Uptake and willingness to use PrEP among Chinese men who have sex with men with experience of sexualized drug use

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Abstract

Background Sexualized drug use (SDU, use of any psychoactive substance before/during sexual intercourse) is prevalent among men who have sex with men (MSM). This study investigated uptake and willingness to use pre-exposure prophylaxis (PrEP) among MSM with experience of SDU. **Methods** A total of 580 Hong Kong Chinese speaking MSM self-reported to be HIV negative/unknown sero-status completed a cross-sectional anonymous telephone interview. **Results** Of the participants, 107 (18.4%) and 56 (9.7%) had experience of SDU and chemsex in their lifetime. The prevalence of PrEP use was 4.0% among all participants and 12.1% among those with experience of SDU. Among MSM with experience of SDU who were not on PrEP (n=94), 59.6% were willing to use daily oral PrEP in the next six months. After adjustment for significant background variables (age group, HIV testing in the past year, and anal intercourse with non-regular male sex partners), having ≥ 3 episodes of SDU per month (adjusted odds ratios (AOR): 3.87, 95%CI: 1.01, 15.28), presence of condomless anal intercourse during SDU (AOR: 2.96, 95%CI: 1.03, 9.55), positive attitudes toward PrEP (AOR: 2.01, 95%CI: 1.37, 2.95), perceived support from significant others to use PrEP (AOR: 11.63, 95%CI: 3.93, 34.37)), and perceived behavioral control of using PrEP (AOR: 20.82, 95%CI: 6.51, 66.64) were significantly associated with higher willingness to use PrEP. **Conclusion** MSM with experience of SDU are potential good candidates of PrEP implementation. Effective strategies to increase PrEP coverage are needed even if affordable PrEP became available, future health promotion may make use of HIV testing and counseling settings and modify perception related to PrEP.

Background

The HIV epidemic is alarming among men who have sex with men (MSM) in China, as the overall HIV prevalence and incidence in this group are both high and increasing (9.9% and 5.6 per 100 person-year in 2016) (1, 2). In Hong Kong, China, where the study was conducted, the HIV prevalence among MSM was 6.54% in 2017 (3). Out of the 681 new HIV cases in 2017, 63% acquired it via homosexual or bisexual contact (3).

Psychoactive substance use and HIV are proven to be intertwined epidemics, especially among MSM (4). Sexualized drug use (SDU) refers to the use of any psychoactive substance before/during sexual intercourse (5). Recent studies in western countries showed that 41–54% of MSM reported SDU (6, 7). Such prevalence was 12.0% in Hong Kong where the study was conducted (2017) (8). Chemsex is considered as a subset of SDU, which is commonly defined as the use of some specific drugs (methamphetamine, mephedrone, γ -hydroxybutyrate (GHB/GBL), ketamine and cocaine) before/during sexual intercourse (6, 7, 9). Psychoactive substances would adversely affect users' capacity to perceive and respond to risks during sexual encounters, leading to high-risk sexual practices (e.g., condomless anal intercourse (CAI), group sex, fisting, etc.) (10) and hence HIV and other sexually transmitted infections (STI) (9). However, there was a lack of effective behavioral interventions in reducing drug use and sexual risk behaviors among MSM with experience of SDU/chemsex (11–14).

Pre-exposure prophylaxis (PrEP) is a potential risk reduction measure for MSM with experience of SDU, which refers to the initiation of Tenofovir Disoproxil Fumarate (TDF) / Emtricitabine (FTC) before and during periods of HIV exposure among HIV-negative individuals in order to prevent HIV acquisition (15). With good adherence, PrEP could significantly reduce the risk of HIV infection among various at-risk groups, including MSM (15) and drug users (16). The World Health Organization (WHO) strongly recommends PrEP to all population at substantial risk of HIV infection (17). Clinical trials did not identify any significant safety concerns with daily PrEP use among psychoactive substance users (16).

Many MSM in Hong Kong had interest in using PrEP, as 3.6% were on PrEP and about half of them were willing to use PrEP if it was provided for free (3, 18). Studies conducted in Hong Kong (19) and other countries (20) showed that MSM with experience of SDU/chemsex might have higher interest to use PrEP. Unlike other countries, PrEP is not available in public hospitals/clinics in Hong Kong. Due to the high cost of obtaining formal prescription in private clinics (8,000 HK\$/month) and limited coverage of demonstration project (n = 70) in Hong Kong, majority (70.6%) of local MSM PrEP users obtained the medication either from overseas clinics or through online purchases (3). They may not have received adequate support services in Hong Kong, which may lead to suboptimal adherence and risk compensation (21). It is hence important to understand the PrEP use in this group.

It is equally important to explore willingness to use PrEP among MSM with experience of SDU as well as related barriers and facilitators in order to identify an appropriate delivery model. To our knowledge, only three quantitative studies (22–24) and one qualitative study (25) investigated PrEP use/acceptability among substance-using MSM, all were conducted outside China. These studies showed that the prevalence of willingness to use PrEP was 47–71% (22–24). Factors associated with willingness to use included those related to socio-demographics (e.g., age), patterns of drug use (e.g., types and frequency), perceptions of HIV risk and PrEP (e.g., perceived effectiveness, would be less worried if on PrEP, concerns related to side effects, and confident to use/adhere to PrEP) (22–24). The qualitative study suggested that being able to relax and not having to worry about getting HIV, and increased comfort and openness to have sexual relationship with HIV positive partners were facilitators of PrEP use among substance-using MSM. The participants of the qualitative study also expressed concerns that substance use/SDU would disrupt their daily routine and negatively impact their ability to take PrEP or adhere to daily PrEP (25). These factors were considered by this study.

