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A Longitudinal Analysis of Cannabis Use and Mental Health Symptoms Among Gay, Bisexual, and Other Men who have Sex with Men in Vancouver, Canada

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Abstract

Background: Cannabis use, anxiety, and depression are common among gay, bisexual, and other men who have sex with men (gbMSM) and some report using cannabis to manage mental health symptoms.

Methods: Sexually-active gbMSM aged ≤16 years were recruited into a longitudinal cohort through respondent-driven sampling and completed study visits every six months. Data on demographics, drug use, and anxiety and depression symptoms were collected via a self-administered computer-based survey. A study nurse determined previous mental health diagnoses and treatment. Using multivariable generalized linear mixed models, we examined factors associated with regular cannabis use (≥weekly in the previous 3 months) and, among individuals who reported anxiety or depression/bipolar diagnoses, factors associated with moderate/severe anxiety or depression symptoms.

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All study procedures were approved by the Research Ethics Boards of the University of British Columbia, the University of Victoria, and Simon Fraser University.

The authors have no conflicts of interest to declare.

Results: Of 774 participants (551 HIV-negative, 223 HIV-seropositive), 250 (32.3%) reported regular cannabis use, 200 (26.4%) reported ever being diagnosed with anxiety, and 299 (39.3%) reported ever being diagnosed with depression or bipolar disorder at baseline. Regular cannabis use was positively associated with HIV-seropositivity (aOR=2.23, 95%CI:1.40-3.54) and previous mental health diagnosis (aOR=1.52, 95%CI: 1.00-2.31, p=0.05). Among those previously diagnosed with anxiety or depression/bipolar disorder, regular cannabis use was not associated with moderate/severe anxiety (aOR=1.16, 95%CI:0.69-1.94) or depression symptoms (aOR=0.96, 95%CI:0.59-1.58), respectively.

Limitations: Because of observational study design, we are unable to determine absolute effect.

Conclusions: Regular cannabis use was more likely among HIV-positive gbMSM and those previously diagnosed with a mental health disorder. No association was found between regular cannabis use and severity of anxious or depressive symptoms among those diagnosed with these conditions.

Keywords

Cannabis; Mental health; Men who have sex with men; Anxiety; Depression; Longitudinal

INTRODUCTION

Despite prohibition spanning nearly a century, prevalence of cannabis use in Canada remains notably high with an estimated lifetime use of 42.5% among individuals aged 15 and older (Rotermann & Langlois, 2015). Use has been reported to be significantly higher among sexual minorities including gay, bisexual, and other men who have sex with men (gbMSM), relative to heterosexual individuals (Bränström & Pachankis, 2018; Cochran et al., 2004; Hughes & Eliason, 2002; Marshal et al., 2008; McCabe et al., 2009; Stall et al., 2001; Trocki et al., 2009). While trends in cannabis use among the general population have remained relatively stable (Rotermann & Macdonald, 2018), recent legalization of recreational cannabis in October 2018 may result in increased use among some groups (Hajizadeh, 2016).

Substance use, including cannabis use, among sexual minorities typically begins in adolescence and persists during transition into young adulthood (Marshal et al., 2009). While some may engage in substance use for pleasure, others may use as a coping strategy, an observation that has sometimes been explained by the minority stress theory (Meyer, 2003). This framework highlights the role of stigma, prejudice, and discrimination in perpetuating experiences of chronic stress among sexual minority individuals, which may ultimately precipitate adverse mental health and substance use (Goldbach et al., 2014), and has been shown to contribute to increased cannabis use among gbMSM (Goldbach et al., 2015). Similarly, rates of mental health conditions are higher in the gbMSM population compared with heterosexual individuals and the general population (Bränström & Pachankis, 2018; Fredriksen-Goldsen et al., 2013; Lachowsky et al., 2017; Mustanski et al., 2010). Results from a Canadian national survey demonstrated that the risk of mood or anxiety disorders is significantly greater among gay and bisexual men relative to heterosexual men (Brennan et al., 2010).

Although positive associations between cannabis use and symptoms of anxiety and/or depression have been reported across numerous studies, determining causality remains an ongoing challenge (Danielsson et al., 2016; Feingold et al., 2016; Volkow et al., 2014; Walsh et al., 2017). There is significant debate regarding the directionality of this relationship as cannabis use may result in greater risk of developing symptoms of anxiety or depression while, inversely, individuals who live with anxiety and depression may engage in increased cannabis use to manage symptoms (Morisano et al., 2014). One explanation of this bidirectionality is the reported use of cannabis to relieve stress and self-medicate for symptoms of anxiety and depression (Bottorff et al., 2009; Osborn et al., 2015). For example, Walsh and colleagues (2013) described reasons for cannabis use and perceived therapeutic effectiveness as reported by a large sample of Canadian users. Intention of use to address symptoms of anxiety and depression was reported by 79% and 67% respectively. Further, among those who disclosed mood disorders as their primary condition, 99% used cannabis to alleviate symptoms of anxiety and 92% to alleviate symptoms of depression.

Self-medication is also common within the gbMSM community with many describing using cannabis and alcohol to cope with chronic stress associated with experiences of social stigma (McAdams-Mahmoud et al., 2014). Bruce and colleagues (2013) investigated cannabis use among gbMSM and found that 54% of participants used drugs or alcohol to relax or fit in and that those who used substances to reduce stress had about three times the odds of engaging in weekly cannabis use. Similarly, gbMSM living with HIV have reported using cannabis to treat HIV-associated symptoms including lack of appetite and chronic neuropathic pain, and as a coping mechanism to address symptoms of anxiety and depression associated with diagnosis (Bruce et al., 2013; Corless et al., 2009). Importantly, there remains limited evidence from randomized controlled trials to validate the effectiveness of cannabis in treating anxiety and depression. In the few available studies, prescribed doses of cannabis have been demonstrated to result in significant anxiolytic effects; however, findings are limited by small sample sizes (Khoury et al., 2017). To date, there are no such trials demonstrating benefit with respect to improving symptoms of depression (Khoury et al., 2017; Whiting et al., 2015).

There remains a notable paucity of research looking at the relationship between cannabis use and symptoms of anxiety and depression among gbMSM. In order to address this gap, we used data from a longitudinal cohort study of gbMSM in Vancouver, Canada to examine factors related to regular cannabis use and associations with symptoms of anxiety and depression among gbMSM who reported being diagnosed with these conditions.

