

Social Capital and Chemsex Initiation in Young Gay, Bisexual, and Other Men Who Have Sex With Men: the Pink Carpet Y Cohort Study

Rayner Kay Jin Tan (✉ rayner.tan@u.nus.edu)

National University of Singapore <https://orcid.org/0000-0002-9188-3368>

Caitlin Alsandria O'Hara

National University Singapore Yong Loo Lin School of Medicine

Wee Ling Koh

National University Singapore Saw Swee Hock School of Public Health

Daniel Le

Action for AIDS Singapore

Avin Tan

Action for AIDS Singapore

Adrian Tyler

Action for AIDS Singapore

Calvin Tan

Action for AIDS Singapore

Chronos Kwok

Action for AIDS Singapore

Sumita Banerjee

Action for AIDS Singapore

Mee Lian Wong

National University Singapore Saw Swee Hock School of Public Health

Research

Keywords: Chemsex, Gay men, MSM, Singapore, Social capital

Posted Date: December 11th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-123546/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Version of Record: A version of this preprint was published on February 19th, 2021. See the published version at <https://doi.org/10.1186/s13011-021-00353-2>.

Abstract

Background: Young gay, bisexual, and other men who have sex with men (YMSM) are especially vulnerable to the risks associated with sexualized substance use, or 'chemsex'. Engaging in chemsex established as a major risk factor for Human Immunodeficiency Virus (HIV) acquisition, and is thus a public health issue of increasing urgency. This paper attempts to explore the association between measures of social capital and patterns of sexualized substance use among a sample of YMSM in Singapore.

Methods: Results of this study were derived from baseline data of the Pink Carpet Y Cohort Study in Singapore, comprising a sample of 570 HIV-negative YMSM aged 18 to 25 years old. Latent class analysis was employed to identify classes with similar patterns of sexualized substance use, and multinomial logistic regression was employed to examine associations between class membership and measures of social capital. Logistic regression was employed to examine associations between measures of social capital and past sexualized substance use.

Results: Latent class analysis revealed three classes of YMSM based on their histories of sexualized substance use, which we labelled as 'substance-naïve', 'substance-novice', and 'chemsex'. Participants with a later age of sexual debut were increasingly less likely to be in the substance novice and chemsex classes, compared to the substance-naïve class; they were also less likely to report sexualized alcohol, poppers and methamphetamine use. Connectedness to the lesbian, gay, bisexual and transgender (LGBT) community was negatively associated with sexualized methamphetamine use, while outness to family was positively associated with sexualized methamphetamine and erectile dysfunction drug use.

Conclusions: Varying measures of social capital such as an earlier age of exposure to sexual networks or family-related stress may predispose YMSM to greater opportunities for sexualized substance use, while on the other hand, community connectedness may be protective. Future interventions should target YMSM who become sexually active at an earlier age to reduce the risks associated with sexualized substance use.

Introduction

Gay, bisexual, and other men who have sex with men (GBMSM) constitute a key population that continues to be disproportionately affected by Human Immunodeficiency Virus (HIV) on a global scale (1). Within communities of GBMSM, young gay, bisexual, and other men who have sex with men (YMSM) experience a greater burden of HIV risk compared to their older counterparts, which may be attributed to a higher incidence of risky sexual behaviors, sexualized substance use, and barriers to health-seeking behaviors (2, 3).

The use of amphetamine-type stimulants (ATS), in particular methamphetamine, has become increasingly prevalent among GBMSM (4). Methamphetamine is a derivative of amphetamine that is often used by GBMSM in sexualized contexts, known colloquially as 'chemsex' (5). Other drugs typically associated with chemsex include gamma-hydroxybutyrate/gamma-butyrolactone (GHB/GBL), mephedrone, ecstasy, ketamine, as well as drugs typically prescribed for erectile dysfunction (ED) such as Viagra or Cialis (6) (*Citation omitted for double-blinded peer review*). Chemsex has been identified in numerous studies as a

significant risk factor for HIV among GBMSM due to the interplay between drug use and behaviors that place such individuals at a higher risk of acquiring HIV, including unprotected anal sexual intercourse with an increased number of sex partners, prolonged sexual encounters, and the sharing of sex toys (7, 8).

Globally, the trend of amphetamine-type stimulant use remains high among GBMSM. A 2012 study among GBMSM in 12 countries across Asia reported ATS to be the most widely used types of drugs among the 10,861 participants sampled, with 8.1% reporting to have recently used ecstasy and 4% having used methamphetamine (9). This trend of ATS use is also reflected in non-Asian settings (4, 10, 11). YMSM are also especially vulnerable to substance use disorders and the risks associated with them. A 2014 study conducted among 595 YMSM aged 12 to 24 years old in across eight cities in the United States found that 10.8% of participants surveyed has reported using methamphetamine in the past 90 days (12); other studies have similarly reported greater instances of substance abuse among YMSM relative to older cohorts of GBMSM (13–15).

The use of amyl nitrites, otherwise known as ‘poppers’, in sexual contexts is has been reported to be common as well for GBMSM across various settings largely as a means of sexual enhancement (16–18). Popper use has been found to be associated with HIV seroconversion as well as sexual risk behaviors such as having multiple sex partners and having unprotected anal intercourse (19–21). Demographic and psychosocial correlates for popper use among GBMSM include being older, being HIV-positive, and reporting visiting sex-on-premises venues, licensed lesbian, gay, bisexual, and transgender (LGBT) venues, and using other substances (18, 22).

Apart from the use of typically illicit substances, heavy alcohol use has also been established to be common among GBMSM, especially in developed country settings (23–25). Past studies have also found that individuals who identify with any sexual minority status, including GBMSM, had initiated alcohol use at a younger age, compared to their heterosexual counterparts (26, 27). An early onset of alcohol initiation among GBMSM has been found to be associated with a greater number of lifetime sexual partners, elevated levels of depressive symptoms, and alcohol abuse later in life (28). Heavy alcohol use among GBMSM, and in particular the use of alcohol during or after sex, has also been found to be associated with behaviors associated with HIV acquisition risk, such as unprotected anal intercourse (29–31); however, these findings have been inconsistent due to methodological differences in measuring alcohol use and the lack of experimental study designs (32).

Risk factors for substance use

Risk factors for substance use in general, including the use of ATS among GBMSM, have been well-established in the extant literature. Depression severity is a risk factor that increases individuals' likelihood of using ATS, with participants reporting that the use of substances help to alleviate the negative effects of such mood disorders (33). Additionally, MSM who experience consistent episodes of neglect or trauma at a young age also report increased susceptibility of eventual methamphetamine use (34). Other studies have qualitatively evaluated that methamphetamine use is perceived to be instrumental in alleviating personal dread of growing old and sickly, or fears of becoming less attractive and unwanted (35). A recent study in

Singapore found that GBMSM engaged in chemsex as a means of coping with societal rejection (*Citation omitted for double-blinded peer review*). Methamphetamine use, especially in the context of chemsex, has also been established as an important means of providing a safe haven from sexual discrimination and isolation among GBMSM living with HIV (36).