Theory-based interventions are more effective than non-theory-based ones (26). In this study, we applied the Theory of Planned Behavior (TPB) (27) as the framework to select perceptions related to PrEP. The TPB postulates that behavioral intention to adopt a health-related behavior (e.g., use PrEP) is a strong predictor of actual behavior. In order to form such an intention, one would evaluate the pros and cons of the behavior (positive and negative attitudes), consider whether their significant others would support such behavior (perceived subjective norm), and appraise how much control one has over the behavior (perceived behavioral control). Studies showed that psychoactive substance use and SDU were associated with poor mental health status (e.g., depression) among MSM (28–31). Poor mental health status was found to be a barrier to start and adhere to PrEP in different populations (32, 33). Therefore,

the associations between mental health problems (i.e., probable depression and anxiety symptoms) and willingness to use PrEP were also investigated by this study.

This study was to investigate PrEP use and willingness to use daily PrEP among Hong Kong MSM of HIV-negative/unknown sero-status and with experience of SDU. Factors associated with willingness to use daily PrEP in the next six months were also investigated.

Methods

Participants and data collection

Data used in this study were derived from a cross-sectional study among MSM in Hong Kong from April to December, 2018. Participants were: 1) Hong Kong Chinese speaking men, 2) aged 18 years or above, and 3) had anal intercourse with at least one man in the last 12 months. Participants were recruited through multiple sources. A recent mapping exercise was conducted by the government and identified 12 gay bars and 16 gay saunas in Hong Kong. Upon approval of the owners, trained and experienced fieldworkers approached prospective MSM participants in these venues at different time slots during weekdays and weekends. They briefed the prospective participants about the details and gave them an information sheet on site. Online outreaching was also actively pursued. The research team posted the information of this study periodically as new discussion topics on two gay websites with highest hit rate in Hong Kong. If prospective participants were interested in this study, they could contact the interviewers through private messaging or other means (e.g., WhatsApp, telephone, email, etc.). Recruitment was supplemented by peer referrals. Guarantees were made on anonymity, right to quit at any time and that refusal would not affect their chance in using any services. Verbal instead of written informed consent was obtained due to maintaining anonymity but the fieldworkers signed a form pledging that the participants had been fully informed about the study. Multiple contacts (mobile, emails, social media account, etc.) was obtained to make an appointment to conduct a telephone interview. Upon appointment, trained telephone interviewers confirmed participants' eligibility and consent to participate in the study, and conducted telephone interview which took about 30 minutes to complete. At least five follow-up calls were made in different time slots during weekdays and weekends before considering the case as a non-contact. Incentive was provided to participants upon completion to compensate their time spent. A HK\$50 supermarket or café coupon was mailed to an address provided by the participant, in an envelope containing no names, nor any information, about the study. Telephone numbers/addresses were cross-checked to avoid repetition. Ethics approval was obtained from the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong.

Measures

Design of the questionnaire

A panel consisted of a public health researcher, an epidemiologist, one psychologist, one MSM and one non-governmental organization (NGO) worker formed to develop the questionnaire. The questionnaire was tested among 10 local MSM. Based on their feedback, the questionnaire was finalized by the panel.

Background characteristics and mental health status

Information collected included socio-demographics (age, highest education level attained, current marital status, monthly personal income and current employment status), sexual orientation, utilization of HIV prevention services, history of other STIs, and sexual behaviors in the last year (anal intercourse with regular male sex partners (RP, defined as lovers/stable boyfriends) and non-regular male sex partners (NRP, defined as casual sex partners and male sex workers).

Probable depression was measured by validated Chinese version of the Center for Epidemiologic Studies Short Depression Scale (CES-D-10) (34), which has been widely used in studies targeting MSM (35, 36). Scores ≥ 10 indicated presence of clinically significant depressive symptoms (range: 0–30) (34). Anxiety symptoms were measured by validated Chinese version of the 7-item Generalized Anxiety Disorder Scale (GAD-7) (37). A cut-off score of 15 is recommended to define severe anxiety (37). In this study, the Cronbach alpha of the CES-D-10 and the GAD-7 was 0.893 and 0.930, respectively.

Patterns of SDU

In this study, In this study, SDU is defined as use of any of the following psychoactive substance before/during sexual intercourse, including: 1) ketamine, 2) methamphetamine, 3) cocaine, 4) cannabis, 5) ecstasy, 6) Dormicum/Halcion/Erimin 5/non-prescription hypnotic drugs, 7) heroin, 8) cough suppressant (not for curing cough), 9) amyl nitrite (popper), 10) GHB/GBL (γ -hydroxybutyrate), 11) 5-methoxy-N, N-diisopropyltryptamine (Foxy), and 12) mephedrone. We defined chemsex as the use of ketamine, methamphetamine, cocaine, GHB/GBL and mephedrone. Such definition was used in a number of studies (6, 7, 9).

Participants with experience of SDU in their lifetime were asked about: 1) types of psychoactive substance used during SDU, 2) poly-use of psychoactive substances during SDU, 3) time since the first episode of SDU, 4) frequency of SDU in the last year, 5) CAI during SDU in the last year and 6) utilization of drug cessation/rehabilitation services. Those who had engaged in SDU in the last year were asked about some details of their most recent episode of SDU, such as number of people involved, use of alcohol and erectile dysfunction drug, and presence of group sex and CAI.

PrEP use and willingness to use PrEP

Participants who were currently on PrEP were asked about sources of PrEP, methods of PrEP use (i.e., daily PrEP: taking PrEP once every day no matter they had anal intercourse or not; on-demand PrEP: using it only before and after anal intercourse, and holiday PrEP: using it either daily or on-demand only in some period of time). Daily PrEP users were asked about whether they had missed more than three doses of PrEP within a week in the past month. Such measurement of adherence was commonly used in published studies (38).