METHODS

Study Design and Participant Selection

Data for the present study were drawn from the [redacted], a bio-behavioural prospective cohort study investigating sexual, psychosocial, and substance use patterns among gbMSM living in Metro Vancouver, Canada. Participants were recruited from February 2012 to February 2015 using respondent-driven sampling (RDS; Heckathorn, 1997), a formalized chain-referral sampling methodology that leverages the social networks of participants in order to recruit from minority or marginalized populations (Heckathorn, 2002). After

participation, all participants were provided with up to six vouchers and encouraged to recruit other eligible gbMSM from their social and sexual networks. Participants were eligible if they: were selected as an initial "seed" or had a valid voucher obtained from another participant, currently lived in Metro Vancouver, were age ≥16 years, gender identified as a man (regardless of sex at birth), reported having sex with a man in the past six months (P6M), and were able to complete a questionnaire in English. Initial seeds were recruited via word of mouth through community partners and through advertisements on gbMSM-targeted websites and apps. Participants attended the downtown Vancouver study office which is located in the traditional gay neighbourhood of the city and were screened in-person for eligibility by study staff. Eligible participants provided written informed consent prior to conducting any study-related procedures. Eligible participants who attended the first visit were also offered enrolment into the cohort study, though participation in both the cross-section (i.e., visit 1) and the cohort was not required. Participation in the cohort included follow-up visits every 6 months, to a maximum of 4 years. At all study visits, participants completed a computer-assisted, self-administered interview (CASI) which asked about socio-demographic, psychosocial, and behavioural factors, including sexual health and substance use. Participants also met with a study nurse for HIV bloodwork (either testing or CD4/viral load counts as appropriate) and STI screening. The nurse also asked about history of lifetime mental health conditions and substance use. Study participants received $50 for each study visit and an additional $10 for each eligible recruit. Full study methodology is published elsewhere (redacted). Research Ethics Board (REB) approval was granted from the [redacted – participating universities]. The present analysis utilizes data from study visits up to February 2017.

Variables of Interest

The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was used to ascertain current symptoms of anxiety and depression. Scores for each subscale (anxiety and depression independently) range from 0 to 21 and are categorized as: normal (0-7), borderline (8-10), and moderate/severe (>10). We also examined factors associated with regular cannabis use, defined as "at least weekly use in the previous three months", and further categorized as occasional (less than monthly, monthly, and weekly use), frequent (more than weekly), and daily use (daily or almost daily use). A particular method of consumption (smoking, eating, etc.) was not specified. The study nurse determined lifetime diagnosis of mental health conditions by asking the participants if they had ever been told by a doctor that they had any of the following mental health concerns: depression, anxiety, bipolar disorder, schizophrenia, alcohol use disorder, or other substance use disorder. Those who responded yes to any of the questions were also asked whether they were currently under treatment for their condition(s).

Key explanatory variables included sociodemographics, sexual behaviour, substance use, and psychosocial factors. In addition to the HADS, participants also completed the Alcohol Use Disorder Identification Test (AUDIT; Saunders et al., 1993) and the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) for cannabis use (WHO, 2002). Sociodemographic variables included age, ethnicity, sexual orientation, education, income, HIV-status, relationship status, perceived presence within the gbMSM community, and

current housing conditions. Sexual behaviours included engagement in sex work in the P6M and number of male anal sex partners in the P6M. Participants were also asked about their substance use patterns over the P6M including tobacco use, categorized as daily, infrequent (regularly but not daily, only when drunk/high/or mixed with cannabis, and not regularly at all), and no use. Other substances of interest included use of crystal meth, stimulants, depressants, opiates, hallucinogens, and alcohol over the P6M.

Statistical Analysis

Descriptive statistics are reported at baseline. Independent variables were tested across all categories of the dependent variables. Using the PROC GLIMMIX subroutine function, univariable mixed effects models utilizing the RDS chain as the first level cluster and participant as second level cluster were constructed and odds ratios were calculated. Variables of interest in the univariable models with a p-value <0.2 were included for consideration in the multivariable generalized linear mixed models. The final models were selected using a backward stepwise selection technique based on two criteria (Akaike Information Criterion (AIC) and Type III p-values), whereby the least significant (i.e., highest Type III p-value) variable was dropped until the final models reached the optimal (minimum) AIC (Lima et al., 2007). All analyses were performed using SAS® Version 9.4 (SAS Corporation Cary, North Carolina, United States) and all statistical tests were two-sided and considered significant at p<0.05. In the first model, we sought to determine factors associated with using cannabis at least weekly during the three months prior to any study visit among the entire sample. In the second model, we restricted the sample to only those who reported ever being doctor-diagnosed with an anxiety disorder and sought to determine factors associated with current anxiety symptomology, including at least weekly cannabis use. In the third model, we restricted the sample to only those who reported ever being doctor-diagnosed with a depressive or bipolar spectrum disorder and sought to determine factors associated with current depressive symptomology, including at least weekly cannabis use.

RESULTS

A total of 774 individuals were enrolled between February 2012 and February 2015, including 134 (17.3%) recruited as initial seeds. Of these, 698 agreed to participate in the longitudinal cohort study and 583 (83.5%) had at least one follow-up visit with a median follow-up time of 3.42 years (Q1-Q3: 2.54-3.52). Overall, median age at baseline was 34 years (Q1-Q3: 26-47), 84.6% identified as gay, and the majority (75.6%) were White. Other ethnicities included Asian (9.6%), Aboriginal (6.5%), Latin American (4.5%), and other (3.9%). The majority of respondents (76.9%) reported some post-secondary education, while 62.7% reported an annual income of <$30,000. 28.8% were HIV-positive and 48.2% reported having ever been diagnosed with a mental health disorder. At baseline, 200 gbMSM (26.4%) reported ever being diagnosed with an anxiety disorder and 299 (39.3%) reported ever being diagnosed with depression or bipolar disorder.

A total of 426 (55.0%) reported any cannabis use in the past 3 months at their enrollment visit; of these, 102 (13.2%) reported using less than once a month, 74 (9.6%) reported using

monthly, 70 (9.0%) reported using weekly, 50 (6.5%) reported more than weekly use, and 130 (16.8%) reported using daily or almost daily. For the purpose of this analysis, we defined regular cannabis use as at least weekly use at enrollment with 32.3% of the total sample meeting this definition (250/774). Factors in the multivariable model (Table 1) that were positively associated with regular cannabis use in the P3M included HIV-seropositivity (aOR=2.23, 95%CI:1.40-3.54), use of hallucinogens (aOR=2.66, 95%CI:1.91-3.70) and stimulants other than cocaine and methamphetamine (aOR=1.59, 95%CI:1.14-2.23) in the P6M, and previous diagnosis of a mental health disorder (aOR=1.52, 95%CI:1.00-2.31, p=0.050). Alcohol use (P6M) in varying frequencies was also significantly associated with increased odds of reporting regular cannabis use in the P3M compared to those who did not consume alcohol: once a week or less (aOR=1.99, 95%CI:1.22-3.27), two to four times per week (aOR=2.64, 95%CI:1.53-4.54), and daily or almost daily (aOR=2.61, 95%CI: 1.16-5.85). In contrast, factors that were negatively associated with regular cannabis use in the P3M included Asian (aOR=0.12, 95%CI:0.05-0.32) or Latino (aOR=0.35, 95%CI: 0.13-0.94) ethnicity compared to White and infrequent (aOR=0.61, 95%CI:0.38-0.98) or no (aOR=0.50, 95%CI:0.33-0.76) tobacco use in the P6M. Respondents who used smartphone applications to seek sex less than or about once per month (aOR=0.72, 95%CI:0.52-0.99) or more than once per month (aOR=0.61, 95%CI:0.42-0.88) over the P6M were also significantly less likely to report regular cannabis use compared with those who never used such applications.

