Beat Drugs Fund

Situations and associated factors of psychoactive substance use among men who have sex with men in Hong Kong

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INTRODUCTION

Prevalence of psychoactive substance use in some vulnerable groups is much higher than that of the general population. Men who have sex with men (MSM) represent one of such populations. The trend is global. Meta-analysis showed that MSM have a 2.4-fold higher risk for psychoactive substance abuse than heterosexual population [1]. National-level data reported prevalent psychoactive substance use among MSM in Australia (32.4%), Asian countries (16.7%), the U.K. (42.0%) and other Western European countries such as France, Ireland and Netherland (28.3%) [2,3]. A growing trend of psychoactive substance use was found in Asian countries such as Mainland China [4,5], Vietnam [6], Taiwan [7] and Thailand [8]. High prevalence of usage has been reported among MSM in Asian countries such as Indonesia (31.0%) [9], Thailand (32.0%) [10], mainland China (21.0%) [11] and Malaysia (10.8%) [12].

In Hong Kong, a survey conducted by the Department of Health in 2014 showed that the prevalence of using psychoactive substances was 11.1% in last six months among 1,026 MSM (5.85% were HIV positive) [13]. Psychoactive substance use and HIV are proven to be intertwined epidemics, especially among MSM [14]. Our unpublished data among 261 HIV positive MSM showed that 28.7% of them had used psychoactive substances since diagnosis [15]. Another piece of local information came from a recent online anonymous survey of 400 local MSM (MSM and Chemsex: consultation report. 2016-1-12), conducted by AIDS Concern, the largest local non-governmental organization (NGO) providing services for local MSM. The preliminary results showed the prevalence of psychoactive substance use was 35.8% in one's lifetime and 20% in the last year. Popper, crystal methamphetamine and G water were most frequently used and poly-use of these psychoactive substances was common among local MSM.

Studies consistently showed that psychosocial variables, such as perceived higher level of stigma toward MSM, poor mental health status (e.g., depression), perceived stress and coping styles (e.g., using psychoactive substance to cope with stress or life events) were commonly associated with psychoactive substance use among MSM (e.g. [16]).

It is important to understand cognitions related to psychoactive substance use, as health promotion modifying cognitions for behavioral change (e.g., healthy diet, smoking and drinking cessation, adoption of preventive behaviors) are well documented in the literature

[17-20]. A qualitative study in the Philippines cited reasons for using psychoactive substances among MSM including the perception that psychoactive substance use was fun and that it could facilitate social interaction and sexual behaviors [21]. A study conducted by our research team in Beijing also found various reasons for why MSM might use popper, such as MSM reported that the drug did not have severe consequences but was beneficial (e.g. made them feel very relaxed and increased sexual pleasure). They also reported a lack of barriers (e.g. using popper is not illegal, popper is accessible and inexpensive), lots of cues to action (e.g. suggested by male sex partners or peers), and low self-efficacy of not using the drug (low level of confidence in refusing to use popper) [22]. However, this study only investigated associations between cognitions and the use of one particular type of psychoactive substance. Moreover, situations of psychoactive substance use [5], social environment surrounding MSM [23] and availability of substance abuse prevention/rehabilitation services are different in Hong Kong and mainland China. As a result, local MSM may have different cognitions regarding psychoactive substance use as compared to their counterparts in mainland China. To our knowledge, no study has investigated the association between cognitive variables and psychoactive substance use among MSM in Hong Kong. A knowledge gap hence exists.

For prevention purposes, it is important to target those with an intention to use psychoactive substances in the recent future. Literature shows that behavioral intention to perform a risk behavior is the strongest predictor of the actual behavior [24]. Meta-analysis showed that theory-based factors are useful for program design as health promotion programs based on health behavioral theories are more effective than non-theory-based ones [25]. We choose Theory of Planned Behavior (TPB) as the framework to select cognitive variables as this study focuses on both behavioral intention and behaviors of psychoactive substance use. TPB has commonly been applied to explain various types of risk behaviors (e.g., [26]) and design various health-related interventions (e.g., [27]). According to the theory [24], positive and negative attitudes toward psychoactive substance use are highly relevant. Subjective norms include injunctive norms which consider whether significant others of the participant (such as close friends or male sex partners) approve of his use of psychoactive substances, and descriptive norms which considers the number of the participant's significant others who have used psychoactive substances. Perceived behavioral control refers to perceived availability of resources and opportunities that enable a person to perform a behavior, in this case, using psychoactive substances. The TPB specifies that attitudes, subjective norm and

perceived behavioral control regarding a behavior would affect the behavioral intention, which in turn determines the actual behavior. It is potentially applicable to understand factors of psychoactive substance use among MSM.

A report showed that 96% of the residents in Hong Kong have access to smartphone [28]. There are 4.4 million users of social networking websites (e.g., Facebook) in Hong Kong, the penetration rate is over 60%, Every day, 3.1 million people log onto these websites [29]. The spread of psychoactive substance use among local MSM is potentially expedited through social media. Posts on these social networking websites (e.g., Facebook, Twitter) are known to portray substance use (e.g., marijuana) as normative [30,31]. In addition, MSM in Hong Kong reported high frequency of using location-aware gay social networking mobile applications (gay apps, such as "Grindr" or "Jack'd"), which provide a quick and convenient means to locate and connect with other MSM nearby [32]. Direct communications with other MSM regarding risk behaviors through these apps are common [32,33]. Previous studies suggested that higher level of exposure to contents related to a risk behavior on social media would have a stronger impact on their attitudes, norms and behavioral intention related to such behavior, and would hence influence occurrence of actual behavior (e.g., [34]). In this study, we will measure the level of exposure to contents normalizing/promoting/against psychoactive substance from the aforementioned social networking websites and apps.

As compared to other high risk populations, MSM tend to have large and intense social networks [35]. Peers of an individual's social network are shown to be the most common source to obtain psychoactive substances [36,37]. Previous studies indicated that number of peers in one's social network who are psychoactive substance users [38,39], the type of relationship one has with substance using peers (e.g., regular sex partner, close friends, etc.) [39,40], and frequency of communication regarding psychoactive substance use with peers [39] have had strong influences on psychoactive substance use behaviors in different populations [38-40], including MSM [39]. These variables are included in this study. The findings will provide insights for developing health promotion campaigns by making use of peer influences and social networking approaches. Such approaches were shown to be effective in reducing risk behaviors among MSM [41] and drug users [42,43].

MSM are less likely to use health-related services than general male population [44]. Although a number of services for substance abuse prevention and cessation are readily

available in Hong Kong (http://www.nd.gov.hk/en/usefullink.htm), it is unclear whether MSM are aware of such services, whether they are willing to receive information related to psychoactive substances (e.g., types of substances, addictiveness and harm), and what their preferable sources of obtaining such information are. For those who are at risk (i.e., ever-users, current-users and/or those with intention to use), it is important to know their actual utilization and intention to use the existing services and new services (e.g., e-health or peer education) and the facilitators and obstacles involved (some might be related to their MSM identity). This study will also investigate these issues.

In this study, types of psychoactive substances included ketamine (or "K"), methamphetamine, cocaine, cannabis (marijuana or hemp), ecstasy (MEDA or "E"), Dormicum/Halcion/Erimin 5/hypnotic drugs (non-prescription), heroin, cough suppressant (not for curing cough), popper, γ-hydroxybutyrate (GHB or G water), and Foxy. Such definition was the same as that used by some national-level studies (e.g., [45]).

The objectives of this study were to investigate:
1. Profiles of psychoactive substance use among MSM in Hong Kong, including: 1) duration, types and occasions of psychoactive substance use, and 2) reasons for using psychoactive substance.
2. Factors associated with psychoactive substance in one's lifetime and/or in the last 12 months and/or intention to use it in the future 12 months. These factors included socio-demographic variables, cognitions related to psychoactive substance use, influence of social media and peers, and psychosocial variables.
3. Awareness of existing substance abuse prevention services and willingness and preferable sources to receive prevention information related to psychoactive substances.
4. Issues related to service utilization among MSM who are ever/current-users and/or with intention to use psychoactive substances. Including 1) utilization of prevention and rehabilitation services, 2) behavioral intention to use such existing services and new services, and 3) perceived facilitators and obstacles of utilizing such services.