Participants with experience of SDU and were not on PrEP were briefed with the following: “PrEP is a strategy that promotes taking oral antiretroviral drugs to prevent HIV infection among HIV-negative individuals. PrEP is strongly recommended by the WHO as an additional HIV prevention strategy for MSM. You are required to take PrEP once every day when you are using it in order to achieve its effect in preventing HIV infection. Daily use of oral PrEP could reduce risk of HIV infection by 92%. PrEP has possible side effects such as nausea, vomiting and headache”. They were then asked whether they were willing to take a once-daily oral pill as PrEP in the next six months (Response categories: 1 = definitely not, 2 = probably not, 3 = neutral, 4 = probably will, 5 = definitely will). Responses were then dichotomized. Willingness to use daily PrEP was defined as “probably will” or “definitely will”. Such a definition has been commonly used in previous studies (18, 39, 40). For those with willingness to use PrEP, they were further asked about the maximum amount (in HK\$) they were willing to pay per month for using daily PrEP.

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Perceptions related to PrEP based on TPB

Two scales based on the TPB were constructed for this study, they are the 3-item Positive Attitude Scale and the 5-item Negative Positive Scale (response categories: 1 = disagree, 2 = neutral, 3 = agree). The Cronbach’s alpha for the Positive Attitude Scale and the Negative Attitude Scale was 0.648 and 0.747, single factors were identified by explanatory factor analysis, explaining for 56.6–61.6% of the total variances. In addition, two single items were used to measure perceived subjective norm (i.e., ‘people who are important to you will support you to use PrEP’) and perceived behavioral control related to PrEP use (i.e., ‘In general, you are confident in taking PrEP every day in the next six months’) (response categories: 1 = disagree, 2 = neutral, 3 = agree).

Statistical analysis

Using SDU in lifetime as the dependent variable, univariate odds ratios (ORu) of background variables (i.e., socio-demographics, service utilization, and sexual behaviors) and mental health status were identified first. A summary multivariate logistic regression model was then fit for this dependent variable, using variables that were found to be statistically significant in the univariate analysis as candidates for selection.

Among PrEP non-users with experience of SDU and using willingness to use PrEP in the next six months as dependent variable, univariate odds ratios (ORu) for the associations between background variables and the dependent variable were estimated. Those background variables with $p < 0.05$ in the univariate analysis were adjusted for in the subsequent multiple logistic regression analysis involving other independent variables (i.e., patterns of SDU, perceptions related to PrEP, and mental health status).

Adjusted odds ratios (AOR) and respective 95% confidence interval (CI) were derived from the analyses. SPSS version 21.0 was used for data analysis, with p values < 0.05 taken as statistically significant.

Results

Background characteristics and mental health status

Out of 1131 prospective participants being approached through outreach in gay venues (n = 211), online recruitment (n = 607) and peer referral (n = 313), 711 were screened to be eligible, 600 provided verbal informed consent and completed the telephone interview. The response rate was 84.3%. This study was based on a subsample of those self-reported to be HIV negative/unknown HIV sero-status. Among the 600 participants, 20 self-reported as HIV positive and were excluded. The effective sample size was 580. Socio-demographics, HIV prevention service utilization, sexual behaviors in the last year, and prevalence of probable depression (CES-D-10 score ≥ 10) and probable cases of severe anxiety (GAD-7 score ≥ 15) were shown in Table 1.

Table 1
Characteristics of MSM with and without experience of sexualized drug use (SDU)

	All (n = 580)	Without experience of SDU (n = 473)	With experience of SDU (n = 107)	With vs. without experience of SDU	
	%	%	%	ORu (95%CI)	ORm (95%CI)
Socio-demographic characteristics					
Age group					
18–30	56.6	59.0	45.8	1.0	1.0
31–40	31.6	29.8	39.3	1.70 (1.07, 2.69)*	2.69 (1.52, 4.75)**
>40	11.9	11.2	15.0	1.72 (0.91, 3.25)	2.49 (1.20, 5.16)*
Highest educational level attained					
Senior high or below	15.5	14.2	21.5	1.0	
College or above	84.5	85.8	78.5	0.60 (0.35, 1.02)	—
Current marital status					
Currently single	49.0	48.4	51.4	1.0	
Married/cohabited with a man	50.2	50.7	47.7	0.89 (0.58, 1.35)	
Married/cohabited with a woman	0.8	0.8	0.9	1.04 (0.11, 9.50)	—

ORu: univariate odds ratios

ORm: multivariate odds ratios obtained by multivariate logistic regression using variables in Table 1 that were found to be statistically significant in the univariate analysis as candidates.

95%CI: 95% confidence interval

† 0.05 < P < 0.10, * P < 0.05, ** P < 0.01, *** P < 0.001

N.A.: not applicable; —: not considered in the model

	All (n = 580)	Without experience of SDU (n = 473)	With experience of SDU (n = 107)	With vs. without experience of SDU	
Monthly personal income (HK\$)					
<10,000	13.4	12.3	18.7	1.0	1.0
10,000–19,999	29.1	28.5	31.8	0.73 (0.39, 1.37)	0.79 (0.29, 2.19)
20,000–39,999	36.7	38.1	30.8	0.53 (0.28, 0.99)*	0.50 (0.17, 1.49)
40,000 and above	19.7	20.1	17.8	0.58 (0.29, 1.18)	0.47 (0.15, 1.51)
Refuse to disclose	1.0	1.1	0.9	0.58 (0.06, 5.27)	0.57 (0.04, 8.23)
Current employment status					
Full-time	83.6	85.4	75.7	1.0	1.0
Part-time/unemployed/retired/ students	16.4	14.6	24.3	1.88 (1.13, 3.13)*	1.30 (0.52, 3.26)
Sexual orientation					
Homosexual	90.7	89.9	94.4	1.0	
Bisexual	8.4	9.1	5.6	0.59 (0.24, 1.42)	
Heterosexual	0.9	1.1	0.0	N.A.	—
Service utilization					

ORu: univariate odds ratios
ORM: multivariate odds ratios obtained by multivariate logistic regression using variables in Table 1 that were found to be statistically significant in the univariate analysis as candidates.
95%CI: 95% confidence interval
† 0.05 < P < 0.10, * P < 0.05, ** P < 0.01, *** P < 0.001
N.A.: not applicable; —: not considered in the model