Over the course of the study, 221 (28.6%) participants reported ever having been diagnosed with anxiety during their lifetime. Of these, 57% reported any cannabis use in the P3M and 37.6% reported regular (i.e., at least weekly) use. Frequency of cannabis use (i.e., no use, occasional use, frequent use, daily use) was not associated with severity of anxious symptoms. In our multivariable model (Table 2), at least weekly cannabis use was not found to be significantly associated with moderate/severe HADS anxiety scores (aOR=1.16, 95%CI:0.69-1.94). Moderate/severe HADS anxiety scores were associated with medium (aOR=1.72, 95%CI:1.04-2.84) and harmful (aOR=2.68, 95%CI:1.37-5.23) AUDIT scores, compared to those with low-risk scores. Factors significantly associated with decreased odds of reporting moderate/severe HADS anxiety scores included Latino ethnicity (aOR=0.09, 95%CI:0.01-0.56), being a student (aOR=0.58, 95%CI:0.33-0.99), having received money in exchange for sex in the P6M (aOR=0.44, 95%CI:0.21-0.91), and reporting having seen or spoken to more gbMSM in the past month (aOR=0.47, 95%CI:0.26-0.87). No significant associations were found between moderate/severe HADS anxiety scores and HIV-serostatus or current treatment for a mental health disorder (aOR=1.39, 95%CI:0.96-2.01) in the multivariable model.

Over the course of the study, 320 (41.3%) participants reported ever being diagnosed with depression or a bipolar disorder during their lifetime. Of these, 58.7% reported any cannabis use in the P3M and 37.5% reported regular (i.e., at least weekly) use. Frequency of cannabis use (i.e., no use, occasional use, frequent use, daily use) was not associated with severity of depression symptoms. In our multivariable model, at least weekly cannabis use was not found to be significantly associated with moderate/severe HADS depressions scores (aOR=0.96, 95%CI: 0.59-1.58) (Table 3). Individuals who were currently under treatment for a mental health disorder were significantly more likely to report moderate/severe HADS

depression scores (aOR=1.73, 95%CI:1.21-2.49), as were those who believed that it was not very or not at all important to be connected to and involved in the gay community (aOR=1.66, 95%CI:1.05-2.61). Those who reported at least some post-secondary education were significantly less likely to report moderate/severe HADS depression scores (aOR=0.43, 95%CI:0.25-0.74), as were those who were under 30 years (aOR=0.39; 95%CI:0.18-0.84), compared to those who were 30-44 years. No significant associations were found between moderate/severe HADS depression scores and HIV-serostatus, AUDIT scores, or other substance use in the multivariable model.

DISCUSSION

Among a longitudinal sample of 774 gbMSM in Metro Vancouver, British Columbia, we did not find associations between regular cannabis use and severity of symptoms of anxiety or depression among those previously diagnosed with the corresponding mental health condition. To further explore this finding, we tested other frequency of use categories (i.e., daily; frequent; occasional; no use) and similarly, did not find any associations between HADS scores and cannabis use suggesting that anxious or depressive symptomology may not be associated with cannabis use in a dose-dependent manner among our sample of gbMSM with diagnosed mental health concerns. These findings add to the existing literature, the majority of which is not specific to gbMSM populations, that remains largely equivocal regarding the utility of cannabis in managing symptoms of anxiety and depression. For example, our findings are consistent with other observational studies (Buckner et al., 2012; Tournier et al., 2003), including work conducted by Danielsson and colleagues (2016) using data obtained via mailed questionnaires from a general sample of residents in Stockholm, Sweden. Their analysis did not reveal any longitudinal associations between frequent cannabis use and anxious or depressive symptomology. Those with baseline symptoms of anxiety and depression were similarly not at increased odds of onset cannabis use at follow-up. On the contrary, cannabis use may exacerbate mental health symptomology as other research suggests that those with existing mood disorders may in fact be prone to more severe mental health concerns (Bonn-Miller et al., 2008; Crippa et al., 2009; Kedzior & Laeber, 2014; Tournier et al., 2003). However, evidence is mixed as Bergamaschi and colleagues (2011) found that cannabis reduced anxiety, cognitive impairment, and discomfort during speech performance in treatment-naive participants diagnosed with social anxiety disorder. As mentioned previously, inferences from existing trials are hindered due to small sample sizes and should be interpreted with caution.

One possible explanation for the disparate findings across studies is the varying frequency of use categories used to measure consumption and, further, lack of information regarding the dosage of cannabis consumed. While our results do not appear to suggest a dose-response relationship, other studies have suggested that heavy cannabis users are at elevated risk of mood disorders compared to less frequent patterns of use (Van Laar et al., 2007), although as mentioned previously, causality is difficult to assess. Future exploratory research may benefit from efforts to elucidate the potential dose-response association between frequency and quantity of cannabis use and mental health symptomology. Inconsistent results may also be attributable to variability in the measurement and control for confounding factors, as certain studies may have only adjusted for demographic and concurrent substance use

factors while leaving other important determinants of cannabis use and mental health disorders unexplored. The contradicting evidence presents an interesting challenge in view of reports both anecdotally and in published literature citing management of symptoms related to anxiety and depression among the most common reasons for cannabis use (Osborn et al., 2015; Walsh et al., 2013). Moreover, given the recent legalization of recreational cannabis and evidence that suggests higher rates of self-medication in regions with established cannabis-use laws (Sarvet et al., 2018), healthcare providers can expect to encounter increased inquiries regarding the use of cannabis to treat mental health symptoms. Safe and informed health services provision ultimately calls for definitive, placebo-controlled trials and large targeted cohort studies to determine the utility of cannabis in this setting.

As expected, cannabis use was highly prevalent among gbMSM in our study with nearly a third (32.3%) of participants reporting regular cannabis use in the P6M. While this figure is generally comparable with rates in other studies of cannabis use among gbMSM (McCabe et al., 2009; Stall et al., 2001; Trocki et al., 2009), it is notably greater than the estimated 12.3% of past-year cannabis users in 2015 among the general Canadian population (Rotermann & Macdonald, 2018). Additionally, our study presents evidence suggesting higher rates of regular cannabis use among gbMSM who have previously been diagnosed with any mental health disorder (56.3%) compared to those without a mental health history (43.7%). These findings are in line with existing research demonstrating that substance use, including cannabis use, and mental health conditions are highly co-occurrent (Lai et al., 2015; Vorspan et al., 2015), particularly among sexual minority individuals (Bränström & Pachankis, 2018; Pakula et al., 2016; Rosario et al., 2006). Our observed association could either be a cause or effect relationship. Recent research in this area has largely focused on syndemic models of substance use and mental health among gbMSM which highlight the role of institutionalized stigma and social isolation as contributing factors that perpetuate co-occurrent adverse health conditions (Halkitis et al., 2015). Findings have highlighted a need for reformed care practices that emphasize holistic approaches to health while simultaneously addressing issues of sexuality, substance use, and mental health.

In line with findings from previous studies (e.g., Okafor et al., 2017), HIV-seropositive gbMSM in our sample were more likely to report regular cannabis use: 43% of HIV-seropositive men reported regular use compared to 28% of HIV-seronegative individuals. Interestingly, these rates appear to be relatively similar to cannabis use among HIV-positive individuals in other settings. For example, Fogarty and colleagues (2007) found that 44.3% of HIV-positive respondents from a cohort sample in Australia reported cannabis use in the P6M for therapeutic or recreational purposes. More recently, prevalence of cannabis use was estimated to be 38.5% among HIV-positive residents in the Canadian Maritimes (Harris et al., 2014). These comparisons suggest that sexual orientation is not a particularly important determinant of cannabis use among those living with HIV. Rather, a likely explanation for the increased prevalence rates in this population is the aforementioned use of cannabis to treat a number of HIV-associated symptoms including mood disorders, nausea and lack of appetite (Corless et al., 2009; Fogarty et al., 2007; Ware et al., 2003). Despite higher prevalence of use, conclusive evidence of benefit has only been demonstrated in select indications, such as HIV-associated neuropathic pain (Abrams et al., 2007), so further

research is needed among gbMSM in general, and HIV-seropositive gbMSM in particular. However, our finding that regular cannabis use did not appear to be associated with worsened symptoms of depression or anxiety suggest that HIV-seropositive gbMSM, and gbMSM more broadly, who use cannabis to treat health issues may not be at increased risk for depression and anxiety as a result of their cannabis use.