Reasons for heavy alcohol use reported by GBMSM in general may include life histories of traumatic experiences such as sexual orientation-based discrimination and childhood sexual abuse (37, 38), while YMSM specifically reported social drinking motivations as a main reason for engaging in heavy alcohol use (39). As for the use of alcohol during sex among GBMSM, reasons included more situational or contextual factors such as the facilitation of cognitive 'escape' for the awareness of HIV risk, or the enhancement of sexual pleasure (40, 41).

Situating social capital as risk factors for sexualized substance use

Adequate social support has been credited in various studies as one of the main reasons for the reduction in risky sexual behaviors among GBMSM (42). Specifically, community connectedness plays an instrumental function in the provision of intangible support, especially for GBMSM who may experience difficulties in tapping on their kinship or peer network for social support, or who have repressed their sexuality out of fear of being discriminated (43, 44). However, other studies have reported a positive association between drug use and GBMSM community engagement as well (Wei et al., 2012); findings from studies pertaining to the relationship between of community connectedness and personal forms of social capital on drug use among GBMSM thus remain mixed. These mixed findings may be attributed to the varying ways in which community affiliation or social capital have been measured or conceptualized in various studies, which may span across measures that reflect access to social networks, psychological feelings of affiliation, or even explicit forms of affiliation that presuppose participation in interest groups or activities.

With regard to alcohol use, GBMSM who report a stronger affiliation with gay male culture and who have met sexual partners through entertainment establishments where alcohol use takes place are more likely to have engaged in heavy alcohol use (23, 25). Among YMSM, gay bar attendance, depression, sensation seeking, peer risk behaviors, multiple sexual partners, and a younger age of alcohol initiation were found to be associated with heavier alcohol use patterns (45, 46).

There has been a lack of consensus around the conceptualization, operationalization, and thus measurement of social capital. This has resulted in a large variety of ways, sometimes conflicting, in which measures that constitute social capital have been linked to substance use-related behaviors among GBMSM. Past studies that measure varying forms of social capital and its relationship with substance use among GBMSM have tended to measure only one form or dimension of social capital, or conflate different nuanced aspects of social capital with one another, which have led to conflicting findings in some cases.

Measures of the *social cohesion* school of social capital, conceptualized as the resources available to members or citizens of a social group or society and as a property that exists at the group level, are relevant

to individual health outcomes as an individual may benefit from being embedded or immersed in a given context. These group level attributes may include group-aggregated, contextual measures such as perceptions of trustworthiness and collective socialization (i.e. adults in community and not just parents shape child development) (47). On the other hand, measures of the *network theory* approach, conceptualized as the resources that are embedded within an individual's social networks, include both egocentric (i.e. individual-centred) and sociometric (i.e. group-centred) properties. At the egocentric level, these may include measures that reflect the functional nature of ties with others in the community, such as measures of social support and those that reflect the availability of necessary resources, or measures that reflect the structural nature of ties, such as the size of one's own network or the density of relationships and ties within those networks (48).

In the context of risk factors for substance use among GBMSM, measures of community connectedness, or a psychological feeling of being connected to the wider community, may align more with the social cohesion approach to social capital. On the other hand, measures that reflect an individual's access to social support from others may reflect the functional nature of ties within a network, whereas one's access to substances via other substance users may reflect more structural aspects of one's own network. In this study, we selected several potential measures of social capital that we thought were potentially epidemiologically relevant as risk factors for substance use among YMSM in Singapore, including age of sexual debut (as a proxy for one's initiation into sexual networks, and thus access to sexualized substance use), bonding social capital, bridging social capital, connectedness to the LGBT community, as well as the extent of sexual orientation disclosure or 'outness' to family, to the world, and to religion, as a proxy for being able to access social support, given major barriers such as prevailing stigma and the criminalization of sexual relations between men in the present setting.

Substance use among GBMSM in Singapore

As of 2018, a total of 8,275 incident HIV infections have been notified with the ministry of health in Singapore (MOH). The spread of HIV in Singapore is characterized by its concentration among GBMSM, as well as older, heterosexual men (49). Despite being an established risk factor for HIV and other STI acquisition, few studies have attempted to study patterns of drug use among GBMSM in Singapore, notwithstanding the Asia Internet MSM Sex Survey (AIMSS) that was conducted from 2009 to 2010 among 4,072 GBMSM from Singapore, which found that 12.8% of participants had reported consuming drugs prior to, or during sex in the preceding six months (50). A more recent qualitative study among GBMSM in Singapore found that chemsex was perceived to be common in Singapore, and openly solicited through geosocial networking apps (*Citation omitted for double-blinded peer review*).

Social capital among GBMSM in Singapore should be interpreted in light of the sociocultural milieu in which they are embedded. Singapore society has largely held negative perceptions of, and attitudes towards lesbian, gay, bisexual, and transgender (LGBT) individuals (51–53), as well as drug users (54). Criminal legislation towards sexual minorities and drug users have corresponded, and arguably, contributed, to these negative attitudes. Section 377A of the Singapore Penal Code criminalizes consensual sexual behaviour between men, with penalties for imprisonment for a term that may extend up to no longer than

two years. Drug use and trafficking of drugs are also punished by severe penalties under the Singapore Penal Code. The Misuse of Drugs Act criminalizes the possession and use of drugs with penalties that range from fines of up to S\$20,000 to a maximum of ten years in prison, and trafficking of drugs beyond stipulated thresholds with a mandatory death penalty or life imprisonment.

The aims of this study are two-fold. Firstly, given the risks associated with substance use, coupled with preliminary data on the rise in the incidence and prevalence of chemsex among GBMSM in Singapore, we embarked on this study to address the dearth of information on the risk factors associated with chemsex among YMSM in Singapore. Secondly, mixed findings around the relationship between measures of social capital and substance use in general may be attributed to the varying ways in which community affiliation or social capital have been measured or conceptualized in various studies, which may span across measures that reflect access to social networks, psychological feelings of affiliation, or even explicit forms of affiliation that presuppose participation in interest groups or activities. To fill this gap, this study simultaneously explores varying measures of social capital, such as age of sexual debut, bonding social capital, bridging social capital, community connectedness, as well as the extent of sexual orientation disclosure or ‘outness’ to varying social groups, on its association with varying patterns of substance use. Doing so will allow us to draw more nuanced, exploratory claims around the role of social capital and its potential relationship with varying patterns of substance use among YMSM

Methods

Participants and Recruitment

The Pink Carpet Y Cohort Study is Singapore's first prospective cohort study exploring the syndemic risks associated with HIV and other sexually transmitted infections (STI) acquisition among YMSM. This study was a partnership between Action for AIDS Singapore (AFA), one of Singapore's longest-running community-based organizations serving the health of GBMSM, and the Saw Swee Hock School of Public Health, National University of Singapore. To be eligible for this cohort, participants had to be HIV-negative or unsure of their HIV status, between the ages of 18 to 25 years old, Singapore citizens or permanent residents, and identify as gay, bisexual, or queer men at the point of recruitment, which spanned across May to September 2019. Participants were asked to self-report these attributes.