	All (n = 580)	Without experience of SDU (n = 473)	With experience of SDU (n = 107)	With vs. without experience of SDU	
HIV testing in the last 12 months					
No	28.4	30.2	20.6	1.0	1.0
Yes	71.6	69.8	79.4	1.67 (1.01, 2.78)*	1.26 (0.71, 2.21)
Other HIV prevention services in the last 12 months (e.g., condom distribution, peer education, pamphlet and lectures)					
No	44.7	47.6	31.6	1.0	1.0
Yes	55.3	52.4	68.4	1.95 (1.25, 3.04)**	1.84 (1.13, 3.01)*
History of other sexual transmitted infections					
History of other sexually transmitted infections					
No	80.5	84.4	83.6	1.0	1.0
Yes	19.5	15.6	36.4	3.09 (1.94, 4.93)***	2.28 (1.35, 3.84)*
Sexual behaviors in the last 12 months					
Had had anal intercourse with regular male sex partners (RP)					
No	14.7	13.7	18.7	1.0	
Yes	85.3	86.3	81.3	0.69 (0.40, 1.20)	—
ORu: univariate odds ratios					
ORM: multivariate odds ratios obtained by multivariate logistic regression using variables in Table 1 that were found to be statistically significant in the univariate analysis as candidates.					
95%CI: 95% confidence interval					
† 0.05 < P < 0.10, * P < 0.05, ** P < 0.01, *** P < 0.001					
N.A.: not applicable; —: not considered in the model					

	All (n = 580)	Without experience of SDU (n = 473)	With experience of SDU (n = 107)	With vs. without experience of SDU	
Had had anal intercourse with non-regular male sex partners (NRP)					
No	39.1	44.6	15.0	1.0	1.0
Yes	60.9	55.4	85.0	4.50 (2.61, 8.03)***	4.20 (1.66, 10.59)**
Condomless anal intercourse (CAI) with men					
No	60.5	64.3	43.9	1.0	1.0
Yes	39.5	35.7	56.1	2.30 (1.50, 3.52)***	2.13 (1.31, 3.45)*
Multiple male sex partnerships					
No	30.7	34.7	13.1	1.0	1.0
Yes	69.3	65.3	86.9	3.53 (1.05, 6.38)***	0.98 (0.36, 2.66)
Use of pre-exposure prophylaxis (PrEP)					
Currently on PrEP					
No	96.0	97.9	87.9	1.0	1.0
Yes	4.0	2.1	12.1	6.40 (2.73, 15.04)***	2.71 (1.03, 7.15)*
Mental health status					
Depressive symptoms					

ORu: univariate odds ratios
ORM: multivariate odds ratios obtained by multivariate logistic regression using variables in Table 1 that were found to be statistically significant in the univariate analysis as candidates.
95%CI: 95% confidence interval
† 0.05 < P < 0.10, * P < 0.05, ** P < 0.01, *** P < 0.001
N.A.: not applicable; —: not considered in the model

	All (n = 580)	Without experience of SDU (n = 473)	With experience of SDU (n = 107)	With vs. without experience of SDU	
No clinical depressive symptoms (CES-D-10 score < 10)	64.1	65.5	57.9	1.0	
Presence of clinical depressive symptoms (CES-D-10 score ≥ 10)	35.9	34.5	42.1	1.38 (0.90, 2.12)	—
Anxiety					
No/mild anxiety (GAD-7 score < 15)	94.0	94.3	92.5	1.0	
Severe anxiety (GAD-7 score ≥ 15)	6.0	5.7	7.5	1.34 (0.59, 3.03)	—
ORu: univariate odds ratios					
ORM: multivariate odds ratios obtained by multivariate logistic regression using variables in Table 1 that were found to be statistically significant in the univariate analysis as candidates.					
95%CI: 95% confidence interval					
† 0.05 < P < 0.10, * P < 0.05, ** P < 0.01, *** P < 0.001					
N.A.: not applicable; —: not considered in the model					

Prevalence of SDU and associated factors

Out of 580 participants, 107 (18.4%) and 56 (9.7%) reported SDU and chemsex in lifetime, respectively. In the multivariate logistic regression model, older age, utilization of HIV prevention services other than HIV testing, history of other STIs, anal intercourse with NRP and CAI with men in the last year, and use of PrEP were associated with higher likelihood of SDU. (Table 1)

Among MSM with experience of SDU (n = 107), popper (80.4%), Methamphetamine (33.6%), and GHB/GBL (29.0%) were the most commonly used psychoactive substances during SDU. Over two-third (68.2%) of them reported poly-use of psychoactive substances during SDU; 39.3% reported CAI during SDU in the last year. Only 1.9% and 7.5% had ever utilized drug cessation/rehabilitation provided by governmental and non-governmental organizations. Among MSM who had engaged in SDU in the last year (n = 83), 14.5–50.6% reported their most episode of SDU involved the following conditions, such as involving more than two people (21.7%), use of alcohol (14.5%) or erectile dysfunction drugs (30.1%), occurrence of group sex (19.3%) and CAI (50.6%). (Table 2)

Table 2
Patterns of SDU and perceptions related PrEP among MSM with experience of SDU

	% / Mean (SD)
Patterns of SDU	(n = 107)
Types of psychoactive substance used during SDU in lifetime	
Ketamine	8.4
Methamphetamine	33.6
Cocaine	3.7
Cannabis	12.1
Ecstasy	12.1
Dormicum / Halcion / Erimin 5 / Hypnotic drugs (non-prescription)	1.9
Heroin	0.0
Cough suppressant (not for curing cough)	1.9
Amyl nitrite	80.4
GHB/GBL	29.0
5-methoxy-N, N-diisopropyltryptamine (Foxy)	5.6
Mephedrone	0.9
Poly-use of psychoactive substances in lifetime	
No	31.8
Yes	68.2

Sexualized drug use is defined as use of the following psychoactive substances before/during anal intercourse, including ketamine, methamphetamine, cocaine, cannabis, ecstasy, Dormicum/Halcion/Erimin 5/non-prescription hypnotic drugs, heroin, cough suppressant (not for curing cough), amyl nitrite (popper), GHB/GBL (γ -hydroxybutyrate), 5-methoxy-N, N-diisopropyltryptamine (Foxy), and mephedrone.

