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Changes in smoking status among a longitudinal cohort of gay, bisexual, and other men who have sex with men in Vancouver, Canada

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Abstract

Background—Cigarette smoking is common among gay, bisexual, and other men who have sex with men (GBMSM) and most of the mortality gap between HIV-positive and HIV-negative individuals is attributable to smoking.

Methods—We recruited sexually active HIV-positive and HIV-negative GBMSM age 16 years using respondent-driven sampling. Study visits occurred every six months for up to four years and

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All authors have approved the final manuscript

Conflict of Interest

No conflict declared

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included a computer-assisted self-interview and clinical assessment. We conducted bivariate analyses to compare factors associated with “never”, “former”, “daily”, or “non-daily” smoking at baseline and longitudinal mixed effects models to examine factors associated with cessation and (re)initiation.

Results—774 participants completed a baseline visit and 525 enrolled in the cohort and completed at least one follow-up visit. At baseline, the median age was 34 years and 31.5% were daily smokers. In follow-up (median=2.5 years), 116 daily or non-daily smokers (41%) quit at least once and of these, 101 (87%) remained former smokers at their last visit. Smoking cessation was positively associated with incomes \geq \$60,000 and self-reported excellent health. Alcohol use, ecstasy use, and having a partner who smokes were associated with decreased odds of cessation. Substance use (cannabis, GHB, and crystal methamphetamine) and having a partner who smokes were positively associated with increasing to/resuming daily smoking. HIV-positive GBMSM were more likely to smoke but not more likely to quit.

Conclusions—Targeted, culturally relevant smoking cessation resources are needed, especially for HIV-positive GBMSM. Engaging couples in cessation interventions may be useful.

Keywords

smoking cessation; men who have sex with men; HIV; longitudinal; respondent-driven sampling; health promotion

1. Introduction

While prevalence of cigarette smoking has declined in general (Reid et al., 2015), rates remain high in many marginalized subpopulations including gay, bisexual, and other men who have sex with men (GBMSM; Clark and Coughlin, 2012; Haley et al., 2014). Among GBMSM, prevalence of smoking ranges between 28–50% across North America (Akhtar-Khaleel et al., 2016a; Gamarel et al., 2015; O’Cleirigh et al., 2015a; Robinson et al., 2014; Storholm et al., 2011). A 2014 cross-sectional study of 1115 GBMSM in Vancouver, Canada found 37% of participants self-identified as current smokers (Haley et al., 2014). Rates were highest among HIV-positive GBMSM (50%), those with annual incomes $<$ \$20,000 (51.6%), and those $<$ 30 years old (40.4%; Haley et al., 2014). Higher incidence of smoking among GBMSM has been associated with isolation and trauma, cultural community factors, and targeted marketing strategies (American Lung Association, 2010; Dilley et al., 2008; Gamarel et al., 2015; Newcomb et al., 2014; O’Cleirigh et al., 2015a; Robinson et al., 2014). Studies of urban GBMSM have also found smoking rates to be higher and cessation rates lower in HIV-positive men (Robinson et al., 2014). People living with HIV/AIDS (PLWHA) who smoke are at elevated risk for several comorbid conditions including pulmonary infectious diseases, cancer, cardiovascular disease, and tuberculosis (Helleberg et al., 2015; Torres et al., 2014). Further, PLWHA who smoke report lower treatment adherence, higher viral load counts, and are less likely to attend routine medical visits (O’Cleirigh et al., 2015b). Even among those who are treated and virally suppressed, mortality rates are significantly higher among PLWHA who smoke, suggesting that smoking-related mortality may be greater than HIV-related mortality among HIV-positive GBMSM (Helleberg et al., 2015) and accentuating the need for targeted smoking cessation resources.

Because of the high prevalence of cigarette smoking among GBMSM, there is a growing body of literature examining smoking cessation in this population. However, the majority of this research has been cross-sectional (e.g., Gamarel et al., 2015; Lifson et al., 2010; Levinson et al., 2012; Newcomb et al., 2014; O’Cleirigh et al., 2015a; Robinson et al., 2014; Torres et al., 2014; Tron et al., 2013) and almost none have adopted a longitudinal design. Cross-sectional studies in the United States found that 45–72% of GBMSM report attempted cessation in the previous year, and preparation to quit was associated with daily (vs. non-daily) smoking, having a smoke-free home, asking a doctor for advice, and having used nicotine replacement therapy (Levinson et al., 2012; Robinson et al., 2014). These studies, however, provide information only on intentions to quit, not long term cessation success, and they offer no details on characteristics associated with different patterns of smoking over time. One longitudinal analysis has been conducted using data from the Multicenter AIDS Cohort Study (Akhtar-Khaleel et al., 2016b). In this study, the majority of participants showed consistent smoking behaviour across the study with only 34% demonstrating a change in behaviour with a third of these reducing their smoking from between 0.5–1 pack a day to almost no daily smoking.