Participants were invited to participate in this study through a recruitment flyer that was disseminated through both online (e.g. social media) and offline (e.g. at the organization's office or outreach areas) channels by a network of community-based organizations in Singapore who are engaged in health advocacy-related activities for GBMSM. Participants who were interested in participating and were eligible for the study signed up through an enrolment link with their self-reported alias, contact details, date of birth, gender, HIV status, sexual orientation, and their residence status. An AFA staff member subsequently verified the eligibility of participants who had signed up prior to sending them a unique identifier, and a link for the baseline survey.

Participants were provided with a Singapore Dollars (SGD) 20.00 (approximately United States Dollars [USD] 15.00) cash reimbursement upon completion of the baseline survey. A total of 570 participants were recruited at the baseline of the cohort, however the response rate could not be established as it was not possible to ascertain the total number of eligible participants that the recruitment flyers had reached. Participants could also refer their friends to participate in the survey and be reimbursed SGD5.00 (approximately USD3.75) for each friend successfully referred and who had completed the baseline survey; a total of 171 (30.0%) of participants were recruited through referrals.

Ethics Declaration

Ethics approval was obtained from the institutional review board at the National University of Singapore (Reference Code S-19-007) prior to data collection.

Variable Measures

The survey collected sociodemographic information from respondents, including age (in years), ethnicity (Chinese vs non-Chinese), gender (cisgender vs non-cisgender), sexual orientation (gay vs non-gay), and monthly household income (SGD5000 and above vs below SGD5000; SGD5000 is approximately USD3668.94). As the YMSM in our sample included respondents who were still in school, educational attainment and gross monthly personal income were omitted as variables, though they were collected in the baseline survey. Household income was chosen as a proxy variable for socioeconomic status among participants, given that most participants were not expected to report a personal monthly income that would reflect the socioeconomic strata in which they were embedded. We collected self-reported histories of the use of alcohol, poppers, methamphetamine, GHB/GBL, and ED drugs in sexual contexts, which were coded as a categorical variable (yes vs no).

Age of sexual debut was measured through a series of questions that asked respondents about their age when they first had either insertive or receptive oral or anal sex with another man. Personal social capital was measured through the brief 16-item personal social capital scale (PSCS-16) validated by Wang and colleagues (55, 56). Participants were asked to describe, through a five-point Likert scale, the perceived quantity and quality of their relationships with individuals and organizations; 1 being *none or a few* and 5 being *all or a lot*. The scale was initially developed to measure two distinct forms of social capital; *bonding* and *bridging* social capital. Putnam (57) conceptualized individual social capital across two distinct forms; bonding and bridging social capital, which are defined as the existence of within-group and between-group network ties, respectively. The first eight items on the PSCS-16 were designed to measure bonding social capital, while the last eight items measured bridging social capital. Both bonding and bridging social capital were measured as indices that were thus the sum score of eight items, with a minimum score of 8 and a maximum score of 40. Cronbach's alpha of 0.77 and 0.89 were reported for the bonding social capital and bridging social capital subscales, respectively.

Connectedness to the LGBT community was an eight-item scale adapted from Frost and Meyer (58). Items in the scale were amended slightly to suit the present setting; for example, the statement "you feel you're a part of NYC's LGBT community" was amended to "You feel you're a part of Singapore's LGBT community".

Each item was measured through a four-point Likert scale from 1 to 4, with 1 being that they *strongly disagree* and 4 being that they *strongly agree*. Community connectedness was measured as an index that was the sum score of all eight items, with a minimum score of 8 and a maximum score of 32. Cronbach's alpha of the scale was reported as 0.86.

Outness was measured through the outness inventory, a 10-item scale developed by Mohr and Fassinger (59). The outness inventory assesses the degree or magnitude to which lesbian, gay, and bisexual individuals are open or 'out' about their sexual orientation to other individuals. Questions asked in this scale required participants to think about how different individuals in their own social networks (e.g. mother, siblings, religious leaders etc.) may know about, or openly talk about the participant's own sexual orientation. Participants could select responses from 1 to 7, with 1 being that *the person definitely does not know about your sexual orientation* and 7 being that *the person definitely knows about your sexual orientation, and it is openly talked about*. The overall outness score was calculated as an average of three subscales, including *outness to family*, *outness to religion*, and *outness to the world*. Cronbach's alpha of the scale was reported as 0.82. The subscales were used in analysis instead of the overall scale as a means of investigating how outness to varying groups may affect the chosen outcome variable.

Statistical Analyses

Statistical analysis was carried out using the statistical software STATA version 15 (Stata Corp, College Station, TX, USA). Latent class analysis (LCA) was performed with STATA's *gsem* function to delineate classes of drug use in sexualized contexts. The chosen variables included a history of using alcohol, poppers, meth, GHB/GBL as well as other ED medication or drugs (e.g. Viagra, Cialis, 'black ants') in sexualized contexts. Details of this LCA are described elsewhere (*Citation omitted for double-blinded peer review*). We employed descriptive and bivariate statistics to identify trends, and differences between such trends across subgroups, respectively. Multinomial logistic regression was employed to examine the association between respondents' sociodemographic attributes and social capital measures with their sexualized substance use class membership. Logistic regression was employed to examine the associations between measures of social capital and self-reported histories of sexualized substance use. Statistical significance was set at $p < 0.05$.

Results

Sociodemographic attributes and description of overall sample

A total of 570 participants were recruited in this study. Table 1 summarizes the sociodemographic attributes and overall description of the overall sample. In terms of their sociodemographic attributes, the mean age of the sample was 21.9 years (Standard Deviation [SD] = 2.17). 83.9% of the participants identified as Chinese ($n = 478$), 92.1% identified as cisgender male ($n = 525$), 71.6% identified as gay ($n = 408$), and 35.6% reported a monthly household income of SGD5000 and above ($n = 203$). A total of 66.7% ($n = 190$), 28.3% ($n = 161$), 4.7% ($n = 27$), 4.7% ($n = 27$) and 4.6% ($n = 26$) reported ever using alcohol,

poppers, methamphetamine, GHB/GBL, and ED medication in sexual contexts, respectively. Participants reported an average age of sexual debut at 17.3 years old ($SD = 2.94$), and 511 out of 570 participants (89.6%) ever had sex in the sample. Participants scored an average of 21.7 ($SD = 4.97$) for the bonding social capital subscale and 18.2 ($SD = 5.45$) for the bridging social capital subscale. An average score of 22.4 ($SD = 4.33$) was reported for the connectedness to the LGBT community scale. Finally, participants reported an average of 2.7 ($SD = 1.60$), 0.7 ($SD = 1.27$), and 2.6 ($SD = 1.74$) on the outness to family, religion, and the world subscales, respectively.

