEP self-efficacy	0.148 (0.03)	0.219	<0.001
Attitudes toward condoms → PrEP self-efficacy	0.178 (0.06)	0.120	0.005
HIV risk perception → PrEP self-efficacy	−0.117 (0.04)	−0.111	<0.001
Social norm PrEP → PrEP self-efficacy	−0.094 (0.03)	−0.131	<0.001
Social support→ Attitudes toward condoms	0.132 (0.02)	0.154	<0.001
Frequency drug use → Attitudes toward condoms	−0.078 (0.03)	−0.098	0.005
Psychological wellbeing → HIV risk perception	−0.580 (0.12)	−0.184	<0.001
Social support → HIV risk perception	−0.214 (0.05)	−0.176	<0.001
Social support → Social norm PrEP	0.197 (0.07)	0.110	0.006
Self-esteem → Social norm PrEP	−0.208 (0.07)	−0.115	0.002
Sex work → Social norm PrEP	1.475 (0.41)	0.136	<0.001
STI diagnosed → Intention to use PrEP	1.620 (0.26)	0.196	<0.001
Frequency drug use → Intention to use PrEP	1.380 (0.39)	0.120	<0.001
STI diagnosed → Intention to use condoms	−1.213 (0.23)	−0.148	<0.001
Sex work → Intention to use condoms	−0.264 (0.06)	−0.152	<0.001

Note: $\chi^2(44) = 103.11$, $p = 0.00$, CFI = 0.98, TLI = 0.94, RMSEA = 0.04 (90% CI [0.03, 0.05]), SRMR = 0.04, $R^2 = 0.49$

more often used by MSM who are unable or unwilling to use condoms for various reasons (Annequin et al., 2020; Di Ciaccio et al., 2022; Sun et al., 2022). The positive effect of the intention to use PrEP on PrEP use with casual partners has also been shown in other studies, whereas the tested model shows that PrEP self-efficacy partially mediates the causal effect. This indicates that for MSM with a high intention to use PrEP, low self-efficacy may be a strong barrier to actual PrEP use. In contrast to these three mentioned factors, the negative effect of HIV risk perception on PrEP use is surprising, as it is inconsistent with the literature (Ssuna et al., 2022; Sun et al., 2022). Some MSM with a high perceived risk of HIV infection may rely more on condoms than on PrEP because they perceive condoms to be more reliable owing to concerns about the efficacy of PrEP. The causal effect may also be opposite to what the theoretical model suggests, which would imply that PrEP use with casual partners leads to a lower perceived HIV risk. However, more specific research is needed to better understand this relationship.

Next, we discuss the factors directly related to PrEP self-efficacy. These variables are intention to use condoms, intention to use PrEP, age, social support, disclosure of sexual orientation, attitudes toward condoms, HIV risk perception, and social norms regarding PrEP. Intention to use condoms, intention to use PrEP, and HIV risk perception were discussed above because these variables also had a direct effect on PrEP use with casual partners. According to our model, PrEP self-efficacy partially mediates these effects. The model also shows that older MSM, MSM with more positive attitudes toward condoms, MSM with more social support in their lives, and MSM whose family and friends know about their sexual orientation have higher PrEP self-efficacy. The last two findings are particularly important for HIV prevention because concrete actions can be drawn from them. An improvement in overall social support and support regarding the coming out process seems to be relevant to enhancing self-efficacy and, through this, also the frequency of PrEP use when having sex with casual partners. Furthermore, a positive attitude toward condoms seems to be also valuable for perceived PrEP self-efficacy. The effect of age is positive which contrasts with other studies in Switzerland, indicating that older MSM are more reluctant and skeptical about PrEP (Nideröst et al., 2018). Furthermore, the analysis shows that social support for PrEP (social norm PrEP) is associated with lower self-efficacy.