METHODS

Study design

A cross-sectional study was conducted among MSM in Hong Kong during April to December, 2018.

Participants

The inclusion criteria were: 1) Hong Kong Chinese speaking men, 2) ≥18 years old, and 3) anal intercourse with ≥1 man (last 12 months).

Data collection

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. 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. Participants were asked to leave their contact information for the telephone interview.

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 referrals of NGOs and peers. Multiple contacts (mobile, emails, social media account, etc.) was obtained to make an appointment to conduct a telephone interview. The interviewers confirmed their eligibility to participate in the study, briefed them about the details of the study and sought their informed consent. The interviewer signed on the same form pledging that he/she had gone through the proper procedures to obtain the verbal informed consent.

A telephone interview was conducted for all participants by trained interviewers upon appointment, 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.

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 (venues: 117; online: 401; referral: 193), 600 provided verbal informed consent and completed the telephone interview (venues: 85; online: 345; referral: 170). The response rate was 84.3%. Ethics approval was obtained from the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong.

Measures

Based on the literature review and discussion involving a panel consisting of a public health researcher, an epidemiologist, one psychologist, one MSM and one NGO worker in Hong Kong, the questionnaires was developed. The questionnaire was tested among 10 local MSM. Based on their feedback, the questionnaire was finalized by the panel.

1. Variables related to psychoactive substance use

1) Participants was given a checklist of psychoactive substances, which included ketamine (or "K"), methamphetamine, cocaine, cannabis (marijuana or hemp), ecstasy (MEDA or "E"), Dormicum/Halcion/Erimin 5/hypnotic drugs (non-prescription), heroin, cough suppressant (not for curing cough), popper, γ-hydroxybutyrate (GHB or G water), and Foxy. The number of different types of substances used in one's lifetime, in the last year and in the last 6 months were recorded.
2) Those who had used any type of the listed psychoactive substances in their lifetime were further asked about: i) duration of psychoactive substance use, ii) presence of injective drug use, and iii) average frequency of using psychoactive substances per month in the last year.
3) Those who had used any type of the listed psychoactive substances in the last year were asked about some details, including: i) sources of psychoactive substances, ii) reasons for using psychoactive substances (e.g., increasing sexual pleasure, reducing pressure, curiosity, etc.), iii) patterns of psychoactive substances use (i.e., psychoactive substances use before/during sexual intercourse, alcohol consumption when using psychoactive substances, poly-use of psychoactive substances).
4) Behavioral intention to use any of the aforementioned types of psychoactive substances in the next year.

2. Cognitions related to psychoactive substance use

The following scales derived from the Theory of Planned Behavior (TPB) [46] were constructed for this study based on Ajzen's guideline [47].

1) Positive attitudes toward psychoactive substance use were measured by two items (i.e., 'Psychoactive substances allow you temporary escape from reality' and 'Psychoactive substances increase your sexual pleasure'). The Positive Attitude Scale was formed by summing up individual item scores (from 1=strongly disagree to 5=strongly agree). Higher score on the scale indicated more positive attitudes toward psychoactive substance use.
2) Two items (from 1=strongly disagree to 5=strongly agree) were used to measure negative attitudes toward psychoactive substance use (i.e., 'Psychoactive substance use will harm your cognitive function' and 'Psychoactive substance use will have negative impact on your relationship with sex partners". The Negative Attitude Scale was formed by summing up individual item scores. Higher score on the scale indicated more negative attitudes toward psychoactive substance use.
3) Two items were used to measure participants' perceived support from their significant others (male sex partners and MSM friends) for using psychoactive substances. Items will be measured on a 5-point Likert Scale from 1=strongly disagree to 5=strongly agree. The Perceived Subjective Norm Scale was constructed by summing up individual item scores. Higher score indicated perceived subjective norm more supportive of psychoactive substance use.
4) Perceived behavioral control in using psychoactive substance use was measured by two items ('If your sex partner asks you to use psychoactive substances, it is difficult for you to refuse' and 'You can exercise self-control not to use psychoactive substances'). The Perceived Behavioral Control Scale was constructed by summing up individual item scores. Higher score indicated higher perceived behavioral control not to use psychoactive substances. Cronbach's alpha for these scales was 0.789, 0.669, 0.790, and 0.666, respectively.

In addition, one item was used to measure perceived descriptive norm related to psychoactive substance use (i.e., 'How many local MSM had ever used psychoactive substances') (Response categories: 1=not at all, 2=less than half, 3=half, 4=more than half, 5=almost all).

3. Influence of social media specific to psychoactive substance use

1) Frequency of exposing to the following information related to psychoactive substance on social media/gay social networking apps in the last 12 months were asked. They were: i)

sharing personal experiences supporting psychoactive substance use, ii) sharing of personal experience against psychoactive substance, iii) receiving personal invitations from MSM friend for using psychoactive substance, iv) receiving personal invitations from strangers for using psychoactive substance, and v) commentary/discussion about psychoactive substance use (response categories: 1=never, 2=seldom, 3=sometimes, 4=always).

2) One item was used to assess overall framing of information specific to psychoactive substance use on social media/gay social networking apps in the last 12 months (Response categories: from 1=strongly against, to 5=strongly support).

4. Influence of peers related to psychoactive substance use

1) Number of peers in one's social network who are ever/current users of psychoactive substances was asked. If they had at least one peer who had done so, they were asked about their relationship with such peers (e.g., regular sex partner, casual sex partner, close friend, other friend and other relationship).
2) Frequency of being invited by their regular sex partner and close/other friends to use psychoactive substances in the last year was asked (response categories: 1=never, 2=seldom, 3=sometimes, 4=always).
3) Frequency of sending out invitation to regular sex partner and close/other friends to use psychoactive substances in the last year was also measured (response categories: 1=never, 2=seldom, 3=sometimes, 4=always)

5. Psychosocial variables

1) Mental health distress including depressive symptoms and anxiety symptoms was measured by validated Chinese versions of CESD-20 Scale [48,49] and GAD-7 Scale [50].
2) Positive and negative mood was measured by the Chinese version of the Positive and Negative Affect Schedule (PANAS) validated by our research team [51].
3) General stress appraisal was assessed using the Perceived Stress Scale (PSS), a 10-item self-report questionnaire with strong reliability and validity [52]. Respondents were asked to indicate how often they have felt or thought a certain way in the past month (e.g., "In the last month, how often have you been upset because of something that happened unexpectedly?" response categories: 0 = never, 4 = very often).
4) Six subscales of the Chinese version of the Brief Coping Orientation to Problems Experienced Scale (Brief COPE) (i.e., Substance use, Denial, Self-blame, Self-distraction, Behavioral disengagement, and Venting) were used to measure coping styles [53].

6. Issues related to services utilization

Among all MSM, the following questions were asked:

1) Their awareness of existing substance abuse prevention and rehabilitation services,
2) Willingness to receive information related to psychoactive substance (e.g., types, addictiveness and harm) and their preferable sources to obtain such information (e.g., Internet, other media, NGO or Department of Health).

Among MSM who are ever/current-users and/or with intention to use in the next 12 months, the following issues related to service utilization were investigated:

1) Utilization of the existing substance abuse prevention and rehabilitation services.
2) Intention to use the existing services and new services (e.g., e-health or peer-education programs)
3) Perceived obstacles (e.g., fear of being stigmatized, concern of privacy) of utilization of such services.