It is important to note several limitations to our study. Notably, among gbMSM who reported anxiety or depression and regular cannabis use, it was not possible to determine what their respective HADS anxiety and depression scores would have been without cannabis use. It is plausible that these individuals may have mental health symptomology which is improved with cannabis use; however, the improvement does not reduce symptoms to non-clinical levels. As such, we cannot conclude that cannabis use has no effect, rather, we can only determine that in the present analysis, regular use was not associated with lower levels of symptoms. Moreover, due to statistical power, we were unable to look at those who initiated regular cannabis use during the course of the study and whether this had any effect on subsequent HADS scores. Lastly, generalizability of our findings to gbMSM populations in rural or more remote locations may be limited given that the majority of our sample are drawn from gbMSM residing in urban centres. Applicability of our findings to other urban settings where cannabis use is not as common may also be limited and may be further affected by pending legalization. Despite these challenges, this present study is the first that has looked longitudinally at these associations among gbMSM, and ultimately indicates that gbMSM who regularly use cannabis are not more likely than less frequent users or non-users to experience decreased severity of symptoms of anxiety and depression to below clinical levels.

CONCLUSION

Regular use of cannabis does not appear to be independently associated with severity of symptomology of anxiety and depression among gbMSM previously diagnosed with these conditions. Given an inability to draw causal conclusions in this study, our findings further support the need for randomized, placebo-controlled trials and other forms of clinical research investigating the effectiveness of cannabis in managing mental health symptomology, particularly in light of legislative changes that may increase access to a therapeutic option with limited evidence of benefit. In line with previous research, regular cannabis use was more likely to be reported among HIV-seropositive gbMSM and those previously diagnosed with mental health conditions. In general, our findings indicate a need for further exploration of health promotion efforts and holistic approaches to care targeting mental health and substance use behaviours simultaneously.

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References

Abrams DI, Jay C, Shade S, Vizoso H, Reda H, Press S, . . . Petersen K (2007). Cannabis in painful HIV-associated sensory neuropathy A randomized placebo-controlled trial. Neurology, 68(7), 515–521. [PubMed: 17296917]

Bergamaschi MM, Queiroz RHC, Chagas MHN, De Oliveira DCG, De Martinis BS, Kapczinski F, . . . Nardi AE (2011). Cannabidiol reduces the anxiety induced by simulated public speaking in treatment-naive social phobia patients. Neuropsychopharmacology, 36(6), 1219. [PubMed: 21307846]

Bonn-Miller MO, Zvolensky MJ, Bernstein A, & Stickle TR (2008). Marijuana coping motives interact with marijuana use frequency to predict anxious arousal, panic related catastrophic thinking, and worry among current marijuana users. Depression and anxiety, 25(10), 862–873. [PubMed: 17849459]

Bottorff JL, Johnson JL, Moffat BM, & Mulvogue T (2009). Relief-oriented use of marijuana by teens. Substance Abuse Treatment, Prevention, and Policy, 4(1), 7.

Bränström R, & Pachankis JE (2018). Sexual orientation disparities in the co-occurrence of substance use and psychological distress: a national population-based study (2008–2015). Social Psychiatry and Psychiatric Epidemiology, 53(4), 403–412. doi:10.1007/s00127-018-1491-4 [PubMed: 29450600]

Brennan DJ, Ross LE, Dobinson C, Veldhuizen S, & Steele LS (2010). Men's sexual orientation and health in Canada. Canadian Journal of Public Health/Revue Canadienne de Santé Publique, 255–258. [PubMed: 20737821]

Bruce D, Harper GW, Fernandez MI, & Adolescent Medicine Trials Network for HIV/AIDS Interventions. (2013). Heavy marijuana use among gay and bisexual male emerging adults living with HIV/AIDS. Journal of HIV/AIDS & social services, 12(1), 26–48. [PubMed: 23805056]

Buckner JD, Crosby RD, Silgado J, Wonderlich SA, & Schmidt NB (2012). Immediate antecedents of marijuana use: An analysis from ecological momentary assessment. Journal of behavior therapy and experimental psychiatry, 43(1), 647–655. [PubMed: 21946296]

Cochran SD, Ackerman D, Mays VM, & Ross MW (2004). Prevalence of non-medical drug use and dependence among homosexually active men and women in the US population. Addiction, 99(8), 989–998. [PubMed: 15265096]

Corless IB, Lindgren T, Holzemer W, Robinson L, Moezzi S, Kirksey K, . . . Hamilton MJ (2009). Marijuana effectiveness as an HIV self-care strategy. Clinical Nursing Research, 18(2), 172–193. [PubMed: 19377043]

Crippa JA, Zuardi AW, Martín-Santos R, Bhattacharyya S, Atakan Z, McGuire P, & Fusar-Poli P (2009). Cannabis and anxiety: a critical review of the evidence. Human Psychopharmacology: Clinical and Experimental, 24(7), 515–523. [PubMed: 19693792]

Danielsson A-K, Lundin A, Agardh E, Allebeck P, & Forsell Y (2016). Cannabis use, depression and anxiety: A 3-year prospective population-based study. Journal of affective disorders, 193, 103–108. [PubMed: 26773900]

Feingold D, Weiser M, Rehm J, & Lev-Ran S (2016). The association between cannabis use and anxiety disorders: Results from a population-based representative sample. European Neuropsychopharmacology, 26(3), 493–505. [PubMed: 26775742]

Fogarty A, Rawstorne P, Prestage G, Crawford J, Grierson J, & Kippax S (2007). Marijuana as therapy for people living with HIV/AIDS: social and health aspects. AIDS care, 19(2), 295–301. [PubMed: 17364413]

Fredriksen-Goldsen KI, Kim H-J, Barkan SE, Muraco A, & Hoy-Ellis CP (2013). Health disparities among lesbian, gay, and bisexual older adults: Results from a population-based study. American journal of public health, 103(10), 1802–1809. [PubMed: 23763391]

Goldbach JT, Schrager SM, Dunlap SL, & Holloway IW (2015). The application of minority stress theory to marijuana use among sexual minority adolescents. Substance use & misuse, 50(3), 366–375. [PubMed: 25493644]

Goldbach JT, Tanner-Smith EE, Bagwell M, & Dunlap S (2014). Minority stress and substance use in sexual minority adolescents: A meta-analysis. Prevention Science, 15(3), 350–363. [PubMed: 23605479]

Hajizadeh M (2016). Legalizing and regulating marijuana in Canada: review of potential economic, social, and health impacts. International journal of health policy and management, 5(8), 453. doi: 10.15171/ijhpm.2016.63 [PubMed: 27694657]

Halkitis PN, Kapadia F, Bub KL, Barton S, Moreira AD, & Stults CB (2015). A longitudinal investigation of syndemic conditions among young gay, bisexual, and other MSM: the P18 Cohort Study. AIDS and Behavior, 19(6), 970–980. [PubMed: 25192900]

Harris GE, Dupuis L, Mugford GJ, Johnston L, Haase D, Page G, . . . Dow G (2014). Patterns and correlates of cannabis use among individuals with HIV/AIDS in Maritime Canada. Canadian Journal of Infectious Diseases and Medical Microbiology, 25(1), e1–e7. [PubMed: 24634690]

Heckathorn DD (1997). Respondent-driven sampling: a new approach to the study of hidden populations. Social problems, 44(2), 174–199.