Social capital attributes by sexualized substance use class membership

LCA revealed three classes, which we labelled post hoc as '*Substance-naïve*', '*Substance-novice*', and '*Chemsex*'. Table 2 describes the social capital attributes of participants by class membership. Participants in the substance-naïve ($n = 403$) class reported only ever using alcohol and never using any other substances during sex. Participants in the substance-novice class ($n = 143$) had mostly ever used poppers during sex ($n = 139$, 97.2%), with some reporting ever using other chemsex-related substances during sex. Most participants in the chemsex class reported using methamphetamine, GHB/GBL, and ED drugs during sex.

Factors associated with substance-using class membership

Table 3 summarizes the multinomial logistic regression models with adjusted relative risk ratios (95%CI) for sexualized substance use class membership. Respondents who reported a later age of sexual debut were increasingly less likely to be in the substance novice ($aRRR=0.93$, $p=0.039$) and chemsex classes ($aRRR=0.85$, $p=0.018$), compared to the substance-naïve class. Respondents who were older ($aRRR=1.19$, $p=0.002$) and who identified as being gay as opposed to being bisexual or queer ($aRRR=2.43$, $p=0.002$) were more likely to be in the substance novice class, compared to the substance-naïve class.

Factors associated with sexualized substance use

Table 4 summarizes the logistic regression models with adjusted odds ratios (95%CI) for sexualized substance use across varying substances. Respondents who reported being older ($aOR = 1.16$, $p = 0.002$) and have a monthly household income of more than SGD5000 ($aOR = 1.53$, $p = 0.039$) were more likely, while those who reported a later age of sexual debut ($aOR = 0.88$, $p < 0.001$) were less likely to have ever reported sexualized alcohol use. Participants who reported being older ($aOR = 1.19$, $p = 0.001$) and gay ($aOR = 2.44$, $p = 0.001$) were more likely, while those who reported a later age of sexual debut ($aOR = 0.88$, $p < 0.001$) were less likely to have ever reported sexualized popper use. Participants who were more out to their families ($aOR = 1.30$, $p = 0.044$) were more likely, while those who reported a later age of sexual debut ($aOR = 0.88$, $p < 0.001$) and higher measures of connectedness to the LGBT community ($aOR = 0.91$, $p = 0.040$) were less likely to have ever reported sexualized methamphetamine use. Lastly, participants who

were more out to their families ($aOR = 1.43$, $p = 0.006$) were more likely to have reported sexualized ED drug use.

Discussion

We classified participants based on their history of sexualized substance use for alcohol, poppers, methamphetamine, GHB/GBL and ED drugs through LCA, which were reported elsewhere (*Citation omitted for double-blinded peer review*). We took this approach to classifying participants by substance use patterns, and subsequently examining the associations between social capital measures with these classes as well as self-reported use of individual substances to identify how social capital may be associated with both patterns of substance use, as well as the use of individual substances in sexualized contexts.

One key finding of this study is that those with a later age of sexual debut were increasingly less likely to be in the substance novice and chemsex classes of YMSM, and were also less likely to have independently reported sexualized alcohol, poppers and methamphetamine use. This may be indicative of how exposure to sexual networks is a risk factor for using illicit substances typically associated with chemsex in Singapore, which corroborates past findings that such drugs are typically largely used in sexual contexts among YMSM (7, 60) (*Citation omitted for double-blinded peer review*). This finding is unsurprising as earlier, and probably sustained exposure to sexually active GBMSM places one at greater risk of encountering methphetamines. However, we were unable to ascertain if this effect is due to the duration of being exposed to such sexual networks, or the nature of the sexual relations that take place at a younger age that may be defined by greater power differentials between sexual partners.

Those who also identified as being gay (vis-à-vis bisexual or queer) or who were older were also more likely to be in the substance novice class compared to the substance-naïve class. Those who reported being older were also independently more likely to have reported sexualized alcohol and popper use. This may firstly reflect the role that age may play in increasing an individual's exposure to the possibility of substance use in any context, as well as the role that one's sexual orientation may play in providing an individual access to certain social or sexual networks. These findings tie in with a possible narrative that a stronger sense of a gay male identity, may be associated with greater participation in a wider gay male sexual culture that typically excludes GBMSM who do not identify as gay men (61) (*Citation omitted for double-blinded peer review*).

Connectedness to the LGBT community, which serves more as a measure of one's psychological sense of connection to the wider LGBT community, was found to be negatively associated with sexualized methamphetamine use. This may tie in with evidence that argues for the role that community connectedness plays in sexual identity formation and self-acceptance (62, 63), as well as buffering the effects of minority stress on well-being among GBMSM (64–66).

Interestingly, being out to one's family was associated with sexualized methamphetamine and ED use. We hypothesize that this may be linked to minority stress as well, which may drive YMSM towards coping through substance use. Specifically, though sexual orientation remains a concealable identity (67), being

out to one's family results in YMSM's sexual orientation no longer being concealed. This can lead to more minority stress for such YMSM who belong to families who stigmatize or discriminate them due to their sexual orientation. This may be further exacerbated by the largely negative views towards non-normative sexual orientations in Singapore. Further studies on the intersections of outness and minority stress are warranted to validate this claim.

We are mindful of several limitations of our study. As only HIV-negative YMSM were recruited in this study, we may have missed out on HIV-positive YMSM who are expected to report higher levels of substance use, which would be consistent with the findings of the other studies (36, 68). Furthermore, as drug use carries with it severe penalties in Singapore, participants may not have been entirely honest with their answers around drug use, which may have led to an underreporting of methamphetamine use in the present sample. This form of non-differential misclassification would have biased our results towards the null.

Conclusions

This study among YMSM in Singapore found that participants with a later age of sexual debut were increasingly less likely to be substance novices or in the chemsex class of YMSM. Our findings also indicate that while growing older in the gay community may lead to exposure to the possibility of substance use, an earlier age of sexual debut, and exposure to sexual networks at a younger age is a greater risk factor for chemsex among YMSM.

Moving forward, interventions could focus on providing YMSM a space to interact and navigate coming to terms with their sexual identities in safe and non-sexual settings. Due to prevailing stigma and the criminalization of sex between men, sexual health promotion and education for YMSM, as well as school-based programmes to address sexual health are not openly available in the present setting. The law criminalizing sex between men thus serves as a major barrier to providing support to YMSM, and should be reconsidered in light of the negative health implications that it may have for sexual minorities. In the absence of such reform, we recommend that NGOs be given the opportunity and resources to provide health promotion and education material and interventions for YMSM instead.

Efforts should also be taken to tackle stigma and a lack of understanding from Singaporeans at large, in order to facilitate YMSM more openly exploring their sexual identities, and lowering the barriers to accessing community-based resources or social support within the GBMSM or LGBT community. Specifically, given that being out to one's family might subject YMSM to greater minority stress, efforts should be made to provide parents and families with support on how to healthily negotiate coming out experiences among children. With a more accepting social environment in Singapore, such offline communities would be far easier to form and sustain.