7. Background variables

1) Socio-demographic variables including age, highest educational level attained and monthly income level were collected.
2) Sexual risk behaviors, including condomless 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) were recorded. Participants were also asked about the number of male sex partners in the last year.
3) History of HIV, sexually transmitted infections (STI), and viral hepatitis were recorded.
4) HIV prevention service utilization in the last year (HIV testing and other services).
5) Binge drinking, defined as consuming five servings of alcohol on one occasion [54].
6) Tobacco use, defined as currently smoking daily or non-daily [55].

Statistical analysis

Prevalence of psychoactive substance use in one's lifetime and/or in the last 12 months and/or intention to use it in the future 12 months and its 95% CI was presented. Using psychoactive substances in one's lifetime and/or in the last 12 months and/or intention to use it in the future 12 months as the dependent variables and background variables measured at the baseline as independent variables, univariate odds ratios (ORu) predicting the dependent

variable were obtained. Adjusted for those significant background variables found in the univariate analysis, adjusted odds ratios (AOR) for the associations between the independent variables (e.g., cognitions based on TPB, influence of peers and social media, and psychosocial variables) and the dependent variables were reported. Respective 95% confident intervals (CI) were derived for the odds ratios. The same analytical methods have been used in a number of published studies [56-58]. SPSS version 16.0 was used for data analysis, with p values <.05 taken as statistically significant.

RESULTS

Background characteristics

Majority of the participants 18-30 years old (56.7%), had attained college education or above (84.2%), had monthly personal income ≥HK$20,000 (56.0%), had a full-time job (83.0%), and identified themselves as homosexuals (90.5%). Less than half of them were married/cohabited with a man (49.7%). Regarding HIV prevention service utilization, 71.7% and 55.5% had taken up HIV testing and other HIV prevention services in the last year. There were 20 participants self-reported to be HIV positive (3.3%), 112 (18.7%) and 17 (2.8%) reported histories of other sexually transmitted infections and viral hepatitis. In the last twelve months, 85.0% and 61.3% had had anal intercourse with RP and NRP, 40.2% and 70.0% reported condomless anal intercourse with men and multiple male sex partnerships, and 23.2% and 36.3% reported cigarette smoking and binge drinking. (Table 1)

Psychoactive substance use

Among all participants, the prevalence of using any types of psychoactive substances was 23.2% in lifetime and 16.8% in the last 12 months. Popper was the most commonly used psychoactive substance (17.8% in lifetime and 13.0% in the last 12 months), followed by Methamphetamine (8.0% in lifetime and 5.7% in the last 12 months), G water (6.0% in lifetime and 5.0% in the last 12 months), and Cannabis (4.2% in lifetime and 2.2% in the last 12 months). No participants reported use of heroin. Among all participants, 19.3% had Chemsex in their lifetime, while 15.0% had done so in the past year. (Table 2)

Among ever-users (n=139), 60% of them had used such substances for at least three years; 2.2% reported injective drug use. Among those who had used any type of psychoactive substance in the last year (n=101), 65.3% used such substances at least once per month, 32.7% had used ≥2 types of psychoactive substances in one occasion, and 20.8% reported

alcohol consumption when using psychoactive substances. Over 60% of participants obtained these substances from friends for free, 29.7% obtained them during Chemsex, and 25.7% purchased them from friends. Common reasons for using such substances included increasing sexual pleasure (69.3%), curiosity (53.5%), influence by sex partners (46.5%) and friends (41.6%). Among all participants, only 5.4% intended to use any types of psychoactive substance in the next year. (Table 3)

Cognitions and influences of social media/peers related to psychoactive substance use and psychosocial variables

Scale scores (Mean and standard deviation) of cognitions related to psychoactive substance use and psychosocial variables were shown in Table 4. On social media/gay social networking apps, 28-42.2% sometimes/always saw commentary/discussion or personal experience sharing supporting/against MSM to use psychoactive substances, 15.5% and 35.3% sometimes/always received invitation from MSM friends and strangers to use such substances, 56.6% found the overall framing of information specific to psychoactive substance use on social media/gay social networking apps to be neutral or supportive of psychoactive substance use. Majority of them reported there was at least one peer in their social network who was ever/current user of psychoactive substance (79.7%). (Table 4)

Factors associated with psychoactive substance use in lifetime

In univariate analysis, without a full-time job (ORu: 1.87, 95%CI: 1.19, 2.98), utilization of other HIV prevention service in the last year (ORu: 1.79, 95%CI: 1.20, 2.66), being HIV positive (ORu: 2.86, 95%CI: 1.16, 7.07), history of STI (ORu: 2.96, 95%CI: 1.91, 4.59), had had anal intercourse with NRP (ORu: 4.45, 95%CI: 2.72, 7.27), presence of condomless anal intercourse with men (ORu: 2.34, 95%CI: 1.59, 3.44) and multiple sex partnership (ORu: 3.39, 95%CI: 2.01, 5.70), and cigarette smoking (ORu: 3.84, 95%CI: 2.54, 5.81) were positively associated with psychoactive substance use in lifetime. A negative and significant association was found between personal monthly income and this dependent variable (HK$20,000-39,999/month: ORu: 0.56, 95%CI: 0.32, 0.99; reference group: <HK$10,000/month). (Table 6)

Adjusted for these significant background variables, all five constructs of the TPB were significantly associated with this dependent variable in expected direction. Positive attitudes toward psychoactive substance use (AOR: 1.42, 95%CI: 1.28, 1.58), perceived subjective

norms supporting psychoactive substance use (AOR: 1.65, 95%CI: 1.44, 1.90), and perceived half/more than half/almost all of local MSM had ever used psychoactive substances (AOR: 1.92, 95%CI: 1.20, 3.07) were associated with higher likelihood of psychoactive substance use in lifetime. Negative and significant associations were found for negative attitudes toward psychoactive substance use (AOR: 0.75, 95%CI: 0.66, 0.85) and perceived behavioral control not to use such substances (AOR: 0.64, 95%CI: 0.56, 0.74). (Table 7)

Regarding influence of social media, higher frequency of exposing to the following information was positively associated with psychoactive substance use in lifetime: 1) sharing personal experiences supporting psychoactive substance use (AOR: 1.51, 95%CI: 1.24, 1.81), 2) sharing of personal experience against psychoactive substance (AOR: 1.43, 95%CI: 1.17, 1.75), 3) receiving personal invitations from MSM friend for using psychoactive substance (AOR: 1.55, 95%CI: 1.24, 1.92), 4) receiving personal invitations from strangers for using psychoactive substance (AOR: 1.28, 95%CI: 1.07, 1.55), and 5) commentary/discussion about psychoactive substance use (AOR: 1.31, 95%CI: 1.03, 1.66). Overall framing of such information on social media/gay social networking apps was not significantly associated with psychoactive substance use in lifetime. (Table 7)

Regarding influence of peers, having higher number of peers in one's social network who were ever/current psychoactive substance users (3-5: AOR: 6.47, 95%CI: 2.53, 16.58; 6-10: AOR: 15.90, 95%CI: 5.40, 46.80; >10: AOR: 17.42, 95%CI: 6.50, 47.73; reference group: 0), being invited by regular sex partners (AOR: 1.84, 95%CI: 1.15, 2.96) or close/other friends (AOR: 2,78, 95%CI: 1.65, 4.68) to use psychoactive substances were also associated with this dependent variable. (Table 7)

None of the psychosocial variables was associated with psychoactive substance use in lifetime, with the exception of substance use coping style (AOR: 1.15, 95%CI: 1.01, 1.32). (Table 7)

Factors associated with psychoactive substance use in the last 12 months

In univariate analysis, the following background variables were significantly associated with psychoactive substance use in the last 12 months. They were: 1) without a full-time job (ORu: 1.80, 95%CI: 1.08, 3.01), 2) utilization of other HIV prevention service in the last year (ORu: 1.64, 95%CI: 1.05, 2.56), 3) being HIV positive (ORu: 3.54, 95%CI: 1.46, 8.91), 4)

history of STI (ORu: 2.58, 95%CI: 1.60, 4.17), 5) had had anal intercourse with NRP (ORu: 7.29, 95%CI: 3.71, 14.34), 6) condomless anal intercourse with men (ORu: 2.70, 95%CI: 1.74, 4.19), 7) multiple sex partnership (ORu: 4.70, 95%CI: 2.39, 9.27), and 8) cigarette smoking (ORu: 3.46, 95%CI: 2.20, 5.54).