¹ Positive Attitude Scale, three items, Cronbach's alpha: 0.648, one factor was identified by explanatory factor analysis, explaining for 61.6% of the total variance. Higher score of the scale indicated more positive attitudes toward PrEP.

² Negative Attitude Scale, five items, Cronbach's alpha: 0.747, one factor was identified by explanatory factor analysis, explaining for 56.6% of the total variance. Higher score of the scale indicated more negative attitudes toward PrEP.

	% / Mean (SD)
Time since the first episode of SDU	
<1 year	32.7
1–2 years	20.6
3–5 years	15.9
>5 years	30.8
Frequency of SDU in the last 12 months	
No SDU in the last 12 months	22.4
1 episode/month	29.9
1–2 episodes/month	22.4
≥3 episodes/month	25.2
Condomless anal intercourse during SDU in the last 12 months	
No/No SDU in the last 12 months	60.7
Yes	39.3
Drug cessation/rehabilitation services provided by governmental organizations	
No	98.1
Yes	1.9
Drug cessation/rehabilitation services provided by non-governmental organizations	
No	92.5
Yes	7.5

Sexualized drug use is defined as use of the following psychoactive substances before/during anal intercourse, including ketamine, methamphetamine, cocaine, cannabis, ecstasy, Dormicum/Halcion/Erimin 5/non-prescription hypnotic drugs, heroin, cough suppressant (not for curing cough), amyl nitrite (popper), GHB/GBL (γ-hydroxybutyrate), 5-methoxy-N, N-diisopropyltryptamine (Foxy), and mephedrone.

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	% / Mean (SD)
Details of the most recent episode of SDU (among those reported SDU in the last 12 months)	(n = 83)
Number of participants	
2	78.3
≥3	21.7
Alcohol consumption	
No	85.5
Yes	14.5
Use of erectile dysfunction drugs	
No	69.6
Yes	30.1
Group sex	
No	80.7
Yes	19.3
Condomless anal intercourse	
No	49.4
Yes	50.6
Perceptions related to PrEP (among participants who were not on PrEP)	(n = 94)

Sexualized drug use is defined as use of the following psychoactive substances before/during anal intercourse, including ketamine, methamphetamine, cocaine, cannabis, ecstasy, Dormicum/Halcion/Erimin 5/non-prescription hypnotic drugs, heroin, cough suppressant (not for curing cough), amyl nitrite (popper), GHB/GBL (γ-hydroxybutyrate), 5-methoxy-N, N-diisopropyltryptamine (Foxy), and mephedrone.

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² Negative Attitude Scale, five items, Cronbach's alpha: 0.747, one factor was identified by explanatory factor analysis, explaining for 56.6% of the total variance. Higher score of the scale indicated more negative attitudes toward PrEP.

	% / Mean (SD)
Willingness to take once-daily oral pill as PrEP in the next six months after being briefed some facts of PrEP	
No (definitely not/probably not/neutral)	40.4
Yes (probably will/definitely will)	59.6
Willingness to pay (HK\$ per month) for using once-daily oral pill as PrEP (among those with willingness to take PrEP in the next six months, n = 56)	
≤300	16.1
301–500	14.3
501–1000	23.2
1000–2000	19.6
2001–4000	21.4
4001–6000	1.8
6001–8000	3.6
>8000	0.0
Perceptions related to PrEP based on the TPB	
Positive attitudes toward PrEP (% agree)	
PrEP can reduce your chance of HIV infection during SDU	78.7
PrEP would reduce your worry of HIV infection when having condomless sex during SDU	66.0
PrEP provides you more choice for HIV prevention	80.9

Sexualized drug use is defined as use of the following psychoactive substances before/during anal intercourse, including ketamine, methamphetamine, cocaine, cannabis, ecstasy, Dormicum/Halcion/Erimin 5/non-prescription hypnotic drugs, heroin, cough suppressant (not for curing cough), amyl nitrite (popper), GHB/GBL (γ-hydroxybutyrate), 5-methoxy-N, N-diisopropyltryptamine (Foxy), and mephedrone.

¹ Positive Attitude Scale, three items, Cronbach's alpha: 0.648, one factor was identified by explanatory factor analysis, explaining for 61.6% of the total variance. Higher score of the scale indicated more positive attitudes toward PrEP.

² Negative Attitude Scale, five items, Cronbach's alpha: 0.747, one factor was identified by explanatory factor analysis, explaining for 56.6% of the total variance. Higher score of the scale indicated more negative attitudes toward PrEP.

	% / Mean (SD)
Positive Attitude Scale ¹	8.0 (1.4)
Negative attitudes toward PrEP (% agree)	
Psychoactive substances that are used during SDU would reduce the protective effect of PrEP	14.9
Psychoactive substances that are used during SDU would aggravate the side-effects of PrEP	29.8
Psychoactive substances that are used during SDU would make you forget to take PrEP	31.9
Daily use of PrEP would cause severe financial burden for you	76.6
You will be stigmatized by medical professionals when you are using PrEP-related services	34.0
Negative Attitude Scale ²	10.1 (2.2)
Perceived subjective norm related to PrEP	
People who are important to you will support you to use PrEP	
Disagree/neutral	39.4
Agree	60.6
Perceived behavioral control to use PrEP	
In general, you are confident in taking PrEP every day in the next six months	
Strongly disagree/disagree/neutral	45.7
Agree/strongly agree	54.3
Sexualized drug use is defined as use of the following psychoactive substances before/during anal intercourse, including ketamine, methamphetamine, cocaine, cannabis, ecstasy, Dormicum/Halcion/Erimin 5/non-prescription hypnotic drugs, heroin, cough suppressant (not for curing cough), amyl nitrite (popper), GHB/GBL (γ-hydroxybutyrate), 5-methoxy-N, N-diisopropyltryptamine (Foxy), and mephedrone.	
¹ Positive Attitude Scale, three items, Cronbach's alpha: 0.648, one factor was identified by explanatory factor analysis, explaining for 61.6% of the total variance. Higher score of the scale indicated more positive attitudes toward PrEP.	
² Negative Attitude Scale, five items, Cronbach's alpha: 0.747, one factor was identified by explanatory factor analysis, explaining for 56.6% of the total variance. Higher score of the scale indicated more negative attitudes toward PrEP.	