Abbreviations

YMSM: Young men who have sex with men

HIV: Human immunodeficiency virus

LGBT: Lesbian, gay, bisexual and transgender

GBMSM: Gay, bisexual and other men who have sex with men

ATS: Amphetamine-type stimulants

GHB/GBL: Gamma-hydroxybutyrate/gamma-butyrolactone

ED: Erectile dysfunction

MOH: Ministry of health

STI: Sexually transmitted infections

AFA: Action for AIDS Singapore

SGD: Singapore dollars

USD: United States dollars

PSCS-16: Personal social capital scale-16

SD: Standard deviation

Declarations

Ethics approval and consent to participate:

Ethics approval was provided by the National University of Singapore Institutional Review Board (Reference Code S-19-007). Participants provided written informed consent to participate.

Consent to publication:

Prior to data collection, participants were given a copy of the participant information sheet and subsequently provided written informed consent by clicking on a link.

Availability of data and materials:

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests

Funding:

This research is supported by the Singapore Ministry of Health's National Medical Research Council under the Seed Funding Programme by Singapore Population Health Improvement Centre (NMRC/CG/C026/2017_NUHS). The funder had no role in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript.

Authors' contributions:

RKJT, DL, SB and WML conceptualized the study; WML provided supervision for the study; RKJT and WML acquired the funding for the study; CAO, WLK and RKJT conducted formal analyses; RKJT, DL, AT, ATy, CT, CK and SB conducted the investigation and curated the data associated with the study; CAO, WLK and RKJT wrote the original draft; All co-authors have reviewed and approved of the manuscript prior to submission.

Acknowledgements:

The study team would like to thank all the participants who took part in the study. We would like to extend our sincerest thanks to Action for AIDS Singapore and the Pink Carpet Y Team for their collaboration on this project. We would like to extend our sincerest gratitude to all community-based organizations who have helped us in the recruitment of participants. This research is supported by the Singapore Ministry of Health's National Medical Research Council under the Seed Funding Programme by Singapore Population Health Improvement Centre (NMRC/CG/C026/2017_NUHS).

References

1. Beyer C, Baral SD, van Griensven F, Goodreau SM, Chariyalertsak S, Wirtz AL, et al. Global epidemiology of HIV infection in men who have sex with men. *Lancet*. 2012;380(9839):367-77.
2. Qi J, Zhang D, Fu X, Li C, Meng S, Dai M, et al. High Risks of HIV Transmission for Men Who Have Sex with Men – A Comparison of Risk Factors of HIV Infection among MSM Associated with Recruitment Channels in 15 Cities of China. *PLOS ONE*. 2015;10(4):e0121267.
3. Singh S, Song R, Johnson AS, McCray E, Hall HI. HIV Incidence, Prevalence, and Undiagnosed Infections in U.S. Men Who Have Sex With MenEstimated HIV Incidence, HIV Prevalence, and Undiagnosed HIV Infections. *Annals of Internal Medicine*. 2018;168(10):685-94.
4. Reback CJ, Shoptaw S, Grella CE. Methamphetamine use trends among street-recruited gay and bisexual males, from 1999 to 2007. *J Urban Health*. 2008;85(6):874-9.
5. Edmundson C, Heinsbroek E, Glass R, Hope V, Mohammed H, White M, et al. Sexualised drug use in the United Kingdom (UK): A review of the literature. *International Journal of Drug Policy*. 2018;55:131-48.
6. Bourne A. Drug use among men who have sex with men. Implications for harm reduction. In: Stoicescu C, editor. *Global State of Health Reduction 2012*. London: Harm Reduction International; 2012. p. 147-55.
7. Bourne A, Reid D, Hickson F, Torres-Rueda S, Weatherburn P. Illicit drug use in sexual settings ('chemsex') and HIV/STI transmission risk behaviour among gay men in South London: findings from

- a qualitative study. *Sexually Transmitted Infections*. 2015;91(8):564-8.
8. Hegazi A, Lee M, Whittaker W, Green S, Simms R, Cutts R, et al. Chemsex and the city: sexualised substance use in gay bisexual and other men who have sex with men attending sexual health clinics. *International Journal of STD & AIDS*. 2017;28(4):362-6.
 9. Wei C, Guadamuz TE, Lim SH, Huang Y, Koe S. Patterns and levels of illicit drug use among men who have sex with men in Asia. *Drug and Alcohol Dependence*. 2012;120(1):246-9.
 10. Sewell J, Cambiano V, Miltz A, Speakman A, Lampe FC, Phillips A, et al. Changes in recreational drug use, drug use associated with chemsex, and HIV-related behaviours, among HIV-negative men who have sex with men in London and Brighton, 2013–2016. *Sexually Transmitted Infections*. 2018;94(7):494.
 11. Schmidt AJ, Bourne A, Weatherburn P, Reid D, Marcus U, Hickson F. Illicit drug use among gay and bisexual men in 44 cities: Findings from the European MSM Internet Survey (EMIS). *International Journal of Drug Policy*. 2016;38:4-12.
 12. Freeman P, Walker BC, Harris DR, Garofalo R, Willard N, Ellen JM, et al. Methamphetamine use and risk for HIV among young men who have sex with men in 8 US cities. *Arch Pediatr Adolesc Med*. 2011;165(8):736-40.
 13. Clatts MC, Goldsamt LA, Yi H. Club Drug Use Among Young Men Who Have Sex with Men in NYC: A Preliminary Epidemiological Profile. *Substance Use & Misuse*. 2005;40(9-10):1317-30.
 14. Kecojevic A, Silva K, Sell RL, Lankenau SE. Prescription Drug Misuse and Sexual Risk Behaviors Among Young Men Who have Sex with Men (YMSM) in Philadelphia. *AIDS and behavior*. 2015;19(5):847-56.
 15. Salomon EA, Mimiaga MJ, Husnik MJ, Welles SL, Manseau MW, Montenegro AB, et al. Depressive Symptoms, Utilization of Mental Health Care, Substance Use and Sexual Risk Among Young Men Who have Sex with Men in EXPLORE: Implications for Age-Specific Interventions. *AIDS and Behavior*. 2008;13(4):811.
 16. Li D, Yang X, Zhang Z, Qi X, Ruan Y, Jia Y, et al. Nitrite inhalants use and HIV infection among men who have sex with men in China. *BioMed research international*. 2014;2014:365261-.
 17. Colfax G, Coates TJ, Husnik MJ, Huang Y, Buchbinder S, Koblin B, et al. Longitudinal patterns of methamphetamine, popper (amyl nitrite), and cocaine use and high-risk sexual behavior among a cohort of san francisco men who have sex with men. *Journal of urban health : bulletin of the New York Academy of Medicine*. 2005;82(1 Suppl 1):i62-i70.
 18. Demant D, Oviedo-Trespalacios O. Harmless? A hierarchical analysis of poppers use correlates among young gay and bisexual men. 2019;38(5):465-72.
 19. Wang Z, Li D, Lau JTF, Yang X, Shen H, Cao W. Prevalence and associated factors of inhaled nitrites use among men who have sex with men in Beijing, China. *Drug and Alcohol Dependence*. 2015;149:93-9.
 20. Zhen-xing C, Jun-jie X, Yong-hui Z, Zhang J, Qing-hai H, Yun K, et al. Poppers use and Sexual Partner Concurrency Increase the HIV Incidence of MSM: a 24-month Prospective Cohort Survey in Shenyang, China. *Scientific Reports (Nature Publisher Group)*. 2018;8:1.