Longitudinal examination of changes in smoking habits is important as transitions from daily to non-daily smoking may highlight potential steps toward complete cessation and increases in smoking consumption may highlight potential risk factors and targets for public health intervention. Between 2001–2005, a large longitudinal study in the US found that smoking status was constant for the majority of current, former, and never smokers (Weinberger et al., 2014). However, among non-daily smokers at baseline, the majority (54%) had quit by follow-up, while 22% increased to daily smoking (Weinberger et al., 2014). Smoking cessation was associated with younger age, being married, and having some college education. A 3-year longitudinal study of 4355 smokers in Ontario, Canada (Bondy et al., 2013), also examined transitions in smoking habits and similarly found that the majority of current and recent non-smokers did not change their smoking status; however, occasional smokers reported more changes in smoking status during follow-up. Among occasional smokers who reported past daily use, 19% reported complete cessation in follow-up but 50% resumed daily smoking. Those who resumed daily smoking were more likely to describe themselves as addicted. Therefore, smoking reduction from daily to non-daily use may be a step toward cessation, but may also be associated with higher likelihood of smoking reinitiation.

Since GBMSM are more likely to smoke and more likely to be living with HIV than the general population –estimated population prevalence of HIV among GBMSM in Vancouver is 23.4% (Moore et al., 2016) – understanding factors associated with changes in smoking status can assist local campaigns and programs to support cessation in this marginalized subpopulation. To address this need, we conducted longitudinal analyses to examine patterns of smoking cessation, initiation, reinitiation, and sustained abstinence in a cohort of Vancouver GBMSM.

2. Methods

Data were collected as part of the Momentum Health Study (Moore et al., 2016), a longitudinal cohort study of GBMSM in Vancouver, British Columbia. Eligibility criteria included being 16 years old, having had sex with a man in the past 6 months, identifying as male (including trans men), living in Metro Vancouver, and ability to complete the study in English. Participants were recruited through respondent-driven sampling (RDS), a formalized peer-recruitment strategy that uses purposefully chosen “seed” participants to target hidden and hard-to-reach populations (Heckathorn, 1997). Participants received a \$50 honorarium per study visit and an additional \$10 for each person they successfully recruited into the study. A detailed description of full study procedures is published elsewhere (Moore et al., 2016).

Participants were recruited from February 2012–February 2015 with follow-up every six months, up to a maximum of 4 years. Participants provided written informed consent before any study activities occurred and all visits took place in the downtown study office. All eligible participants who attended the first visit were also offered enrollment in the cohort study but participation in both was not required. At each visit, eligible participants completed a computer-assisted self-interview assessing a range of health behaviors, including tobacco use, and relevant psychosocial and demographic factors. A study nurse collected additional health information and conducted HIV and STI testing as part of the larger study.

At each visit, participants reported their smoking history over the past 6 months as: “never used tobacco”, “have used tobacco, but not in the past 6 months”, “daily”, “regularly but not every day”, “not regularly at all, just every now and then”, or “only when drunk or high, or mixed with cannabis”. Based on their answers, participants were placed into four groups: “never smoker”, “non-daily smoker”, “daily smoker”, and “former smoker”. We aimed to understand factors associated with transitions between categories over the course of the study including: relationship status, HIV status, quality of overall physical and mental health, method of access to primary health care, past medical history, substance use, partner’s tobacco use, gay community involvement, and demographics. Additionally, the Hospital Anxiety and Depression Scale (HADS; Zigmond and Snaith, 1983), the Alcohol Use Disorder Identification Test (AUDIT; Saunders et al., 1993), and the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST; World Health Organization, 2002) were administered. All study procedures were approved by the research ethics boards of the University of British Columbia, Simon Fraser University, and the University of Victoria.