Adjusted for these significant background variables, all five constructs of the TPB were significantly associated with this dependent variable in expected direction. They were: 1) the Positive Attitude Scale (AOR: 1.44, 95%CI: 1.28, 1.62), 2) the Negative Attitude Scale (AOR: 0.68, 95%CI: 0.59, 0.78), 3) the Subjective Norm Scale (AOR: 1.76, 95%CI: 1.52, 2.05), 4) the Perceived Behavioral Control Scale (AOR: 0.63, 95%CI: 0.54, 0.73), and 5) perceived half/more than half/almost all of local MSM were psychoactive substance users (descriptive norm) (AOR: 3.20, 95%CI: 1.94, 5.30).

Higher frequency of exposing to: 1) sharing personal experiences supporting psychoactive substance use (AOR: 1.51, 95%CI: 1.21, 1.89), 2) sharing of personal experience against psychoactive substance (AOR: 1.33, 95%CI: 1.07, 1.67), 3) receiving personal invitations from MSM friend for using psychoactive substance (AOR: 1.68, 95%CI: 1.33, 2.12), 4) receiving personal invitations from strangers for using psychoactive substance (AOR: 1.43, 95%CI: 1.16, 1.76), and 5) commentary/discussion about psychoactive substance use (AOR: 1.39, 95%CI: 1.07, 1.82) were significantly associated with this dependent variable. (Table 7)

Having higher number of peers in one's social network who were ever/current psychoactive substance users (3-5: AOR: 8.69, 95%CI: 2.51, 30.05; 6-10: AOR: 14.77, 95%CI: 3.75, 58.19; >10: AOR: 20.24, 95%CI: 5.70, 71.87; reference group: 0) and being invited by regular sex partners to use psychoactive substances (AOR: 7.56, 95%CI: 3.99, 14.32) were also associated with this dependent variable. (Table 7)

The only significant psychosocial variable was substance use coping style (AOR: 1.22, 95%CI: 1.05, 1.43). (Table 7)

Factors associated with behavioral intention to use any psychoactive substance in the next 12 months

In univariate analysis, six background variables were significantly associated with this dependent variable. They were: 1) being HIV positive (ORu: 4.65, 95%CI: 1.46, 14.84), 2)

history of STI (ORu: 6.48, 95%CI: 3.12, 13.49), 3) history of viral hepatitis (ORu: 4.09, 95%CI: 1.11, 15.05), 4) had had anal intercourse with NRP (ORu: 3.60, 95%CI: 1.36, 9.47), 5) condomless anal intercourse with men (ORu: 4.10, 95%CI: 1.86, 9.03), and 6) multiple sex partnership (ORu: 6.85, 95%CI: 1.62, 28.96).

Adjusted for these significant background variables, all five constructs of the TPB were significantly associated with this dependent variable, including: 1) the Positive Attitude Scale (AOR: 1.46, 95%CI: 1.21, 1.75), 2) the Negative Attitude Scale (AOR: 0.65, 95%CI: 0.54, 0.80), 3) the Subjective Norm Scale (AOR: 1.61, 95%CI: 1.34, 1.94), 4) the Perceived Behavioral Control Scale (AOR: 0.79, 95%CI: 0.65, 0.95), and 5) perceived half/more than half/almost all of local MSM were psychoactive substance users (descriptive norm) (AOR: 3.06, 95%CI: 1.41, 6.64).

Higher frequency of exposing to sharing personal experiences supporting psychoactive substance use (AOR: 1.58, 95%CI: 1.11, 2.25), being invited by regular sex partners to use psychoactive substances (AOR: 4.27, 95%CI: 1.85, 9.83), and substance use coping style (AOR: 1.22, 95%CI: 1,01, 1.48) were also associated with higher behavioral intention to use psychoactive substances in the next 12 months.

Issues related to services utilization

Among all participants, 46.7% were aware of drug cessation/rehabilitation services in Hong Kong; 51.7% were willing to receive information related to psychoactive substances (e.g., types, harms and addictiveness). The most preferable sources to obtain such information was Internet (62.5%), followed by non-governmental organizations (54.7%), Department of Health (36.2%), other media (e.g., TV, radio) (27.8%) and other channels (7.3%). (Table 5)

Among MSM who are ever/current-users and/or with intention to use psychoactive substances (n=140), only 2.9% and 7.9% had ever used governmental and non-governmental drug cessation/rehabilitation services, respectively. The prevalence of behavioral intention to use governmental (1.4%) and non-governmental (3.6%) drug cessation/rehabilitation services in the next year was also very low. Major obstacles to use such services in Hong Kong included: 1) concerns that others would know their privacy (55.0%), 2) concerns that service providers are not familiar with MSM sub-culture (47.9%), 3) inconvenience to go to facilities

providing such services, and 4) concerns about being stigmatized by service providers due to their MSM identity (42.1%). (Table 5)

DISCUSSION

Findings of this study showed that psychoactive substance use was prevalent among local MSM. Such prevalence (23.8% in lifetime and 16.8% in the past year) was comparable to their counterparts in mainland China (27.7% in lifetime and 21% in the past year) [11], but lower than those reported among MSM in Australia (32.4% in the last six months) [2], U.K. (42.0% in the last year) [3], Thailand (32.0% in lifetime) [10] and Indonesia (31.0% in lifetime) [9]. As compared to the findings of a survey conducted by the Department of Health in 2014, a slight increase in prevalence of psychoactive substance use (last six months) was also observed (14.3% versus 11.1%) [13]. Very few participants showed behavioral intention to use these substances. However, the responses may subject to social disability bias and hence under-reported.

Information about the patterns of psychoactive substance use would provide health care workers with some insights for prevention of substance use. Close to 40% of the MSM who had used psychoactive substances in the last year had used them for at least three times a month; a significant proportion of them are regular substance users. Our findings also suggested that psychoactive substance use among MSM may start early, as about 40% reported their first attempt to be more than five years ago. Therefore, primary prevention programs should start early. Early detection of high risk adolescents and provision of secondary prevention are also warranted. Some harm reduction health promotion may also be needed for local MSM. It is dangerous to use multiple psychoactive substances and to use it with alcohol. However, our data showed that such practices were quite common among local MSM. It is uncertain how many of them worried about potential harms of such dangerous practices.

Choices of psychoactive substances may be quite different between MSM and other groups. While Hong Kong young drug abusers were mainly using ecstasy and ketamine [59], popper (amyl nitrites), methamphetamine and γ-hydroxybutyrate (GHB or G water) were favored by our participants. Recent studies showed that MSM use psychoactive substances mainly in sexual settings [60,61], which may be different from other substance abusers. Our study showed that over 80% of psychoactive substance users had used such substances before or

during sexual intercourse (83.2% in lifetime and 89.3% in the last year), a phenomenon colloquially known as Chemsex. It is known that popper, methamphetamine and G water could facilitate anal intercourse and increase sexual pleasure. For example, popper dilates the anal sphincter, facilitates anal intercourse among MSM, and increases euphoria and sexual orgasms. Methamphetamine could dramatically increase sexual libido, heighten sexual pleasure, and prolong sexual activities by postponing ejaculation [62]. In particular, it may prompt MSM to engage in sexual practices (e.g., group sex) that are usually considered taboo or unachievable [63]. Other reasons included facilitation of partner acquisition (e.g.,[64]), enhancement of sexual self-confidence and self-esteem (e.g., [64]), prompting people to act more freely in sexual behaviors (e.g., [65]) and overcoming concerns related to body images or sexual performance (e.g., [64]). Service providers should understand these differences and reasons behind in order to develop tailored programs for MSM substance abusers.