21. Prestage G, Jin F, Kippax S, Zablotska I, Imrie J, Grulich A. Use of Illicit Drugs and Erectile Dysfunction Medications and Subsequent HIV Infection among Gay Men in Sydney, Australia. 2009;6(8):2311-20.
22. Barrett P, O'Donnell K, Fitzgerald M, Schmidt AJ, Hickson F, Quinlan M, et al. Drug use among men who have sex with men in Ireland: Prevalence and associated factors from a national online survey. International Journal of Drug Policy. 2019;64:5-12.
23. Stall R, Paul JP, Greenwood G, Pollack LM, Bein E, Crosby GM, et al. Alcohol use, drug use and alcohol-related problems among men who have sex with men: the Urban Men's Health Study. 2001;96(11):1589-601.
24. McCabe SE, Hughes TL, Bostwick WB, West BT, Boyd CJ. Sexual orientation, substance use behaviors and substance dependence in the United States. Addiction (Abingdon, England). 2009;104(8):1333-45.
25. Lea T, Ryan D, Prestage G, Zablotska I, Mao L, de Wit J, et al. Alcohol use among a community-based sample of gay men: Correlates of high-risk use and implications for service provision. 2015;34(4):349-57.
26. Corliss HL, Rosario M, Wypij D, Fisher LB, Austin SB. Sexual Orientation Disparities in Longitudinal Alcohol Use Patterns Among Adolescents: Findings From the Growing Up Today Study. Arch Pediatr Adolesc Med. 2008;162(11):1071-8.
27. Garofalo R, Wolf RC, Kessel S, Palfrey J, DuRant RH. The Association Between Health Risk Behaviors and Sexual Orientation Among a School-based Sample of Adolescents. 1998;101(5):895-902.
28. Gross AL, Downing MJ, Thomann M, Chiasson MA, Schrimshaw EW, Hirshfield S. Age of Onset of Alcohol Consumption and Subsequent Negative Health Outcomes in Gay and Bisexual Men Who Have Sex With Men. Journal of Homosexuality. 2019;66(11):1609-25.
29. Washington TA, Patel SN, Meyer-Adams N. Drinking Patterns and HIV Risk Behaviors Among Black and Latino Men Who Have Sex Within Los Angeles County. 2017;11(4):834-44.
30. Li J, McDaid LM. Alcohol and drug use during unprotected anal intercourse among gay and bisexual men in Scotland: what are the implications for HIV prevention? 2014;90(2):125-32.
31. Bolton R, Vincke J, Mak R, Dennehy E. Alcohol and risky sex: In search of an elusive connection. Medical Anthropology. 1992;14(2-4):323-63.
32. Woolf S, Maisto S. Alcohol Use and Risk of HIV infection among Men Who Have Sex with Men. AIDS and Behavior. 2008;13(4):757-82.
33. Vu NTT, Holt M, Phan HTT, La LT, Tran GM, Doan TT, et al. Amphetamine-Type-Stimulants (ATS) Use and Homosexuality-Related Enacted Stigma Are Associated With Depression Among Men Who Have Sex With Men (MSM) in Two Major Cities in Vietnam in 2014. Substance Use & Misuse. 2017;52(11):1411-9.
34. Lopez-Patton M, Kumar M, Jones D, Fonseca M, Kumar AM, Nemerooff CB. Childhood trauma and METH abuse among men who have sex with men: Implications for intervention. Journal of Psychiatric Research. 2016;72:1-5.
35. Kurtz SP. Post-Circuit Blues: Motivations and Consequences of Crystal Meth Use Among Gay Men in Miami. AIDS and Behavior. 2005;9(1):63-72.

36. Lewis LA, Ross MW. The Gay Dance Party Culture in Sydney. *Journal of Homosexuality*. 1995;29(1):41-70.
37. Marshall BDL, Shoveller JA, Kahler CW, Koblin BA, Mayer KH, Mimiaga MJ, et al. Heavy drinking trajectories among men who have sex with men: a longitudinal, group-based analysis. *Alcohol Clin Exp Res*. 2015;39(2):380-9.
38. Wray TB, Pantalone DW, Kahler CW, Monti PM, Mayer KH. The role of discrimination in alcohol-related problems in samples of heavy drinking HIV-negative and positive men who have sex with men (MSM). *Drug and Alcohol Dependence*. 2016;166:226-34.
39. Ristuccia A, LoSchiavo C, Kapadia F, Halkitis PN. Motivations for alcohol use to intoxication among young adult gay, bisexual, and other MSM in New York City: The P18 Cohort Study. *Addictive Behaviors*. 2019;89:44-50.
40. Sabin LL, Beard J, Agyarko-Poku T, DeSilva M, Ashigbie P, Segal T, et al. "Too Much Sex and Alcohol": Beliefs, Attitudes, and Behaviors of Male Adolescents and Young Men Who have Sex with Men in Ghana. *Open AIDS J*. 2018;12:69-80.
41. McKirnan DJ, Venable PA, Ostrow DG, Hope B. Expectancies of sexual "escape" and sexual risk among drug- and alcohol-involved gay and bisexual men. *Journal of Substance Abuse*. 2001;13(1):137-54.
42. Shuper PA, MacLachlan DJ, Joharchi N, Guimond TH, Maxwell J, Adam BD. HIV Risk and Protective Factors in the Context of Alcohol and Substance Use During Pride. *AIDS and Behavior*. 2018;22(9):2797-806.
43. Li X, Wu G, Lu R, Feng L, Fan W, Xiao Y, et al. HIV-Testing Behavior and Associated Factors Among MSM in Chongqing, China: Results of 2 Consecutive Cross-Sectional Surveys From 2009 to 2010. *2014;93(27):e124*.
44. Feng Y, Wu Z, Detels R. Evolution of men who have sex with men community and experienced stigma among men who have sex with men in Chengdu, China. *Journal of acquired immune deficiency syndromes (1999)*. 2010;53 Suppl 1(Suppl 1):S98-S103.
45. Wong CF, Kipke MD, Weiss G. Risk factors for alcohol use, frequent use, and binge drinking among young men who have sex with men. *Addictive behaviors*. 2008;33(8):1012-20.
46. Greenwood GL, White EW, Page-Shafer K, Bein E, Osmond DH, Paul J, et al. Correlates of heavy substance use among young gay and bisexual men: The San Francisco Young Men's Health Study. *Drug and Alcohol Dependence*. 2001;61(2):105-12.
47. Kawachi I, Subramanian SV, Kim D. Social Capital and Health. In: Kawachi I, Subramanian SV, Kim D, editors. *Social Capital and Health*. New York, NY: Springer New York; 2008. p. 1-26.
48. Lakon CM, Godette DC, Hipp JR. Network-Based Approaches for Measuring Social Capital. In: Kawachi I, Subramanian SV, Kim D, editors. *Social Capital and Health*. New York, NY: Springer New York; 2008. p. 63-81.
49. Health Mo. Update on the HIV/AIDS Situation in Singapore 2017 2018 [Available from: [https://www.moh.gov.sg/resources-statistics/infectious-disease-statistics/hiv-stats/update-on-the-hiv-aids-situation-in-singapore-2017-\(june-2018\)](https://www.moh.gov.sg/resources-statistics/infectious-disease-statistics/hiv-stats/update-on-the-hiv-aids-situation-in-singapore-2017-(june-2018))].