We conducted bivariate analyses of factors associated with each category of smoking status at enrollment using the Kruskal-Wallis test for continuous variables and Chi-square or Fisher’s Exact Test for categorical variables. RDS weighting was used for all analyses conducted at baseline and RDS recruitment chains were treated as clustered data for longitudinal modeling. Independent variables were then tested across all four categories of the dependent variable, and between each pair of categories. Univariable and multivariable mixed effects models using PROC GLIMMIX subroutine, with log link function, treating RDS referrer as first level cluster and participant as second level cluster, were constructed

and adjusted risk ratios calculated for daily smoking initiation and smoking cessation. Variables of interest with p -value <0.2 in the univariable model were included for consideration in the multivariable model. We selected the final model using a backward selection technique based on two criteria (AIC and Type III p -values), with the least significant variable dropped until minimum AIC was attained (Lima et al., 2007). This technique balances the trade-off between goodness of fit and model complexity and allows determination of significance of predictors after adjusting for potential confounding effects of other variables in the model (Card et al., 2016; Dohoo et al., 2012). Daily smoking initiation was defined as a transition from “never”, “former”, or “current non-daily smoker” to “current daily smoker” between any two consecutive visits. Smoking cessation was defined as transition from “daily” or “non-daily smoker” to “former smoker” between any two consecutive visits. For participants who reported past or current smoking behavior, the responses from any later visit where they indicated never having used tobacco were excluded from analysis. A Cochran-Mantel-Haenszel test was conducted on the relative percentages of each group across the course of the study to identify any trends for changes in group membership. All analyses were conducted using SAS Version 9.4 (SAS Corporation Cary, NC).

3. Results

774 participants completed the baseline visit, of whom 134 (17.3%) were recruited as seeds. All baseline values are reported as RDS-adjusted percentages. Median age was 34 years. The majority (68.6%) was White; other races/ethnicities included Asian (9.2%), Aboriginal (9.8%), Latino (7.3%), and other (5.1%). Most (80.4%) identified as gay, 14.7% as bisexual, and 4.9% as other. 67.4% reported some post-secondary education; 72.8% reported an annual income $< \$30,000$, whereas 8.6% reported an annual income $\geq \$60,000$. 19.9% self-reported as HIV-positive.

At baseline, 31.5% were daily smokers, 29.9% were former smokers, 17.7% were non-daily smokers, and 21.0% reported never smoking cigarettes regularly. Most daily smokers (59.9%) reported smoking 10 cigarettes a day (i.e., more than half a pack). Baseline characteristics by smoking status are reported in Table 1. Only 24.1% of participants <30 years were daily smokers compared to 35.5% of those 30–44 years and 36.1% of those 45 years. The majority of White men in the sample were daily (34.0%) or former smokers (29.2%), whereas the majority of Asian men had never smoked (51.0%). The majority of bisexual men (62.4%) were daily smokers, as opposed to 26.6% of gay men and 27.3% of other MSM. We also found differences in smoking status by self-reported HIV status; 33.1% of HIV-positive participants were daily smokers compared with 28.8% of HIV-negative and 45.3% of unknown status participants. However, 96.4% of HIV-positive GBMSM had a family doctor compared with 51.2% of HIV-negative and 47.8% of GBMSM with unknown HIV status. Interactions between smoking and HIV status, race, and sexual orientation were tested and no significant associations were found.

Self-reported current health status was found to differ significantly between daily smokers and all other groups ($p < 0.001$), with 53.2% of daily smokers reporting fair/poor health compared with only 12.2% of never smokers reporting the same. When compared with never

smokers, daily smokers were also significantly more likely to report a history of cardiovascular disease ($p=0.016$), respiratory disease ($p=0.009$), depression ($p=0.010$), anxiety/panic attacks ($p<0.001$), bipolar disorder ($p<0.001$), alcohol dependency ($p=0.003$), and other substance dependency ($p<0.0001$).

Of the 774 participants in the cross-sectional survey, 698 consented to participate in the longitudinal study and 525 (75.2%) had at least one valid (see below) follow-up visit. The median follow-up time for these participants was 2.47 years (Q1-Q3:1.55-2.98) and the median number of study visits was 4 (Q1-Q3:2-6). In 486 (15.4%) follow-up study visits, participants reported never having smoked after previously reporting some level of smoking so these visits were excluded from the analysis. Relative proportions (not RDS-adjusted) of the “never smoker” and “non-daily smoker” group at each visit remained mostly constant throughout the study at 26–32% and 19–23%, respectively (Table 2), and the overall trend was not significant ($p=0.35$). However, the proportion of former smokers increased from a low of 21% of participants at Visit 2 to 31% at last visit and the proportion of daily smokers fell from 23% at Visit 1 to 18% by the last visit. Across the study, 24.2% consistently reported never smoking, 16.6% were consistently former smokers, 8.0% consistently reported non-daily smoking, and 13.0% consistently reported daily use.