Similar to the findings of studies conducted in mainland China [66] and some western countries [67], our study confirmed the strong association between psychoactive substance use and HIV/STI risk. Positive associations between psychoactive substance use and HIV/STI infection were found in this study. Moreover, HIV-positive MSM expressed much higher intention to use these substances in the next year. Psychoactive substance use/intention was strongly associated with higher likelihood of anal intercourse with casual sex partner, condomless anal intercourse and multiple male sex partnerships in the last year. As suggested by previous studies, psychoactive substance use would adversely affect users' capacity to perceive and respond to risks during sexual encounters and prompt them to engage in sexual risk behaviors, increasing risk of HIV/STI transmission (e.g., [64,65]). It was interesting to find that MSM using psychoactive substances were more likely to seek HIV prevention services in the last year, probably due to their elevated risk of HIV/STI. Therefore, local organizations providing drug prevention/cessation/rehabilitation services should work with those providing HIV prevention services for MSM to enhance their service coverage. Special attention should be given to HIV-positive MSM.

In contrast to our hypothesis, mental health status, positive and negative affect, and perceived stress were not significantly associated with past behaviors or behavioral intention to use psychoactive substance. One possible explanation was that the main purpose for using these substances among local MSM was to facilitate sexual behaviors instead of coping with stress. Studies consistently showed that psychoactive substance dependence was significantly

associated with poorer mental health status [68]. Since most participants in our study used psychoactive substance episodically with sex and they mainly used popper which had not been proven to cause tolerance or physical dependence, the level of psychoactive substance dependence may be quite low among our participants.

Importantly, the results confirmed that cognitive behavioral theories such as the TPB are potential useful in designing relevant interventions, as all five constructs of the TPB used in this study were significantly associated with past behaviors/behavioral intention to use psychoactive substances in expected direction. Negative attitudes toward psychoactive substance use was a protective factor and should be strengthened in future interventions. In addition to the long-term harmful effects on cognitive function, health communication should emphasize that using such substances may adversely affect their capacity to perceive and respond to risks during sexual encounters, and hence resulting in sex with casual partners. HIV/STI infection is likely to happen under such condition, which will destroy the dyadic trust and intimacy with sex partners that they value [69]. Removing positive attitudes toward psychoactive substance use is also needed. About 20% of the participants would allow them escape from reality and enhance sensation during anal intercourse, a state of ambivalence exists between short-term benefits and long-term adverse effects. Motivational interviewing (MI) is a client-centered, non-directive, goal-oriented counseling technique that facilitates clients to explore and resolve ambivalence, the process may lead to behavioral changes [70]. MI is effective in changing various health behaviors including illicit drug use, alcohol consumption, tobacco use, and sexual risk behaviors [70-74], and was included among U.S. CDC's list of best evidence interventions [75]. It is a potential useful means for preventing psychoactive substance use among MSM.

Although less than 5% of the participants perceived their significant others (e.g., sex partners or MSM friends) would support their use of psychoactive substances, such perception was positively associated with past behaviors/behavioral intention of psychoactive substance use. Health promotion lead by influential peers may be useful to build up subjective norm against psychoactive substance use. Over 30% of the participants perceived at least half of local MSM had ever used these substance, such perception was another risk factor of psychoactive substance use. Future health promotion should correct this misconception. Perceived behavioral control in avoiding psychoactive substance use need to be further strengthened as

it was a protective factor. Enhancement in refusal skills is warranted. Rehearsals may be a useful part of future health promotion programs.

The findings also highlighted strong influence of social media/gay social networking apps on psychoactive substance use among local MSM. Review article suggested that Internet is now acting as an ideal platform to promote and market these substances, leading to a global phenomenon [76]. Hidden by several aliases, these substances are sold across the Internet, and information about consumption is shared by online communities through forums, Facebook, YouTube channels, and smartphone applications [76]. Our results showed that 28-42.2% of local MSM are frequently exposed to information related to psychoactive substances, and 15.5-35.3% had received personal invitation to use psychoactive substances from their friends and strangers. All these exposures were associated with higher prevalence of psychoactive substance use/behavioral intention to use. Our findings also indicated that overall framing of information on these online platforms to be against psychoactive substance use was a protective factor. Since Internet was the most preferable source to obtain drug cessation/rehabilitation information among local MSM, future health promotion should consider using these same channels responsible for diffusing psychoactive substances to make users aware of the harm and risk associated with these substances.

About 80% of the participants had at least one peer in their social network who was psychoactive substance users. Higher number of substance using peers and being invited by regular sex partners and MSM friends were among the strongest risk factors in this study. The literature suggested that not all types of social support would lead to desirable health outcomes. Social support from drug users was especially found to have adverse effects, such as HIV infection and sexual risk. Future health promotion campaigns should consider replace substance-using peers by those living healthy life-styles.

Serious issues related to drug cessation/rehabilitation service utilization was observed. Although these services are readily available in Hong Kong, only less than half of the participants were aware of such services. Among those who were ever/current/intended users, only 2.9% and 7.9% had ever used drug cessation/rehabilitation services provided by governmental and non-governmental organizations. Their intention to use these services was also very low. Drug cessation/rehabilitation service are under-utilized by local MSM. In addition to logistic barriers, considering service providers being not gay-friendly was another

obstacle to use these services. It is hence needed to provide training for the existing counselors in these organizations about sub-culture of MSM. These organizations should also consider recruiting MSM peers as service providers.

Our study was the first one looking at details of psychoactive substance use among local MSM. However, it had some limitations. First of all, participants were recruited by non-probabilistic sampling in the absence of sampling frame; the results might not be representative of MSM in Hong Kong. However, studies using similar sampling approaches were commonly used both locally and internationally. 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, we confined our sample to those with anal intercourse. Ideally, we could have stratified our data analysis by subgroups with and without anal sex behavior, as different factors of psychoactive substance use and different implications for interventions might be involved. Such separate analysis, however, not feasible due to our limited resources. We hence focused on those with anal intercourse. Fourth, the results were self-reported, and reporting bias may exist. The prevalence of psychoactive substance use may have been under-reported, although anonymity should have reduced the bias. Moreover, some scales/items were self-constructed for this study. Last but not least, this was a cross-sectional survey and could not establish causal relationship.

CONCLUSION

Although psychoactive substance use was prevalent among local MSM, their utilization of drug cessation/rehabilitation services are very low. Use of psychoactive substances was associated with sexual risk behaviors and HIV/sexual transmitted infections. Effective interventions are warranted. Such interventions should consider perceptions, influence of social media and peers.

Table 1 Background characteristics of the participants (n=600)

	N	%
Socio-demographic characteristics		
Age group		
18-30	340	56.7
31-40	188	31.3
>40	72	12.0
Highest educational level attained		
Senior high or below	95	15.8
College or above	505	84.2
Current marital status		
Currently single	296	49.3
Married/cohabited with a man	298	49.7
Married/cohabited with a woman	6	1.0
Monthly personal income (HK$)		
<10,000	84	14.0
10,000-19,999	174	29.0
20,000-39,999	220	36.7
40,000 and above	116	19.3
Refuse to disclose	6	1.0
Current employment status		
Full-time	498	83.0
Part-time/unemployed/retired/students	102	17.0
Sexual orientation		
Homosexual	543	90.5
Bisexual	52	8.7
Heterosexual	5	0.8
Service utilization		
HIV testing in the last 12 months		
No	170	28.3
Yes	430	71.7
Other HIV prevention services in the last 12 months (e.g., condom distribution, peer education, pamphlet and lectures)		
No	267	44.5
Yes	333	55.5
History of HIV/sexual transmitted infections		
Self-reported HIV status		
Had never tested for HIV	24	4.0