Heckathorn DD (2002). Respondent-driven sampling II: deriving valid population estimates from chain-referral samples of hidden populations. Social problems, 49(1), 11–34.

Hughes TL, & Eliason M (2002). Substance use and abuse in lesbian, gay, bisexual and transgender populations. Journal of Primary Prevention, 22(3), 263–298.

Kedzior KK, & Laeber LT (2014). A positive association between anxiety disorders and cannabis use or cannabis use disorders in the general population-a meta-analysis of 31 studies. BMC psychiatry, 14(1), 136. [PubMed: 24884989]

Khoury JM, Neves M. d. C. L. d., Roque MAV, Queiroz D. A. d. B., Corrêa de Freitas AA, de Fátima Â, … Garcia FD (2017). Is there a role for cannabidiol in psychiatry? The World Journal of Biological Psychiatry, 1–16.

Lachowsky NJ, Dulai JJ, Cui Z, Sereda P, Rich A, Patterson TL, … Hogg RS (2017). Lifetime Doctor-Diagnosed Mental Health Conditions and Current Substance Use Among Gay and Bisexual Men Living in Vancouver, Canada. Substance use & misuse, 52(6), 785–797. [PubMed: 28379111]

Lai HMX, Cleary M, Sitharthan T, & Hunt GE (2015). Prevalence of comorbid substance use, anxiety and mood disorders in epidemiological surveys, 1990–2014: A systematic review and meta-analysis. Drug and alcohol dependence, 154, 1–13. [PubMed: 26072219]

Lima VD, Geller J, Bangsberg DR, Patterson TL, Daniel M, Kerr T, … Hogg RS (2007). The effect of adherence on the association between depressive symptoms and mortality among HIV-infected individuals first initiating HAART. Aids, 21(9), 1175–1183. [PubMed: 17502728]

Marshal MP, Friedman MS, Stall R, King KM, Miles J, Gold MA, … Morse JQ (2008). Sexual orientation and adolescent substance use: a meta-analysis and methodological review. Addiction, 103(4), 546–556. [PubMed: 18339100]

Marshal MP, Friedman MS, Stall R, & Thompson AL (2009). Individual trajectories of substance use in lesbian, gay and bisexual youth and heterosexual youth. Addiction, 104(6) 974–981. [PubMed: 19344440]

McAdams-Mahmoud A, Stephenson R, Rentsch C, Cooper H, Arriola KJ, Jobson G, … McIntyre J (2014). Minority stress in the lives of men who have sex with men in Cape Town, South Africa. Journal of homosexuality, 61(6), 847–867. [PubMed: 24392722]

McCabe SE, Hughes TL, Bostwick WB, West BT, & Boyd CJ (2009). Sexual orientation, substance use behaviors and substance dependence in the United States. Addiction, 104(8), 1333–1345. [PubMed: 19438839]

Meyer IH (2003). Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: conceptual issues and research evidence. Psychological bulletin, 129(5), 674. [PubMed: 12956539]

Moore DM, Cui Z, Lachowsky N, Raymond HF, Roth E, Rich A, … Lal A (2016). HIV community viral load and factors associated with elevated viremia among a community-based sample of men who have sex with men (MSM) in Vancouver, Canada. Journal of acquired immune deficiency syndromes, 72(1), 87. [PubMed: 26825177]

Morisano D, Babor TF, & Robaina KA (2014). Co-occurrence of substance use disorders with other psychiatric disorders: Implications for treatment services. Nordic studies on alcohol and drugs, 31(1), 5–25.

Mustanski BS, Garofalo R, & Emerson EM (2010). Mental health disorders, psychological distress, and suicidality in a diverse sample of lesbian, gay, bisexual, and transgender youths. American journal of public health, 100(12), 2426–2432. [PubMed: 20966378]

Okafor CN, Cook RL, Chen X, Surkan PJ, Becker JT, Shoptaw S, … Plankey MW (2017). Trajectories of Marijuana Use among HIV-seropositive and HIV-seronegative MSM in the Multicenter AIDS Cohort Study (MACS), 1984–2013. AIDS and Behavior, 21(4), 1091–1104. [PubMed: 27260179]

Osborn LA, Lauritsen KJ, Cross N, Davis AK, Rosenberg H, Bonadio F, & Lang B (2015). Self-medication of somatic and psychiatric conditions using botanical marijuana. Journal of psychoactive drugs, 47(5), 345–350. [PubMed: 26595140]

Pakula B, Shoveller J, Ratner PA, & Carpiano R (2016). Prevalence and co-occurrence of heavy drinking and anxiety and mood disorders among gay, lesbian, bisexual, and heterosexual Canadians. American journal of public health, 106(6), 1042–1048. [PubMed: 26985615]

Rosario M, Schrimshaw EW, & Hunter J (2006). A model of sexual risk behaviors among young gay and bisexual men: Longitudinal associations of mental health, substance abuse, sexual abuse, and the coming-out process. AIDS Education & Prevention, 18(5), 444–460. [PubMed: 17067255]

Rotermann M, & Langlois K (2015). Prevalence and correlates of marijuana use in Canada, 2012. Health reports, 26(4), 10.

Rotermann M, & Macdonald R (2018). Analysis of trends in the prevalence of cannabis use in Canada, 1985 to 2015. Health reports, 29(2), 10–20.

Sarvet AL, Wall MM, Keyes KM, Olfson M, Cerdá M, & Hasin DS (2018). Self-medication of mood and anxiety disorders with marijuana: Higher in states with medical marijuana laws. Drug and alcohol dependence, 186, 10–15. [PubMed: 29525698]

Saunders JB, Aasland OG, Babor TF, De la Fuente JR, & Grant M (1993). Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. Addiction, 88(6), 791–804. [PubMed: 8329970]

Stall R, Paul JP, Greenwood G, Pollack LM, Bein E, Crosby GM, … Catania JA (2001). Alcohol use, drug use and alcohol-related problems among men who have sex with men: the Urban Men's Health Study. Addiction, 96(11), 1589–1601. [PubMed: 11784456]

Tournier M, Sorbara F, Gindre C, Swendsen JD, & Verdoux H (2003). Cannabis use and anxiety in daily life: a naturalistic investigation in a non-clinical population. Psychiatry research, 118(1), 1–8. [PubMed: 12759155]

Trocki KF, Drabble LA, & Midanik LT (2009). Tobacco, marijuana, and sensation seeking: comparisons across gay, lesbian, bisexual, and heterosexual groups. Psychology of Addictive Behaviors, 23(4), 620. [PubMed: 20025368]

Van Laar M, Van Dorsselaer S, Monshouwer K, & De Graaf R (2007). Does cannabis use predict the first incidence of mood and anxiety disorders in the adult population? Addiction, 102(8), 1251–1260. [PubMed: 17624975]