PrEP use, willingness to use daily oral PrEP and perceptions related to PrEP

Twenty-three participants (4.0%) were on PrEP at the date of the survey. Sources of their PrEP included online purchase (7/23), clinics in Thailand (6/23), clinics in Hong Kong (3/23), the ongoing PrEP demonstration project in Hong Kong (6/23), and given by friends (1/23). Majority of them (14/23) were taking daily PrEP, six were using on-demand PrEP, and three were on holiday PrEP. Five out of 14 daily PrEP users reported sub-optimal adherence to daily regimen in the past month.

After being briefed about some facts of PrEP, the prevalence of willingness to use daily oral PrEP in the next six months was 59.6% among participants with experience of SDU and were not on PrEP. Among those with willingness to use PrEP, 73.2% were willing to pay no more than HK\$2,000 per month for using daily PrEP. Item responses and means (standard deviation, SD) of the scales related to perceptions of PrEP were described in Table 2.

2

Factors associated with willingness to use daily oral PrEP in the next six months

In univariate analysis, age group (31–40 years: ORu: 0.38, 95%CI: 0.15, 0.96; reference group: 18–30 years), HIV testing (ORu: 2.72, 95%CI: 1.02, 7.23) and anal intercourse with NRP in the last year (ORu: 3.64, 95%CI: 1.13, 11.72) were significantly associated with willingness to use PrEP in the next six months. (Table 3)

Table 3

Associations between background characteristics and willingness to take once-daily oral pill as PrEP in the next six months

	Row%	ORu (95%CI)
Socio-demographic characteristics		
Age group		
18–30	71.4	1.0
31–40	48.6	0.38 (0.15, 0.96)*
>40	53.3	0.46 (0.14, 1.54)
Highest educational level attained		
Senior high or below	72.7	1.0
College or above	55.6	0.47 (0.17, 1.34)
Current marital status		
Currently single	64.0	1.0
Married/cohabited with a man	55.8	0.71 (0.31, 1.64)
Married/cohabited with a woman	0.0	N.A.
Monthly personal income (HK\$)		
<10,000	62.5	1.0
10,000–19,999	68.8	1.32 (0.38, 4.65)
ORu: univariate odds ratios		
95%CI: 95% confidence interval		
ORu and 95% were bold for variables with $p < 0.05$ in univariate analysis		
† $0.05 < P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$		
N.A.: not applicable		

	Row%	ORu (95%CI)
20,000–39,999	63.3	1.04 (0.30, 3.64)
40,000 and above	31.3	0.27 (0.06, 1.18)
Current employment status		
Full-time	60.3	1.0
Part-time/unemployed/retired/ students	57.1	0.88 (0.33, 2.34)
Sexual orientation		
Homosexual	58.4	1.0
Bisexual	80.0	2.85 (0.31, 26.51)
Service utilization		
HIV testing in the last 12 months		
No	40.9	1.0
Yes	65.3	2.72 (1.02, 7.23)*
Other HIV prevention services in the last 12 months (e.g., condom distribution, peer education, pamphlet and lectures)		
No	60.0	1.0
Yes	59.4	0.97 (0.40, 2.36)

ORu: univariate odds ratios
95%CI: 95% confidence interval
ORu and 95% were bold for variables with $p < 0.05$ in univariate analysis
† $0.05 < P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$
N.A.: not applicable

	Row%	ORu (95%CI)
Drug cessation/rehabilitation services provided by governmental organizations		
No	60.9	1.0
Yes	0.0	N.A.
Drug cessation/rehabilitation services provided by non-governmental organizations		
No	59.8	1.0
Yes	57.1	0.90 (0.19, 4.26)
History of sexual transmitted infections/viral hepatitis		
History of sexually transmitted infections		
No	59.1	1.0
Yes	60.7	1.07 (0.43, 2.64)
History of viral hepatitis		
No	58.9	1.0
Yes	75.0	2.09 (0.21, 20.93)
Sexual behaviors in the last 12 months		
Had had anal intercourse with regular male sex partners (RP)		
No	61.1	1.0
Yes	59.2	0.92 (0.32, 2.65)

ORu: univariate odds ratios
95%CI: 95% confidence interval
ORu and 95% were bold for variables with $p < 0.05$ in univariate analysis
† $0.05 < P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$
N.A.: not applicable

	Row%	ORu (95%CI)
Had had anal intercourse with non-regular male sex partners (NRP)		
No	33.3	1.0
Yes	64.6	3.64 (1.13, 11.72)*
ORu: univariate odds ratios		
95%CI: 95% confidence interval		
ORu and 95% were bold for variables with $p < 0.05$ in univariate analysis		
† $0.05 < P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$		
N.A.: not applicable		