Negative	549	91.5
Positive	20	3.3
Refuse to disclose	7	1.2
History of sexually transmitted infections (STI)		
No	488	81.3
Yes	112	18.7
History of viral hepatitis		
No	583	97.2
Yes	17	2.8
Sexual behaviors in the last 12 months		
Had had anal intercourse with regular male sex partners (RP)		
No	90	15.0
Yes	510	85.0
Had had anal intercourse with non-regular male sex partners (NRP)		
No	232	38.7
Yes	368	61.3
Condomless anal intercourse with men		
No	359	59.8
Yes	241	40.2
Multiple male sex partnerships		
No	180	30.0
Yes	420	70.0
Other risk behaviors in the last 12 months		
Cigarette smoking		
No	461	76.8
Yes	139	23.2
Binge drinking		
No	382	63.7
Yes	218	36.3

Table 2 Psychoactive substance use and Chemsex in different reference periods among MSM in Hong Kong (n=600)

	Lifetime	In the past year	In the past six months
	%	%	%
Use of specific type of psychoactive substance in the reference period			
K/Ketamine	2.3	0.7	0.5
Methamphetamine	8.0	5.7	4.8
Cocaine	1.2	0.3	0.3
Cannabis / Marijuana / Hemp	4.2	2.2	1.5
MEDA / E	3.3	1.0	0.7
Dormicum / Halcion / Erimin 5 / Hypnotic drugs (non-prescription)	0.3	0.0	0.0
Heroin	0.0	0.0	0.0
Cough suppressant (not for curing cough)	0.3	0.2	0.2
Popper	17.8	13.0	10.8
G water	6.0	5.0	3.7
Foxy	1.5	1.0	0.8
Others	0.2	0.0	0
Any of above	23.2	16.8	14.3
Chemsex (Use of psychoactive substance before/during sexual intercourse)	19.3	15.0	--

Table 3 Details of psychoactive substance use

	%
Among those who had ever used psychoactive substances (n=139)	
Duration of psychoactive substance use	
<6 months	5.0
6-11 months	8.6
1-2 years	27.3
3-5 years	20.9
>5 years	38.1
History of injective drug use	
No	97.8
Yes	2.2
Among those who had used any types of psychoactive substance in the last year (n=101)	
Frequency of psychoactive substance use in the last year	
<1 episode/month	34.7
1-2 episodes/month	27.8
3-4 episodes/month	32.7
≥5 episodes/month	5.0
Had had used two or more types of psychoactive substances in one occasion	
No	67.3
Yes	32.7
Alcohol consumption when using psychoactive substances	
No	79.2
Yes	20.8
Had had used psychoactive substance under any circumstances that does not involve sexual behaviors	
No	16.8
Yes	83.2
Sources of psychoactive substances	
Provided by friends for free	68.3
Purchased from friends	25.7
Purchased online	13.9
Purchased from local drug dealers	12.9
Obtained it during Chemsex	29.7
Obtained it during sex party / group sex	12.9
Obtained it from outside Hong Kong	12.9
Other sources	3.0

Reasons for using psychoactive substances	
Increasing sex pleasure	69.3
Reducing pressure	37.6
Curiosity	53.4
Influence of friends	41.6
Influence of sex partners	46.5
Influence of social media	8.9
Had ever used governmental drug cessation and rehabilitation services	
No	96.0
Yes	4.0
Had ever used non-governmental drug cessation and rehabilitation services	
No	89.1
Yes	10.9

Table 4 Perceptions, influence of peers and social media related to psychoactive substance use (n=600)

	%	Mean (SD)
Behavioral intention to use any type of psychoactive substances		
Likelihood of using any type of psychoactive substances in the next year		
Very low / low / moderate	94.7	
High / very high	5.3	
Perceptions related to psychoactive substances based on the Theory of Planned Behavior		
Positive attitudes toward psychoactive substances (% agree/strongly agree)		
Psychoactive substances allows you temporary escape from reality	17.7	
Psychoactive substances increases your sexual pleasure	23.2	
Positive Attitude Scale		4.6 (2.4)
Negative attitudes toward psychoactive substances (% agree/strongly agree)		
Psychoactive substances will harm your cognitive function	94.0	
Psychoactive substances will have negative impact on your relationship with sex partners	64.0	
Negative Attitude Scale		8.7 (1.6)
Perceived subjective norm related to psychoactive substance use (% agree/strongly agree)		
Your male sex partners will support you to use psychoactive substances	4.8	
Your MSM friends will support you to use psychoactive substances	2.8	
Subjective Norm Scale		3.0 (1.6)
Perceived descriptive norm related to psychoactive substance use		
Number of local MSM who had ever used psychoactive substance		
Not at all / less than half	69.0	
Half / more than half / almost all	31.0	
Perceived behavioral control related to psychoactive substance use (% agree/strongly agree)		
If your sex partner ask you to use psychoactive substances, it is difficult for you to refuse (R)	10.0	
You can exercise self-control to stop using psychoactive substance	90.2	
Perceived Behavioral Control Scale		8.8 (1.7)

Influence of social media specific to psychoactive substance use	
Frequency of exposing to information related to psychoactive substance on social media/gay social networking apps in the last 12 months (% sometimes/always)	
Sharing of personal experiences to support MSM to use psychoactive substances	42.2
Sharing of personal experience to against MSM to use psychoactive substances	30.0
Receiving personal invitations to use psychoactive substances from MSM friends	15.5
Receiving personal invitations to use psychoactive substances from strangers	35.3
Commentary/discussion about psychoactive substance use	28.0
Overall framing of information specific to psychoactive substance use on social media/gay social networking apps	
Strongly against / against	37.0
Neutral	39.3
Support / strongly support	23.6
Influence of peers specific to psychoactive substance use	
Number of peers in your social network who are ever/current users of psychoactive substances	
0	20.3
1-2	23.7
3-5	31.3
6-10	8.2
>10	16.5
Relationships with ever/current psychoactive substance users (among 478 participants who had such peers)	
Regular sex partners	10.0
Non-regular sex partners	22.8
Commercial sex partners	2.7
Close friends	27.0
Other friends	77.6
Colleague	4.4
Others	1.7
Frequency of being invited by the regular sex partners to use psychoactive substance in the last 12 months	

Never	88.8
Seldom	6.3
Sometimes	2.0
Always	2.8
Frequency of being invited by the close/other friends to use psychoactive substance in the last 12 months	
Never	82.3
Seldom	12.3
Sometimes	3.8
Always	1.5
Frequency of sending out invitation to regular sex partners to use psychoactive substance in the last 12 months	
Never	96.3
Seldom	1.5
Sometimes	1.5
Always	0.8
Frequency of sending out invitation to close/other friends to use psychoactive substance in the last 12 months	
Never	98.0
Seldom	1.0
Sometimes	0.7
Always	0.3
Psychosocial variables	
CESD-10	7.8 (6.1)
GAD-7	4.6 (5.3)
Positive and Negative Affect Schedule	
Positive mood	27.7 (7.1)
Negative mood	17.8 (7.2)
Perceived Stress Scale	15.7 (6.5)
Brief Cope Scale	
Substance use	3.4 (1.7)
Denial	2.9 (1.4)
Self-blame	4.7 (1.9)
Self-distraction	5.2 (1.8)
Behavioral disengagement	3.7 (1.7)
Venting	5.8 (1.6)