Volkow ND, Baler RD, Compton WM, & Weiss SR (2014). Adverse health effects of marijuana use. New England Journal of Medicine, 370(23), 2219–2227. [PubMed: 24897085]

Vorspan F, Mehtelli W, Dupuy G, Bloch V, & Lépine J-P (2015). Anxiety and substance use disorders: co-occurrence and clinical issues. Current psychiatry reports, 17(2), 4. [PubMed: 25617040]

Walsh Z, Callaway R, Belle-Isle L, Capler R, Kay R, Lucas P, & Holtzman S (2013). Cannabis for therapeutic purposes: patient characteristics, access, and reasons for use. International Journal of Drug Policy, 24(6), 511–516. [PubMed: 24095000]

Walsh Z, Gonzalez R, Crosby K, Thiessen MS, Carroll C, & Bonn-Miller MO (2017). Medical cannabis and mental health: A guided systematic review. Clinical psychology review, 51, 15–29. [PubMed: 27816801]

Ware MA, Rueda S, Singer J, & Kilby D (2003). Cannabis use by persons living with HIV/AIDS: patterns and prevalence of use. Journal of Cannabis Therapeutics, 3(2), 3–15.

Whiting PF, Wolff RF, Deshpande S, Di Nisio M, Duffy S, Hernandez AV, … Ryder S (2015). Cannabinoids for medical use: a systematic review and meta-analysis. Jama, 313(24), 2456–2473. [PubMed: 26103030]

World Health Organization. (2002). The alcohol, smoking and substance involvement screening test (ASSIST): development, reliability and feasibility. Addiction, 97(9), 1183–1194. [PubMed: 12199834]

Zigmond AS, & Snaith RP (1983). The hospital anxiety and depression scale. Acta psychiatrica scandinavica, 67(6), 361–370. [PubMed: 6880820]

HIGHLIGHTS

- One third of gbMSM reported using cannabis at least weekly
- Regular cannabis use was more common among gbMSM living with HIV
- Regular cannabis use was not associated with severity of mental health symptoms

Table 1:

Univariable and multivariable generalized linear mixed models of factors associated with regular cannabis use in the past three months among gbMSM living in Metro Vancouver, Canada. (n = 774)

	Cannabis use at least weekly in the past three months				Univariable		Multivariable	
	Yes (*n* = 250)		No (*n* = 524)		Cannabis use at least weekly P3M *Yes vs. No*		Cannabis use at least weekly P3M *Yes vs. No*	
	n	%	*n*	%	OR	95% CI	aOR	95% CI
Age at interview date								
Under 30	86	34.4	203	38.7	1.44	0.94, 2.18	Not selected	
30 to 44	66	26.4	190	36.3	Ref			
45 and over	98	39.2	131	25.0	**1.95**	**1.26, 3.01**		
Sexual identity								
Gay	195	78.0	460	87.8	Ref			
Bisexual	40	16.0	33	6.3	**1.94**	**1.04, 3.63**	Not selected	
Other	15	6.0	31		1.42	0.79, 2.56		
Ethnicity								
White	204	81.6	381	72.7	Ref		Ref	
Asian	5	2.0	69	13.2	**0.06**	**0.02, 0.15**	**0.12**	**0.15, 0.32**
Aboriginal	19	7.6	31	5.9	0.64	0.28, 1.49	0.48	0.20, 1.16
Latin American	8	3.2	27	5.2	**0.30**	**0.11, 0.80**	**0.35**	**0.13, 0.94**
Other	14	5.6	16	3.1	1.16	0.42, 3.21	1.49	0.54, 4.08
Born in Canada								
No	35	14.0	142	27.1	Ref			
Yes	215	86.0	382	72.9	**3.00**	**1.72, 5.23**	Not selected	
Current neighbourhood								
Downtown or West End (not including the Downtown Eastside)	136	54.4	246	46.9	Ref			
Elsewhere Vancouver (outside downtown)	76	30.4	164	31.3	0.82	0.58, 1.16		
Outside Vancouver	38	15.2	114	21.8	**0.67**	**0.45, 0.99**	Not selected	
Highest level of education								
High school or less	74	29.6	105	20.0	Ref		Ref	
Greater than high school	176	70.4	419	80.0	**0.48**	**0.31, 0.76**	0.67	0.41, 1.10
Currently a Student								
No	207	82.8	410	78.4	Ref			
Yes	43	17.2	113	21.6	0.71	0.48, 1.05	Not selected	
Total annual income last year								
Less than $30,000	175	70.0	310	59.2	Ref			
$30,000 or more	75	30.0	214	40.8	**0.72**	**0.53, 0.97**	Not selected	
Being Out								
No I am not out	3	1.2	17	3.2	Ref			

	Cannabis use at least weekly in the past three months				Univariable		Multivariable	
	Yes (*n* = 250)		No (*n* = 524)		Cannabis use at least weekly P3M *Yes vs. No*		Cannabis use at least weekly P3M *Yes vs. No*	
	n	**%**	***n***	**%**	**OR**	**95% CI**	**aOR**	**95% CI**
Yes I am out	192	76.8	419	80.0	**4.50**	**1.62, 12.48**	Not selected	
I am still coming out	9	3.6	43	8.2	2.64	0.92, 7.62		
Not asked as did not report being gay/ lesbian/queer	46	18.4	45	8.6	**7.79**	**2.60, 23.31**		
HIV status								
HIV-negative	154	61.6	397	75.8	Ref		Ref	
HIV-positive	96	38.4	127	24.2	**2.51**	**1.62, 3.89**	**2.23**	**1.40, 3.54**
Transactional sex in the P6M								
Received	32	12.8	42	8.0	1.64	0.99, 2.72	Not selected	
Given	9	3.6	16	3.1	1.01	0.53, 1.93		
Both given and received	20	8.0	24	4.6	1.87	0.95, 3.67		
No transactional sex	189	75.6	441	84.3	Ref			
Frequency of tobacco use in the P6M								
Daily	92	36.8	96	18.3	Ref		Ref	
Infrequent	54	21.6	97	18.5	**0.55**	**0.35, 0.89**	**0.61**	**0.38, 0.98**
No tobacco use in the P6M	104	41.6	331	63.2	**0.34**	**0.22, 0.51**	**0.50**	**0.33, 0.76**
Crystal meth use in the P6M								
No	188	75.2	432	82.4	Ref			
Yes	62	24.8	92	17.6	**1.91**	**1.33, 2.76**	Not selected	
Use of other stimulants* in the P6M								
No	103	41.2	351	67.0	Ref		Ref	
Yes	147	58.8	173	33.0	**2.46**	**1.81, 3.34**	**1.59**	**1.14, 2.23**
Use of depressants in the P6M								
No	167	66.8	405	77.3	Ref		Ref	
Yes	83	33.2	119	22.7	**2.10**	**1.53, 2.87**	1.21	0.87, 1.69
Use of hallucinogens in the P6M								
No	175	70.0	467	89.1	Ref		Ref	
Yes	75	30.0	57	10.9	**3.25**	**2.38, 4.42**	**2.66**	**1.91, 3.70**
Opiate use in the P6M								
No	211	84.4	472	90.1	Ref			
Yes	39	15.6	52	9.9	**1.68**	**1.07, 2.64**	Not selected	
Frequency of alcohol use in the P6M								
No use	26	10.5	82	15.7	Ref		Ref	
Once a week or less	122	49.4	281	53.9	**2.01**	**1.25, 3.22**	**1.99**	**1.22, 3.27**
2 to 4 times per week	86	34.8	134	25.7	**2.63**	**1.58, 4.37**	**2.64**	**1.53, 4.54**
Daily or almost daily	13	5.3	24	4.6	**3.07**	**1.41, 6.69**	**2.61**	**1.16, 5.85**
AUDIT zone								