Finally, we draw attention to the IMB model variables that were excluded from the model because of small or insignificant effects. Contrary to the theoretical proposition of the IMB model, information had no effect on self-efficacy or PrEP use with casual partners in the tested model. Other studies have emphasized that PrEP knowledge affects the intention to use PrEP (Kelly et al., 2024). The difference may be that our measure of information included different knowledge items related to general HIV protection knowledge, whereas other studies used a narrower and more focused definition of PrEP knowledge. Furthermore, HIV/STI-related knowledge (information) was good in the MSM sample, resulting in a low variance in the variable ($M = 6.7$, $Mdn = 7.0$, $SD = 1.3$). This could result in a ceiling effect. Attitudes toward PrEP had no effect on PrEP self-efficacy or PrEP use. This variable includes questions about fear of the possible side effects of PrEP, doubts about its efficacy, and PrEP stigma, which have been important factors in other recent studies (Gredig et al., 2016; Moyo & Nunu, 2023; Nguyen et al., 2021; Sun et al., 2022; Voglino et al., 2021). Qualitative studies are required to shed more light on these two aspects of the model.

Limitations

Despite these findings, this study had several limitations. First, the study design was cross-sectional, making it difficult to identify causal factors. The direction of an effect may be opposite to that assumed in the theoretical model. A possible example is the discussed negative effect of the perceived HIV risk on PrEP use with casual partners which may be opposite to what the theoretical model suggests.

Second, this was not a study of MSM but of different key populations for HIV prevention in Switzerland. For this reason, the item wording of the dependent variable also included PrEP use during *vaginal* sex, which could introduce measurement noise among MSM. It would have been beneficial to promote this study with a more explicit focus on MSM.

Third, there are potential biases in the sample. As in other studies on MSM conducted in Switzerland, the proportion of MSM who live in urban areas and are highly educated is high (Nideröst et al., 2018). This could be due to sampling bias, as it is difficult to reach MSM living in rural areas or MSM who have not yet disclosed their sexual orientation. As a possible result, we might overestimate the proportion of

MSM using PrEP with casual partners. There is also a possible bias regarding sex workers in the convenience sample. As we worked with NGOs during the recruitment process, we may have mainly reached sex workers who used the prevention and testing services of their respective organizations. Furthermore, sex workers were reimbursed with vouchers of 40 Swiss Francs which could also lead to a possible bias in the data.

Fourth, data were self-reported. The estimates of the different construct variables and frequency of PrEP use with casual partners were subjective. There may be a social desirability effect in the survey responses (King, 2022). In addition, HIV risk perception was measured using a single item which could lead to problems with respect to reliability.

Fifth, we removed variables without significant effects or with standardized coefficients smaller than 0.1 from the model. This could lead to possible overfitting of the model, which occurs when a theoretical model is statistically adjusted to the sample. This results in a limited generalizability of the results.

Conclusion

PrEP is widely accepted among MSM who have sex with causal partners in Switzerland. MSM using PrEP with casual partners appeared confident about the new HIV prevention option and reported a strong intention to continue using PrEP in the future. However, there are still MSM who have sex with causal partners in Switzerland who intend to use PrEP but currently do not. Therefore, more knowledge about these MSM is needed to further improve PrEP acceptability and use. PrEP use can be further promoted by increasing PrEP self-efficacy among MSM. Another way to increase PrEP use among eligible MSM would be to provide social support to MSM and support them in the process of coming out. This study also highlights that a high intention to use condoms is associated with lower PrEP use, as other studies have shown. The use of an extended version of the IMB model appears appropriate to theoretically explain PrEP use with casual partners among MSM. However, as some findings contradict those of previous studies on the role of HIV risk perception, knowledge, and attitudes toward PrEP, further research is needed to gain deeper insight into this topic.

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Author contributions statement

BH, SN, and PW were involved in the conception and design of the work. BH, SN, and PW were involved in the analysis and interpretation of the data. BH and SN wrote the first draft of the paper. PW reviewed the draft critically for intellectual content. All authors approved the final submission and agreed to be accountable for all aspects of the work.

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