After adjustment for these background variables, having ≥ 3 episodes of SDU per month (AOR: 3.87, 95%CI: 1.01, 15.28; reference group: no SDU in the last year) and CAI during SDU in the last year (AOR: 2.96, 95%CI: 1.37, 2.95; reference group: no SDU in the last year) were associated with higher willingness to use PrEP. The association between poly-use of psychoactive substance during SDU was of marginal statistically significant. Three out of four constructs of TPB were significantly and positively associated with willingness to use PrEP. They were: 1) the Positive Attitude Scale (AOR: 2.01, 95%CI: 1.37, 2.95), 2) perceived support from significant others to use PrEP (subjective norm) (AOR: 11.63, 95%CI: 3.93, 34.37), and 3) perceived behavioral control of taking PrEP every day in the next six months (AOR: 20.82, 95%CI: 6.51, 66.64). (Table 4)

Table 4

Factors associated with willingness to take once-daily oral pill as PrEP in the next six months

	ORu (95%CI)	AOR (95%CI)
Patterns of SDU		
Types of psychoactive substance used during SDU in lifetime		
Ketamine	0.37 (0.08, 1.67)	—
Methamphetamine	1.16 (0.47, 2.85)	—
Cocaine	N.A.	—
Cannabis	0.83 (0.21, 3.33)	—
Ecstasy	0.41 (0.11, 1.57)	—
Dormicum / Halcion / Erimin 5 / Hypnotic drugs (non-prescription)	0.67 (0.04, 11.10)	—
Heroin	0.67 (0.04, 11.10)	—
Cough suppressant (not for curing cough)	1.62 (0.58, 4.56)	—
Amyl nitrite	1.18 (0.45, 3.06)	—
GHB/GBL	2.09 (0.21, 20.93)	—
5-methoxy-N, N-diisopropyltryptamine (Foxy)	N.A.	—
Mephedrone	N.A.	—
Poly-use of psychoactive substances during SDU in lifetime		
No	1.0	1.0
Yes	2.70 (1.12, 6.50)*	2.27 (0.88, 5.88)†
Time since the first episode of SDU		
ORu: univariate odds ratios; AOR: adjusted odds ratios, odds ratios adjusted for significant background variables univariate analysis (age group, HIV testing in the last 12 months, had had anal intercourse with non-regular male sex partners in the last 12 months)		
95%CI: 95% confidence interval		
ORu, AOR and 95% were bold for variables with $p < 0.05$		
† $0.05 < P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, —: not considered in the model		
N.A.: not applicable		

	ORu (95%CI)	AOR (95%CI)
<1 year	1.0	
1–2 years	0.71 (0.21, 2.39)	
3–5 years	0.68 (0.19, 2.44)	
>5 years	0.42 (0.15, 1.21)	—
Frequency of SDU in the last 12 months		
No SDU in the last 12 months	1.0	1.0
1 episode/month	2.80 (0.90, 8.75)	1.68 (0.47, 6.01)
1–2 episodes/month	2.53 (0.75, 8.52)	1.88 (0.48, 7.39)
≥3 episodes/month	4.15 (1.18, 14.59)*	3.87 (1.01, 15.28)*
Condomless anal intercourse during SDU in the last 12 months		
No SDU in the last 12 months	1.0	1.0
No	3.18 (1.06, 9.58)*	2.59 (0.75, 8.90)
Yes	3.61 (1.24, 10.56)*	2.96 (1.03, 9.55)*
Perceptions related to PrEP		
Positive Attitude Scale	1.95 (1.37, 2.76)***	2.01 (1.37, 2.95)***
Negative Attitude Scale	1.04 (0.86, 1.25)	—
People who are important to you will support you to use PrEP		
Disagree/neutral	1.0	1.0

ORu: univariate odds ratios; AOR: adjusted odds ratios, odds ratios adjusted for significant background variables univariate analysis (age group, HIV testing in the last 12 months, had had anal intercourse with non-regular male sex partners in the last 12 months)

95%CI: 95% confidence interval

ORu, AOR and 95% were bold for variables with $p < 0.05$

† $0.05 < P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, —: not considered in the model

N.A.: not applicable

	ORu (95%CI)	AOR (95%CI)
Agree	11.29 (4.24, 30.07) ^{***}	11.63 (3.93, 34.37) ^{***}
In general, you are confident in taking PrEP every day in the next six months		
Strongly disagree/disagree/neutral	1.0	1.0
Agree/strongly agree	21.82 (7.31, 65.10) ^{***}	20.82 (6.51, 66.64) ^{***}
Mental health status		
Depressive symptoms		
No clinical depressive symptoms	1.0	
Presence of clinical depressive symptoms	0.86 (0.38, 1.98)	—
Anxiety		
No/mild/anxiety	1.0	
Severe anxiety	0.90 (0.19, 4.26)	—
ORu: univariate odds ratios; AOR: adjusted odds ratios, odds ratios adjusted for significant background variables univariate analysis (age group, HIV testing in the last 12 months, had had anal intercourse with non-regular male sex partners in the last 12 months)		
95%CI: 95% confidence interval		
ORu, AOR and 95% were bold for variables with $p < 0.05$		
† $0.05 < P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, —: not considered in the model		
N.A.: not applicable		

Discussion

About 20% of our sampled MSM in Hong Kong had experience of SDU in their lifetime. As compared to those without such experience, MSM with experience of SDU reported much higher prevalence of sexual risk behaviors (i.e., anal intercourse with non-regular sex partner and CAI) and other STIs. Many MSM frequently engaged in SDU, and SDU commonly involved group sex and CAI. Therefore, MSM with experience of SDU are of much higher risk of HIV infection.

At the time of the survey, 4% of all participants were on PrEP. Such prevalence was comparable to a representative MSM survey conducted in 2017 (3.6%) (3). Our results confirmed that MSM with experience of SDU had higher interest to use PrEP, as they reported much higher uptake than those without such experience (12.1% vs. 2.1%, $p < 0.001$). Mathematical models suggested that achieving 75%

PrEP coverage among high-risk HIV-negative MSM in China would prevent 25.7% of new HIV infection among MSM (41). Given the high-risk profiles, MSM with experience of SDU should be priority group for future PrEP implementation. Strategies to increase PrEP access and coverage are hence needed for MSM with experience of SDU in Hong Kong.