	Cannabis use at least weekly in the past three months				Univariable		Multivariable	
	Yes (*n* = 250)		No (*n* = 524)		Cannabis use at least weekly P3M *Yes vs. No*		Cannabis use at least weekly P3M *Yes vs. No*	
	n	**%**	***n***	**%**	**OR**	**95% CI**	**aOR**	**95% CI**
Low risk (scores 0 to 7)	139	56.3	322	61.7	Ref			
Medium risk (scores 8 to 15)	62	29.1	132	25.3	1.35	1.00, 1.82	Not selected	
Harmful or Possible dependence (scores 16 to 40)	36	14.6	68	13.0	1.39	0.84, 2.29		
Used smartphone apps to seek sex in the P6M								
Never	132	52.8	221	42.2	Ref		Ref	
Less than or About once per month	58	23.2	114	21.8	0.80	0.59, 1.08	**0.72**	**0.52, 0.99**
More than once per month	60	24.0	189	36.1	**0.65**	**0.47, 0.92**	**0.61**	**0.42, 0.88**
Currently have a regular family doctor								
No or Not sure	72	28.8	177	33.8	Ref			
Yes	178	71.2	347	66.2	1.30	0.90, 1.90	Not selected	
Ever diagnosed with anxiety disorder								
No	165	67.6	394	76.5	Ref			
Yes	79	32.4	121	23.5	**1.77**	**1.12, 2.79**	Not selected	
Ever diagnosed with depression or bipolar disorder								
No	132	53.9	330	64.0	Ref			
Yes	113	46.1	186	36.0	**1.75**	**1.19, 2.59**	Not selected	
Ever diagnosed with mental health disorder								
No	107	43.7	288	55.7	Ref		Ref	
Yes	138	56.3	229	44.3	**2.00**	**1.36, 2.95**	1.52	1.00, 2.31

P3M = past 3 months; P6M = past 6 months; AUDIT = Alcohol Use Disorders Identification Test; OR = odds ratio; aOR = adjusted odds ratio; 95% CI = 95% confidence interval.

*Stimulants other than cocaine and methamphetamine. Note that bivariate data are derived from study enrollment visit. GLMM data includes all study visits. Significant results (p≥0.05) in bold.

Table 2:

Univariable and multivariable generalized linear mixed model showing probability of abnormal HADS anxiety scores among gbMSM previously diagnosed with anxiety disorder. (n=221)

	HADS Anxiety Subscale				Univariable		Multivariable	
	Normal/Borderline (0-10) (*n* = 120)		Moderate/Severe (>10) (*n* = 101)		HADS Anxiety *Abnormal vs. Normal/Borderline*		HADS Anxiety *Abnormal vs. Normal/Borderline*	
	***n* or (median)**	**% or (IQR)**	***n* or (median)**	**% or (IQR)**	**OR**	**95% CI**	**aOR**	**95% CI**
Cannabis use at least weekly in the P3M								
Yes	46	38.3	37	36.6	1.10	0.66, 1.83	1.16	0.69, 1.94
No	74	61.7	64	63.4	Ref		Ref	
Age at Interview Date								
Under 30	34	28.3	28	27.7	1.32	0.73, 2.38	1.38	0.77, 2.48
30 to 44	43	35.8	40	39.6	Ref		Ref	
45 and over	43	35.8	33	32.7	0.64	0.37, 1.09	0.67	0.38, 1.18
Sexual identity								
Gay	99	82.5	80	79.2	Ref			
Bisexual	12	10.0	10	9.9	0.73	0.38, 1.41		
Other	9	7.5	11	10.9	1.47	0.78, 2.78		
Ethnicity								
White	102	85.0	86	85.1	Ref		Ref	
Asian	4	3.3	4	4.0	2.35	0.79, 6.99	1.92	0.45, 8.17
Aboriginal	7	5.8	8	7.9	1.40	0.51, 3.82	1.11	0.40, 3.02
Latin American	2	1.7	1	1.0	0.20	0.03, 1.58	**0.09**	**0.01, 0.56**
Other	5	4.2	2	2.0	0.35	0.05, 2.63	0.29	0.04, 2.13
Current neighbourhood								
Downtown or West End (not including the Downtown Eastside)	65	54.2	55	54.5	Ref			
Elsewhere Vancouver (outside downtown)	34	28.3	24	23.8	0.88	0.52, 1.49		
Outside Vancouver	21	17.5	22	21.8	1.73	0.98, 3.05	Not selected	
Highest level of education								
High school or less	40	33.3	29	28.7	Ref			
Greater than high school	80	66.7	72	71.3	0.63	0.37, 1.10	Not selected	
Currently a Student								
No	104	86.7	89	88.1	Ref		Ref	
Yes	16	13.3	12	11.9	0.68	0.40, 1.18	**0.58**	**0.33, 0.99**
Total annual income last year								
Less than $30,000	80	66.7	70	69.3	Ref			
$30,000 or more	40	33.3	31	30.7	0.80	0.50, 1.28		
HIV status								
HIV-negative	67	55.8	67	66.3	Ref			
HIV-positive	53	44.2	34	33.7	**0.51**	**0.30, 0.88**	Not selected	

	HADS Anxiety Subscale				Univariable		Multivariable	
	Normal/Borderline (0-10) (*n* = 120)		Moderate/Severe (>10) (*n* = 101)		HADS Anxiety *Abnormal vs. Normal/Borderline*		HADS Anxiety *Abnormal vs. Normal/Borderline*	
	***n* or (median)**	**% or (IQR)**	***n* or (median)**	**% or (IQR)**	**OR**	**95% CI**	**aOR**	**95% CI**
Received money in exchange for sex in the P6M								
No	104	86.7	91	90.1	Ref		Ref	
Yes	16	13.3	10	9.9	0.63	0.32, 1.24	**0.44**	**0.21, 0.91**
Currently under treatment for a mental health disorder								
No	56	46.7	30	30.6	Ref		Ref	
Yes	64	53.3	68	69.4	1.29	0.91, 1.84	1.39	0.96, 2.01
Opiate use in the P6M								
No	110	91.7	82	81.2	Ref			
Yes	10	8.3	19	18.8	1.75	0.93, 3.27	Not selected	
AUDIT zone								
Low risk (scores 0 to 7)	72	60.0	52	52.0	Ref		Ref	
Medium risk (scores 8 to 15)	35	29.2	24	24.0	**1.70**	**1.04, 2.79**	**1.72**	**1.04, 2.84**
Harmful or Possible dependence (scores 16 to 40)	13	10.8	24	24.0	**2.99**	**1.54, 5.84**	**2.68**	**1.37, 5.23**
Belonging to the gay/bi/queer community is not a good thing								
Strongly disagree or Disagree	112	93.3	83	82.2	Ref			
Agree or Strongly Agree	8	6.7	18	17.8	1.67	0.99 2.81	Not selected	
Number of MSM in Vancouver you have seen or spoken to in the past month (per 100 units increase)	(15)	(7-30)	(12)	(5-25)	**0.54**	**0.33, 0.89**	**0.47**	**0.26, 0.87**

HADS = Hospital Anxiety and Depression Scale; P3M = past 3 months; P6M = past 6 months; AUDIT = Alcohol Use Disorders Identification Test; OR = odds ratio; aOR = adjusted odds ratio; 95% CI = 95% confidence interval. Note that bivariate data are derived from study enrollment visit. GLMM data includes all study visits. Significant results (p≥0.05) in bold.