50. Koe S. Self-reported HIV prevalence, HIV testing history and risk behaviour among MSM in 17 countries in Southeast and East Asia: comparing results from two large scale, multi-language online surveys in 2009 and 2010. Asia Internet MSM Sex Survey: Preliminary Report. 2011 [cited 2018 March 17]. Available from: http://www.fridae.asia/download/aimss_stats_A4.pdf.
51. Detenber BH, Ong CPL, Tong HY, Yeow MLH, Cenite M, Ku MKY. Singaporeans' Attitudes toward Lesbians and Gay Men and their Tolerance of Media Portrayals of Homosexuality. *International Journal of Public Opinion Research*. 2007;19(3):367-79.
52. Mathews M, Gee C, Chiang WF, World S. Singapore perspectives 2014: differences. Hackensack, N.J;Singapore;: World Scientific Pub. Co; 2015.
53. Panchapakesan C, Li L, Ho SS. Examining How Communication and Demographic Factors Relate to Attitudes Toward Legalization of Same-Sex Marriage in Singapore. *International Journal of Public Opinion Research*. 2014;26(3):355-68.
54. Teo AKJ, Prem K, Chen MIC, Roellin A, Wong ML, La HH, et al. Estimating the size of key populations for HIV in Singapore using the network scale-up method. 2019:sextrans-2018-053747.
55. Wang P, Chen X, Gong J, Jacques-Tiura AJ. Reliability and Validity of the Personal Social Capital Scale 16 and Personal Social Capital Scale 8: Two Short Instruments for Survey Studies. *Social Indicators Research*. 2014;119(2):1133-48.
56. Chen X, Stanton B, Gong J, Fang X, Li X. Personal Social Capital Scale: an instrument for health and behavioral research. *Health Education Research*. 2008;24(2):306-17.
57. Putnam RD. *Bowling alone: the collapse and revival of American community*. New York: Simon & Schuster; 2000.
58. Frost DM, Meyer IH. Measuring community connectedness among diverse sexual minority populations. *J Sex Res*. 2012;49(1):36-49.
59. Mohr J, Fassinger R. Measuring dimensions of lesbian and gay male experience. *Measurement and Evaluation in Counseling and Development*. 2000;33(2):66-90.
60. Halkitis PN, Parsons JT, Stirratt MJ. A double epidemic: crystal methamphetamine drug use in relation to HIV transmission among gay men. *J Homosex*. 2001;41(2):17-35.
61. Jaspal R. Coping with perceived ethnic prejudice on the gay scene. *Journal of LGBT Youth*. 2017;14(2):172-90.
62. Moody RL, Starks TJ, Grov C, Parsons JT. Internalized Homophobia and Drug Use in a National Cohort of Gay and Bisexual Men: Examining Depression, Sexual Anxiety, and Gay Community Attachment as Mediating Factors. *Archives of Sexual Behavior*. 2018;47(4):1133-44.
63. Bourne A, Weatherburn P. Substance use among men who have sex with men: patterns, motivations, impacts and intervention development need. *Sexually Transmitted Infections*. 2017;93(5):342-6.
64. Wong CF, Schrager SM, Holloway IW, Meyer IH, Kipke MD. Minority Stress Experiences and Psychological Well-Being: The Impact of Support from and Connection to Social Networks Within the Los Angeles House and Ball Communities. *Prevention Science*. 2014;15(1):44-55.

65. Lelutiu-Weinberger C, Pachankis JE, Golub SA, Walker JNJ, Bamonte AJ, Parsons JT. Age Cohort Differences in the Effects of Gay-Related Stigma, Anxiety and Identification with the Gay Community on Sexual Risk and Substance Use. *AIDS and Behavior*. 2013;17(1):340-9.
66. Carpiano RM, Kelly BC, Easterbrook A, Parsons JT. Community and Drug Use among Gay Men: The Role of Neighborhoods and Networks. *Journal of Health and Social Behavior*. 2011;52(1):74-90.
67. Quinn DM, Chaudoir SR. Living With a Concealable Stigmatized Identity: The Impact of Anticipated Stigma, Centrality, Salience, and Cultural Stigma on Psychological Distress and Health. *Journal of personality and social psychology*. 2009;97(4):634-51.
68. Semple SJ, Strathdee SA, Zians J, Patterson TL. Factors associated with experiences of stigma in a sample of HIV-positive, methamphetamine-using men who have sex with men. *Drug and alcohol dependence*. 2012;125(1-2):154-9.

Tables

Table 1.
Sociodemographic attributes and description of analytic sample (n=570)

Demographic Variables	n	%	Mean	SD
Age			21.9	2.17
Ethnicity				
Chinese	478	83.9%		
Non-Chinese	92	16.1%		
Gender				
Cisgender male	525	92.1%		
Transgender, genderqueer, or others	45	7.9%		
Sexual orientation				
Gay	408	71.6%		
Bisexual, queer, or others	162	28.4%		
Monthly household income				
SGD 5000 and above	203	35.6%		
Below SGD 5000	367	64.4%		
Ever had sexualized alcohol use				
Yes	190	66.7%		
No	380	33.3%		
Ever had sexualized popper use				
Yes	161	28.3%		
No	409	71.8%		
Ever had sexualized methamphetamine use				
Yes	27	4.7%		
No	543	95.3%		
Ever had sexualized GHB / GBL use				
Yes	27	4.7%		
No	543	95.3%		
Ever used erectile dysfunction drugs for sex				
Yes	26	4.6%		
No	544	95.4%		

Age of sexual debut (n=511)	17.3	2.94
Bonding social capital	21.7	4.97
Bridging social capital	18.2	5.45
Connectedness to LGBT community	22.4	4.33
Outness to family	2.7	1.60
Outness to religion	0.7	1.27
Outness to the world	2.6	1.74