This study also identified some issues among MSM PrEP users in Hong Kong. Similar to some western countries, over half (13/23) of the users obtained PrEP through internet or overseas clinics, probably due to high cost of obtaining PrEP in local clinics and limited coverage of the demonstration project (42). These PrEP users may encounter supply difficulties, which reduces their adherence and hence diminishes the effectiveness of PrEP (43). We found that five out of 14 daily PrEP users reported sub-optimal adherence to daily regimen, while three other users were on holiday PrEP. Future studies should explore reasons for sub-optimal adherence among local MSM PrEP users, especially those who obtained PrEP through online purchases or overseas clinics.

Among participants who were not on PrEP, about 60% of them were willing to use daily PrEP in the next six months. Such prevalence was higher than MSM in general in Hong Kong. The results also suggested that the current market rate for obtaining PrEP in Hong Kong (\$8,000 per month) was not affordable for local MSM, as none of the participants were willing to pay such amount. Future PrEP implementation in Hong Kong should take potential users' willingness to pay into consideration.

To achieve high coverage of PrEP, health promotion is needed even if affordable PrEP is made available in Hong Kong. Findings of this study provided some insights for promoting PrEP among Hong Kong MSM with experience of SDU. Similar to other studies, younger participants showed higher willingness to use PrEP (18). They may be more responsive to future PrEP promotion. Special attention should be given to those having anal intercourse with NRP in the last year, as they perceived a stronger need to protect themselves against HIV. Those who have taken up HIV testing in the last year also showed higher willingness to use PrEP. HIV testing and counseling may be an ideal setting to promote PrEP, as confirmed HIV-negative sero-status is a prerequisite for initiate PrEP, and users may already be motivated to take up HIV protective measures and should be more ready to use PrEP (44). Local NGO may play an important role in future PrEP implementation, as they are main providers of HIV testing services for local MSM (45).

This study examined the association between SDU patterns and willingness to use PrEP for the first time. Higher frequency of SDU, poly-use of psychoactive substances and CAI during SDU were associated with higher willingness to use PrEP. It is understandable as MSM having these behaviors during SDU were of higher risk of HIV infection, and they had stronger need to use PrEP to protect themselves against HIV. Demonstration studies showed that MSM may continue or even increase their high risk behaviors after using PrEP (46–48). Therefore, interventions promoting condom use/drug-cessation should be essential parts for future PrEP implementation program targeting MSM with experience of SDU to ensure the effectiveness of PrEP.

Our results also suggested that increasing positive attitudes toward PrEP, creating subjective norm supporting PrEP use, and enhancing perceived behavioral control of using PrEP are potential useful strategies to promote PrEP, as these factors were significantly associated with willingness to use PrEP. Health communication messages should emphasize PrEP is an effective strategy in preventing HIV during SDU. Future health promotion should also encourage MSM with experience of SDU to discuss PrEP with their significant others, so as to obtain support. Simplification of the procedures to obtain PrEP and provision of gay-friendly services may be useful strategies to enhance perceived behavioral control of using PrEP. In contrast to our hypothesis, negative attitudes such as concerns about psychoactive substances would reduce effectiveness, increase severity of side effects or risk of non-adherence, or lead to stigmatization originated from service providers was not significantly associated with willingness to use PrEP. Removing these negative attitudes may not be useful strategies to promote PrEP in this group.

This study was one of the first studies looking at PrEP use among Chinese MSM with experience of SDU. However, it had some limitations. First of all, participants were recruited by non-probabilistic sampling in the absence of sampling frame. As compared to a representative MSM survey in Hong Kong, our participants similar level of sexual risk behaviors, but higher HIV testing rate. Second, we were not able to obtain characteristics of participants who refused to join the study; selection bias might exist. The response rate was relatively higher than other published study involving MSM in China and outside China. Third, the results were self-reported, and the prevalence of SDU as well as risk behaviors during SDU may be under-reported, although anonymity should have reduced the bias. Fourth, we did not ask willingness to use PrEP among those without experience of SDU, and was not able to compare willingness/perceptions between those with and without such experience. Moreover, we did not ask participants' willingness to use on-demand PrEP (49). The willingness to use PrEP may be underestimated. Finally yet importantly, this was a cross-sectional survey and could not establish causal relationship.

Conclusion

MSM with experience of SDU had much higher prevalence of sexual risk behaviors and STIs, making them potential good candidates for PrEP implementation. As compared to MSM without such experience, this group of MSM reported higher interest to use PrEP. Effective strategies to increase PrEP coverage are needed even if affordable PrEP became available, future health promotion may make use of HIV testing and counseling settings and modify perception related to PrEP. Gay-friendly services promoting adherence, condom use, drug cessation, and STI screening/treatment are essential to support PrEP implementation in this group.

Abbreviations

MSM: men who have sex with men

HIV: Human Immunodeficiency virus

SDU: sexualized drug use

CAI: condomless anal intercourse

PrEP: pre-exposure prophylaxis

NGO: non-governmental organization

STI: sexually transmitted infection

ORu: univariate odds ratios

AOR: adjusted odds ratios

CI: confidence interval

SD: Standard deviation

Declarations

Ethics approval and consent to participate: All procedures performed in studies involving human participants were in accordance with the ethical standards of the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Verbal instead of written informed consent was obtained due to maintaining anonymity but the fieldworkers signed a form pledging that the participants had been fully informed about the study.

Consent for publication: All authors have read and approved the manuscript for publication

Availability of data and materials: All data are included in the manuscript.

Competing interest: The authors declare that they have no conflict of interest.

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Authors' contribution: Author ZW and JTFL designed the study and wrote the protocol. Author ZW and PM designed the questionnaire and analytical plan. Author ZW and MI supervised the data collection process. Author ZW and FY analyzed and interpreted the data and wrote the manuscript. Author ZW and JTFL revised the manuscript critically and finalized the paper. All authors contributed to and approved the final manuscript.

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