R: reverse scoring

Table 5 Issues related to drug cessation/rehabilitation services

	N	%
Among MSM who are ever/current users and/or with intention to use psychoactive substance use (n=140)		
Had ever used governmental drug cessation/rehabilitation services		
No	136	97.1
Yes	4	2.9
Had ever used non-governmental drug cessation/rehabilitation services		
No	129	92.1
Yes	11	7.9
Intention to use governmental drug cessation/rehabilitation services in the next year		
Very unlikely / unlikely /neutral	138	98.6
Likely / very likely	2	1.4
Intention to use non-governmental drug cessation/rehabilitation services in the next year		
Very unlikely / unlikely /neutral	135	96.4
Likely / very likely	5	3.6
Willingness to use the following drug cessation/rehabilitation services (% Yes)		
Online drug cessation/rehabilitation services	0	0.0
MSM-initiated drug cessation/rehabilitation services	0	0.0
Perceived obstacles of using drug cessation/rehabilitation services in Hong Kong (% agree)		
Concerns of being stigmatized by service providers due to MSM identity	59	42.1
Concerns that service providers are not familiar with MSM sub-culture	67	47.9
Concerns about others would know your privacy	77	55.0
It is inconvenient for you to go to facilities providing such services	61	43.6
Among all participants (n=600)		
Awareness of drug cessation/rehabilitation services in Hong Kong		
No/uncertain	320	53.3
Yes	280	46.7
Willingness to receive information related to psychoactive substances		
Very unlikely/unlikely/neutral	290	48.3
Likely/very likely	310	51.7
Preferable sources to obtain information related to psychoactive substances		
Department of Health	217	36.2
Non-governmental organizations	328	54.7

Internet	375	62.5
Other media (e.g., TV, radio)	167	27.8
Other channels	44	7.3

Table 6 Background variables associated with past behaviors and behavioral intention use of psychoactive substances (n=600)

	Use of any psychoactive substances in lifetime		Use of any psychoactive substance in the last year		Behavioral intention to use psychoactive substance in the next year	
	Row%	ORu (95%CI)	Row%	ORu (95%CI)	Row%	ORu (95%CI)
Socio-demographic characteristics						
Age group						
18-30	20.6	1.0	15.6	1.0	4.4	1.0
31-40	27.7	1.48 (0.98, 2.23)	20.2	1.37 (0.87, 2.18)	8.5	2.02 (0.97, 4.18)†
>40	23.6	1.19 (0.65, 2.18)	13.9	0.87 (0.42, 1.81)	1.4	0.31 (0.04, 2.35)
Highest educational level attained						
Senior high or below	29.5	1.0	23.2	1.0	4.2	1.0
College or above	22.0	0.67 (0.41, 1.10)	15.6	0.62 (0.36, 1.05)†	5.5	1.34 (0.46, 3.90)
Current marital status						
Currently single	24.7	1.0	18.9	1.0	4.2	1.0
Married/cohabited with a man	21.5	0.84 (0.57, 1.23)	14.8	0.74 (0.48, 1.14)	6.7	1.70 (0.82, 3.55)
Married/cohabited with a woman	33.3	1.53 (0.27, 8.51)	16.7	0.86 (0.10, 7.48)	0.0	N.A.
Monthly personal income (HK$)						
<10,000	31.0	1.0	21.4	1.0	2.4	1.0
10,000-19,999	24.1	0.71 (0.40, 1.27)	19.5	0.89 (0.47, 1.69)	6.3	2.77 (0.60, 12.78)
20,000-39,999	20.0	**0.56 (0.32, 0.99)***	14.1	0.60 (0.32, 1.15)	5.9	2.58 (0.57, 11.66)
40,000 and above	22.4	0.64 (0.34, 1.22)	14.7	0.63 (0.30, 1.31)	5.2	2.24 (0.44, 11.37)
Refuse to disclose	16.7	0.45 (0.05, 4.01)	16.7	0.73 (0.08, 6.68)	0.0	N.A.
Current employment status						

Full-time	21.1	1.0	15.3	1.0	5.6	1.0
Part-time/unemployed/retired/students	33.3	**1.87 (1.18, 2.98)****	24.5	**1.80 (1.08, 3.01)***	3.9	0.69 (0.24, 2.00)
Sexual orientation						
Homosexual	23.6	1.0	16.8	1.0	5.3	1.0
Bisexual	21.2	0.87 (0.43, 1.74)	19.2	1.18 (0.57, 2.44)	5.8	1.09 (0.32, 3.69)
Heterosexual	0.0	N.A.	0.0	N.A.	0.0	N.A.
Service utilization						
HIV testing in the last 12 months						
No	20.6	1.0	15.9	1.0	4.7	1.0
Yes	24.2	1.23 (0.80, 1.90)	17.2	1.10 (0.68, 1.78)	5.6	1.20 (0.53, 2.72)
Other HIV prevention services in the last 12 months (e.g., condom distribution, peer education, pamphlet and lectures)						
No	17.6	1.0	13.1	1.0	4.9	1.0
Yes	27.6	**1.79 (1.20, 2.66)****	19.8	**1.64 (1.05, 2.56)***	5.7	1.18 (0.57, 2.44)
History of HIV/sexual transmitted infections						
Self-reported HIV status						
Negative	22.0	1.0	15.8	1.0	5.1	1.0
Positive	45.0	**2.86 (1.16, 7.07)***	40.0	**3.54 (1.46, 8.91)****	20.0	**4.65 (1.46, 14.84)****
Refuse to disclose	57.1	**4.67 (1.03, 21.13)***	42.9	3.98 (0.88, 18.11)†	0.0	N.A.
Had never tested for HIV	16.7	0.70 (0.24, 2.09)	12.5	0.76 (0.22, 2.60)	0.0	N.A.
History of sexually transmitted infections (STI)						
No	19.1	1.0	13.9	1.0	2.9	1.0
Yes	41.1	**2.96 (1.91, 4.59)*****	29.5	**2.58 (1.60, 4.17)*****	16.1	**6.48 (3.12, 13.49)*****
History of viral hepatitis						

No	23.0	1.0	16.6	1.0	5.0	1.0
Yes	29.4	1.40 (0.48, 4.03)	23.5	1.54 (0.49, 4.83)	17.6	**4.09 (1.11, 15.05)***
Sexual behaviors in the last 12 months						
Had had anal intercourse with regular male sex partners (RP)						
No	28.9	1.0	23.5	1.0	2.2	1.0
Yes	22.2	0.70 (0.42, 1.16)	15.7	0.61 (0.36, 1.05)†	5.9	2.75 (0.65, 11.72)
Had had anal intercourse with non-regular male sex partners (NRP)						
No	9.5	1.0	4.3	1.0	2.2	1.0
Yes	31.8	**4.45 (2.72, 7.27)*****	24.7	**7.29 (3.71, 14.34)*****	7.3	**3.60 (1.36, 9.47)***
Condomless anal intercourse with men						
No	17.0	1.0	11.1	1.0	2.2	1.0
Yes	32.4	**2.34 (1.59, 3.44)*****	25.3	**2.70 (1.74, 4.19)*****	9.5	**4.10 (1.86, 9.03)*****
Multiple male sex partnerships						
No	10.6	1.0	5.6	1.0	1.1	1.0
Yes	28.6	**3.39 (2.01, 5.70)*****	21.7	**4.70 (2.39, 9.27)*****	7.1	**6.85 (1.62, 28.96)****
Other risk behaviors in the last 12 months						
Cigarette smoking						
No	16.9	1.0	12.1	1.0	4.6	1.0
Yes	43.9	**3.84 (2.54, 5.81)*****	32.4	**3.46 (2.20, 5.44)*****	7.9	1.08 (0.85, 3.83)
Binge drinking						
No	20.9	1.0	14.9	1.0	5.0	1.0
Yes	27.1	1.40 (0.95, 2.06)†	20.2	1.44 (0.93, 2.23)†	6.0	1.21 (0.59, 2.50)

ORu: univariate odds ratios, CI: confidence interval; *** P<0.001, ** P<0.01, * P<0.05, † 0.05<P<0.10

Table 7 Factors associated with past behaviors and behavioral intention use of psychoactive substances (n=600)