Abbreviation: SD, Standard Deviation; GHB/GBL, gamma-hydroxybutyrate/gamma-butyrolactone; LGBT, Lesbian Gay Bisexual Transgender

Table 2.
Sociodemographic attributes and description of analytic sample by substance-using classes (n=570)

Demographic Variables	Substance-Naïve (n=404)		Substance-Novice (n=143)		Chemsex (n=23)		Test for difference (p-value)*
	n/Mean	%/SD	n/Mean	%/SD	n/Mean	%/SD	
Age	21.7	2.18	22.4	2.11	22.3	1.77	0.001
Chinese ethnicity (Ref=Non-Chinese)	336	83.2%	124	86.7%	18	78.3%	0.436
Cisgender male (Ref=Transgender, genderqueer, or others)	365	90.4%	139	97.2%	21	91.3%	0.018
Gay (Ref=Bisexual, queer, or others)	268	66.3%	122	85.3%	18	78.3%	<0.001
Monthly household income ≥ SGD5000 (Ref <SGD5000)	131	32.4%	65	45.5%	7	30.4%	0.019
Ever had sexualized substance use with							
Alcohol	96	76.2%	81	56.6%	13	56.5%	<0.001
Amyl nitrites (Poppers)	0	0.0%	139	97.2%	22	95.7%	<0.001
Crystal methamphetamine	0	0.0%	5	3.5%	22	95.7%	<0.001
GHB/GBL	0	0.0%	5	3.5%	22	95.7%	<0.001
Erectile dysfunction drugs	0	0.0%	9	6.3%	17	73.9%	<0.001
Age of sexual debut (n=511)	17.5	2.89	17.1	3.13	16.2	2.33	0.078
Bonding social capital	21.4	4.97	22.6	4.64	22.0	6.48	0.037
Bridging social capital	18.2	5.56	18.3	4.89	18.4	6.76	0.957
Connectedness to LGBT community	22.3	4.42	22.7	3.96	21.5	5.04	0.457
Outness to family	2.6	1.61	2.9	1.51	3.3	1.73	0.016
Outness to religion	0.6	1.14	0.8	1.57	0.5	1.27	0.441
Outness to the world	2.4	1.62	2.9	1.92	3.0	2.28	0.004

Abbreviation: SD, Standard Deviation; GHB/GBL, gamma-hydroxybutyrate/gamma-butyrolactone; LGBT, Lesbian Gay Bisexual Transgender

*Fisher's Exact Test were employed for categorical variables while One-Way ANOVA was employed for continuous variables

Table 3.

Multinomial logistic regression with adjusted relative risk ratios (95%CI) for sexualized substance use class membership (n=511)

	Substance-naïve	Substance novice			Chemsex		
		aRRR	95% CI	p-value	aRRR	95% CI	p-value
Age	Ref	1.19	(1.07 - 1.32)	0.002	1.18	(0.95 - 1.47)	0.134
Chinese ethnicity (Ref=Non-Chinese)	Ref	1.12	(0.61 - 2.05)	0.726	0.64	(0.21 - 1.92)	0.427
Cisgender male (Ref=Transgender, genderqueer, or others)	Ref	2.46	(0.79 - 7.62)	0.119	0.93	(0.18 - 4.69)	0.927
Gay (Ref=Bisexual, queer, or others)	Ref	2.43	(1.39 - 4.27)	0.002	1.74	(0.58 - 5.25)	0.324
Monthly household income ≥ SGD5000 (Ref <SGD5000)	Ref	1.51	(0.98 - 2.33)	0.064	0.91	(0.34 - 2.41)	0.848
Age of sexual debut	Ref	0.93	(0.86 - 1.00)	0.039	0.85	(0.74 - 0.97)	0.018
Bonding social capital	Ref	1.03	(0.98 - 1.09)	0.221	0.99	(0.89 - 1.10)	0.838
Bridging social capital	Ref	1.00	(0.95 - 1.04)	0.873	1.02	(0.93 - 1.12)	0.666
Connectedness to LGBT community	Ref	1.00	(0.95 - 1.05)	0.924	0.92	(0.83 - 1.02)	0.125
Outness to family	Ref	1.02	(0.88 - 1.18)	0.806	1.28	(0.97 - 1.68)	0.078
Outness to religion	Ref	1.07	(0.91 - 1.25)	0.445	0.89	(0.60 - 1.32)	0.555
Outness to the world	Ref	1.11	(0.98 - 1.26)	0.098	1.09	(0.85 - 1.40)	0.502

Notes

Abbreviation: CI, Confidence Interval; aRRR, Adjusted Relative Risk Ratio; LGBT, Lesbian Gay Bisexual Transgender

Statistically significant results at $p < 0.05$ are bolded

Table 4.
Logistic regression with adjusted odds ratios (95%CI) for sexualized substance use (n=511)

	Alcohol		Poppers		Meth		GHB/GBL		ED drugs											
	(n=190)	aOR p-value	(n=161)	aOR p-value	(n=27)	aOR p-value	(n=27)	aOR p-value	(n=26)	aOR p-value										
Age	1.16	0.002	1.19	0.001	1.05	0.642	1.11	0.287	1.05	0.603										
Chinese ethnicity (Ref=Non-Chinese)	1.02	0.942	1.11	0.726	0.72	0.548	0.62	0.355	0.93	0.903										
Cisgender male (Ref=Transgender, genderqueer, others)	0.69	0.336	1.80	0.236	0.79	0.772	2.20	0.462	0.40	0.201										
Gay (Ref=Bisexual, queer, or others)	0.98	0.931	2.44	0.001	1.82	0.275	1.46	0.485	2.28	0.167										
Monthly household income ≥ SGD5000 (Ref <SGD5000)	1.53	0.039	1.48	0.066	1.05	0.905	0.57	0.228	0.93	0.864										
Age of sexual debut	0.88	<0.001	0.91	0.008	0.87	0.028	0.90	0.098	0.88	0.066										
Bonding social capital	1.05	0.066	1.02	0.484	0.97	0.579	1.01	0.809	0.99	0.863										
Bridging social capital	0.99	0.556	1.00	0.886	1.04	0.321	1.02	0.692	1.00	0.997										
Connectedness to LGBT community	1.04	0.067	0.99	0.678	0.91	0.040	0.95	0.296	0.94	0.190										
Outness to family	1.01	0.896	1.05	0.460	1.30	0.044	1.24	0.090	1.43	0.006										
Outness to religion	1.03	0.706	1.05	0.564	0.91	0.554	0.82	0.287	0.95	0.743										
Outness to the world	1.07	0.287	1.12	0.071	1.03	0.788	1.06	0.607	0.95	0.642										
Notes																				
Abbreviation: CI, Confidence Interval; aOR, Adjusted Odds Ratio; LGBT, Lesbian Gay Bisexual Transgender; Meth, Methamphetamine; GHB/GBL, Gamma-Hydroxybutyrate/Gamma-Butyrolactone; ED, Erectile Dysfunction																				
Statistically significant results at p < 0.05 are bolded																				