Table 3:

Univariable, and multivariable generalized linear mixed model showing probability of abnormal HADS depression scores among gbMSM previously diagnosed with depression or bipolar spectrum disorder. (n = 320)

	HADS Depression Subscale				Univariable		Multivariable	
	Normal/Borderline (0-10) (*n* = 285)		Moderate/Severe (>10) (*n* = 35)		HADS Depression *Abnormal vs. Normal/Borderline*		HADS Depression *Abnormal vs. Normal/Borderline*	
	n	(%)	*n*	(%)	OR	95% CI	aOR	95% CI
Cannabis use at least weekly in the P3M								
Yes	106	37.2	14	40	0.98	0.62, 1.56	0.96	0.59, 1.58
No	179	62.8	21	60	Ref		Ref	
Age at interview date								
Under 30	74	26.0	4	11.4	**0.42**	**0.19, 0.91**	**0.39**	**0.18, 0.84**
30 to 44	97	34.0	17	48.6	Ref		Ref	
45 and over	114	40.0	14	40.0	0.76	0.42, 1.37	0.79	0.43, 1.47
Sexual identity								
Gay	232	81.4	28	80.0	Ref			
Bisexual	29	10.2	5	14.3	1.33	0.60, 2.95		
Other	24	8.4	2	5.7	0.81	0.30, 2.15		
Ethnicity								
White	226	79.3	31	88.6	Ref			
Non-white	59	20.7	4	11.4	0.72	0.31, 1.65		
Highest level of education								
High school or less	77	27.0	14	40.0	Ref		Ref	
Greater than high school	208	73.0	21	60.0	**0.43**	**0.25, 0.73**	**0.43**	**0.25, 0.74**
Currently a Student								
No	252	88.7	31	88.6	Ref			
Yes	32	11.3	4	11.4	0.52	0.25, 1.10	Not selected	
Total annual income last year								
Less than $30,000	199	69.8	24	68.6	Ref			
$30,000 or more	86	30.2	11	31.4	0.79	0.49, 1.27		
HIV status								
HIV-negative	170	59.6	20	57.1	Ref			
HIV-positive	115	40.4	15	42.9	1.49	0.83, 2.69	Not selected	
Received money from escort or sex work in the P6M								
No	267	93.7	31	88.6	Ref			
Yes	18	6.3	4	11.4	1.76	0.76, 4.08	Not selected	
Currently under treatment for a mental health disorder								
No	120	42.6	11	32.4	Ref		Ref	
Yes	162	57.4	23	67.6	**1.70**	**1.20, 2.40**	**1.73**	**1.21, 2.49**

	HADS Depression Subscale				Univariable		Multivariable	
	Normal/Borderline (0-10) (*n* = 285)		Moderate/Severe (>10) (*n* = 35)		HADS Depression *Abnormal vs. Normal/Borderline*		HADS Depression *Abnormal vs. Normal/Borderline*	
	n	(%)	*n*	(%)	OR	95% CI	aOR	95% CI
Frequency of tobacco use in the P6M								
Daily	87	30.5	13	37.1	Ref			
Infrequent	59	20.7	2	5.7	0.47	0.20, 1.08	Not selected	
No tobacco use in the P6M	139	48.8	20	57.1	0.90	0.53, 1.54		
Crystal meth use in the P6M								
No	212	74.4	21	60.0	Ref			
Yes	73	25.6	14	40.0	**1.83**	**1.03, 3.26**	Not selected	
Use of depressants in the P6M								
No	201	70.5	20	57.1	Ref		Ref	
Yes	84	29.5	15	42.9	1.50	0.93. 2.44	1.61	0.98, 2.64
Use of hallucinogens in the P6M								
No	233	81.8	27	77.1	Ref			
Yes	52	18.2	8	22.9	1.42	0.84, 2.41	Not selected	
Frequency of alcohol use in the P6M								
No use	56	19.6	10	28.6	Ref		Ref	
Once a week or less	141	49.5	17	48.6	0.68	0.39, 0.24.	0.68	0.39, 1.19
2 to 4 times per week	72	25.3	6	17.1	0.50	0.24, 1.04	0.49	0.24, 1.01
Daily or almost daily	16	5.6	2	5.7	1.23	0.54, 2.79	1.37	0.58, 3.25
AUDIT zone								
Low risk (scores 0 to 7)	180	63.2	22	62.9	Ref			
Medium risk (scores 8 to 15)	60	21.1	5	14.3	1.11	0.62, 1.98		
Harmful or Possible dependence (scores 16 to 40)	45	15.8	8	22.9	1.27	0.62, 2.62		
Visited gay bars or clubs in the P6M								
Never	69	24.2	11	31.4	Ref			
Less than or About once per month	124	43.5	17	48.6	0.78	0.50, 1.24		
More than once per month	92	32.3	7	20.0	0.61	0.32, 1.17	Not selected	
Used smartphone apps to seek sex in the P6M								
Never	148	51.9	18	51.4	Ref		Ref	
Less than or About once per month	63	22.1	6	17.1	**0.51**	**0.29, 0.90**	0.56	0.31, 1.00
More than once per month	74	26.0	11	31.4	0.86	0.52, 1.42	1.08	0.67, 1.74
Importance of being connected to and involved in the gay community								
Very or Somewhat important	223	78.2	28	80.0	Ref		Ref	
Not very important or Not important at all	62	21.8	7	20.0	**1.63**	**1.02, 2.59**	**1.66**	**1.05, 2.61**
Being part of the gay/bi/queer community is an important reflection of who I am								
Strongly agree or Agree	179	62.8	22	62.9	Ref			
Disagree or Strongly disagree	106	37.2	13	37.1	1.45	0.91, 2.30	Not selected	

	HADS Depression Subscale				Univariable		Multivariable	
	Normal/Borderline (0-10) (*n* = 285)		Moderate/Severe (>10) (*n* = 35)		HADS Depression *Abnormal vs. Normal/Borderline*		HADS Depression *Abnormal vs. Normal/Borderline*	
	n	**(%)**	***n***	**(%)**	**OR**	**95% CI**	**aOR**	**95% CI**
Belonging to the gay/bi/queer community is not a good thing								
Strongly disagree or Disagree	257	90.2	28	80.0	Ref			
Agree or Strongly agree	28	9.8	7	20.0	1.49	0.85, 2.60	Not selected	

HADS = Hospital Anxiety and Depression Scale; P3M = past 3 months; P6M = past 6 months; AUDIT = Alcohol Use Disorders Identification Test; OR = odds ratio; aOR = adjusted odds ratio; 95% CI = 95% confidence interval. Note that bivariate data are derived from study enrollment visit. GLMM data includes all study visits. Significant results (p≥0.05) in bold.