	Use of any psychoactive substances in lifetime		Use of any psychoactive substance in the last year		Behavioral intention to use psychoactive substance in the next year	
	ORu (95%CI)	AOR(95%CI)	ORu (95%CI)	AOR (95%CI)	ORu (95%CI)	AOR(95%CI)
Perceptions related to psychoactive substances based on the Theory of Planned Behavior						
Positive Attitude Scale	**1.49**	**1.42**	**1.52**	**1.44**	**1.54**	**1.46**
	(1.36, 1.64)* **	**(1.28, 1.58)*** **	**(1.38, 1.69)*** **	**(1.28, 1.62)*** **	**(1.31, 1.81)*** **	**(1.21, 1.75)*** **
Negative Attitude Scale	**0.71**	**0.75**	**0.65**	**0.68**	**0.66**	**0.65**
	(0.64, 0.80)* **	**(0.66, 8.53)*** **	**(0.58, 0.74)*** **	**(0.59, 0.78)*** **	**(0.55, 0.78)*** **	**(0.54, 0.80)*** **
Subjective Norm Scale	**1.77**	**1.65**	**1.87**	**1.76**	**1.66**	**1.61**
	(1.56, 2.01)* **	**(1.44, 1.90)*** **	**(1.63, 2.15)*** **	**(1.52, 2.05)*** **	**(1.41, 1.94)*** **	**(1.34, 1.94)*** **
Perceived Behavioral Control Scale	**0.66**	**0.64**	**0.63**	**0.63**	**0.73**	**0.79**
	(0.59, 0.74)* **	**(0.56, 0.74)*** **	**(0.56, 0.71)*** **	**(0.54, 0.73)*** **	**(0.62, 0.87)*** **	**(0.65, 0.95)***
Number of local MSM who had ever used psychoactive substance						
Not at all / less than half	1.0	1.0	1.0	1.0	1.0	1.0
Half / more than half / almost all	**3.70**	**1.92**	**3.72**	**3.20**	**3.51**	**3.06**
	(2.49, 5.49)* **	**(1.20, 3.07)** **	**(2.39, 5.78)*** **	**(1.94, 5.30)*** **	**(1.69, 7.27)** **	**(1.41, 6.64)** **
Influence of social media specific to psychoactive substance use						
Frequency of exposing to information						

related to psychoactive substance on social media/gay social networking apps in the last 12 months						
Sharing of personal experiences to support MSM to use psychoactive substances	**1.53 (1.29, 1.82)*** **	**1.51 (1.24, 1.84)*** **	**1.51 (1.25, 1.83)*** **	**1.51 (1.21, 1.89)*** **	**1.59 (1.15, 2.20)** **	**1.58 (1.11, 2.25)***
Sharing of personal experience to against MSM to use psychoactive substances	**1.42 (1.19, 1.68)*** **	**1.43 (1.17, 1.75)*** **	**1.31 (1.08, 1.59)** **	**1.33 (1.07, 1.67)***	1.12 (0.81, 1.54)	---
Receiving personal invitations to use psychoactive substances from MSM friends	**1.79 (1.48, 2.17)*** **	**1.55 (1.24, 1.92)*** **	**1.96 (1.60, 2.40)*** **	**1.68 (1.33, 2.12)*** **	**1.60 (1.17, 2.17)*** **	1.31 (0.93, 1.85)
Receiving personal invitations to use psychoactive substances from strangers	**1.46 (1.24, 1.72)*** **	**1.28 (1.07, 1.55)** **	**1.58 (1.32, 1.91)*** **	**1.43 (1.16, 1.76)** **	**1.54 (1.13, 2.08)** **	1.33 (0.97, 1.84)†
Commentary/discussion about psychoactive substance use	**1.38 (1.13, 1.71)*** **	**1.31 (1.03, 1.66)***	**1.45 (1.16, 1.83)** **	**1.39 (1.07, 1.82)***	1.13 (0.77, 1.65)	---
Overall framing of information specific to psychoactive substance use on social media/gay social networking apps	**1.25 (1.05,1.50)***	**1.31 (1.07, 1.61)***	**1.33 (1.09, 1.62)** **	**1.41 (1.11, 1.78)** **	**1.71 (1.22, 2.40)** **	**1.77 (1.22, 2.56)** **
Influence of peers specific to psychoactive substance use						
Number of peers in your social						

network who are ever/current users of psychoactive substances						
0	1.0	1.0	1.0	1.0	1.0	---
1-2	1.31	1.41	1.15	1.21	N.A.	
	(0.45, 3.79)	(0.47, 4.27)	(0.25, 5.24)	(0.26, 5.68)		
3-5	**6.44**	**6.47**	**9.40**	**8.69**	N.A.	
	(2.66, 15.61)* **	**(2.53, 16.58)*** **	**(2.82. 31.25)*** **	**(2.51, 30.05)** **		
6-10	**15.75**	**15.90**	**15.87**	**14.77**	N.A.	
	(5.82, 42.61)* **	**(5.40, 46.80)*** **	**(4.31, 58.37)*** **	**(3.75, 58.19)*** **		
>10	**24.17**	**17.42**	**31.73**	**20.24**	N.A.	
	(0.92, 60.12)* **	**(6.50, 46.73)*** **	**(9.44, 106.67)*** **	**(5.70, 71.87)*** **		
Frequency of being invited by the regular sex partners to use psychoactive substance in the last 12 months						
Never	1.0	1.0	1.0	1.0	1.0	1.0
Seldom/sometimes/always	**8.16**	**1.84**	**10.58**	**7.56**	**7.56**	**4.27**
	(4.72, 14.08)* **	**(1.15, 2.96)***	**(6.09, 18.40)*** **	**(3.99, 14.32)*** **	**(3.56, 16.06)*** **	**(1.85, 9.83)** **
Frequency of being invited by the close/other friends to use psychoactive substance in the last 12 months						
Never	1.0	1.0	1.0	1.0	1.0	---
Seldom/sometimes/always	**3.14**	**2.78**	**2.35**	1.72	1.90	
	(2.01, 4.90)* **	**(1.65, 4.68)*** **	**(1.44, 3.85)** **	(0.98, 3.03)†	(0.85, 4.23)	

Psychosocial variables						
CESD-10	**1.03**	0.99	1.03	0.99	1.03	---
	(1.01-1.06)*	(0.96, 1.03)	(0.99. 1.07)†	(0.95, 1.03)	(0.97, 1.09)	
GAD-7	1.01	---	1.00	---	1.01	---
	(0.98, 1.05)		(0.96, 1.04)		(0.95, 1.08)	
Positive and Negative Affect Schedule						
Positive mood	1.01	---	0.99	---	1.00	---
	(0.98, 1.03)		(0.96, 1.02)		(0.95, 1.06)	
Negative mood	**1.03**	1.00	1.03	1.00	1.01	---
	(1.01, 1.05)*	(0.97, 1.03)	(1.00, 1.05)†	(0.97. 1.03)	(0.97, 1.06)	
Perceived Stress Scale	**1.03**	1.01	1.02	---	0.99	---
	(1.01, 1.06)*	(0.98, 1.04)	(0.99, 1.06)		(0.94, 1.05)	
Brief Cope Scale						
Substance use	**1.26**	**1.15**	**1.31**	**1.22**	**1.33**	**1.22**
	(1.14, 1.40)***	**(1.01, 1.32)***	**(1.17, 1.47)*****	**(1.05, 1.43)***	**(1.12, 1.58)****	**(1.01, 1.48)***
Denial	1.01	---	1.00	---	1.03	---
	(0.88, 1.16)		(0.86, 1.17)		(0.80, 1.33)	
Self-blame	**1.17**	1.11	**1.13**	1.05	1.12	---
	(1.06, 1.29)**	(0.99, 1.24)†	**(1.01, 1.27)***	(0.93, 1.19)	(0.93, 1.35)	
Self-distraction	0.94	---	0.92	---	0.91	---
	(0.85, 1.04)		(0.82, 1.03)		(0.75, 1.11)	
Behavioral disengagement	1.08	---	1.05	---	0.98	---
	(0.97, 1.20)		(0.93, 1.19)		(0.79, 1.21)	

Venting	0.99	---	0.96	---	1.14	---
	(0.89, 1.12)		(0.85, 1.11)		(0.90. 1.43)	

ORu: univariate odds ratios, CI: confidence interval, AOR: adjusted odds ratios, odds ratios adjusted for significant background variables listed in Table 6

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

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