Daily or non-daily smoking was reported by 285 participants in 870 study visits. Of these, 116 (41%) participants indicated at least one cessation attempt by transitioning their status to former smoker in any subsequent visit and of these, 101 (87%) remained former smokers at the last study visit. In the final multivariable model (Table 3), GBMSM with annual incomes \geq \$60,000 were more likely than those with an income $<$ \$30,000 to report smoking cessation (aRR=1.80, 95%CI:1.06-3.07). Compared with those who reported excellent current health, men who reported very good (aRR=0.46, 95%CI:0.28-0.76), good (aRR=0.52, 95%CI: 0.32-0.84), or fair (aRR=0.40, 95%CI:0.21-0.76) health were less likely to have stopped smoking. Cessation was also less likely among social drinkers (aRR=0.38, 95%CI: 0.22-0.67), binge drinkers (aRR=0.48, 95%CI:0.30-0.76), and heavy binge drinkers (aRR=0.40, 95%CI:0.17-0.93) compared with non-drinkers. Those who reported ecstasy use were also less likely to quit compared with non-users (aRR=0.63, 95%CI:0.40-1.00) as were those with a partner who used tobacco daily or almost daily compared to single participants (aRR=0.47, 95%CI:0.23-0.95). No statistically significant associations were found between cessation and sexual identity, education level, HIV status, type of primary care received, HADS or AUDIT scores, or gay community involvement in univariable or multivariable models (data not shown).

Never, former, or non-daily smoking was reported by 446 participants in 1441 study visits. Of these, 69 (15%) participants reported initiation or reinitiation of daily smoking at least once over the course of the study; a total of 78 transitions were reported between any two consecutive visits. Multivariable modeling (Table 4) indicated that compared with single men, men with partners who smoked daily or almost daily were more likely to (re)initiate daily smoking (aRR=2.12, 95%CI:1.03-4.36); however, having a non-smoking partner versus being single was protective (aRR=0.34, 95%CI:0.16-0.72). Men who used cannabis weekly (aRR=3.27, 95%CI:1.17-9.20) or more than weekly (aRR=2.97, 95%CI:1.00-8.79) were more likely to (re)initiate compared with those who used less than monthly. Compared

with non-users, men who used GHB (aRR=2.03, 95% CI:1.01-4.06,) or crystal methamphetamine (aRR=2.26, 95% CI:1.13-4.50) were more likely to (re)initiate daily smoking as were men who received primary medical care in emergency rooms the majority of the time compared to those who received primary care elsewhere (aRR=3.23, 95% CI: 1.11-9.37). Finally, compared with non-drinkers, daily smoking (re)initiation was less likely among those who reported social drinking (aRR=0.45, 95% CI:0.22-0.92), binge drinking (aRR=0.39, 95% CI:0.20-0.77), or heavy binge drinking (aRR=0.17, 95% CI:0.05-0.67). Self-reported HIV-positive status and bisexual identity were associated with greater risk of (re)initiation in the univariable model but were not selected into the final multivariable model. No statistically significant associations were found between (re)initiation and self-reported current health, HADS or AUDIT scores, or gay community involvement in univariable or multivariable models (data not shown).

4. Discussion

Cigarette smoking remains a serious public health concern and is the leading cause of premature chronic disease and mortality in Canada, accounting for 21% of deaths over the last decade (Jones et al., 2010). In 2014, 14.3% of British Columbians 12 years reported smoking, with 17.4% of males and 11.3% of females reporting current smoking (Statistics Canada, 2016). In the present study, we found a population parameter estimate of daily smoking of 32% among GBMSM in Vancouver with an estimated additional 18% using non-daily. While this is much higher than the proportion of smokers in the general BC male population (Statistics Canada, 2016), it is comparable with rates reported elsewhere for American GBMSM (Gamarel et al., 2015; Greenwood et al., 2005; Haley et al., 2014; O’Cleirigh et al., 2015a; Robinson et al., 2014). A previous cross-sectional survey conducted among GBMSM in Vancouver, recruited through venues which cater to GBMSM, found a slightly higher smoking prevalence at 37.0% (Haley et al., 2014). However, the use of RDS in our current study is more likely to provide prevalence estimates which are representative of the overall GBMSM population in Vancouver.

As noted in previous studies (Akhtar-Khaleel et al., 2016b; Haley et al., 2014; Robinson et al., 2014), HIV-positive GBMSM were more likely to smoke than HIV-negative or unknown status participants; nearly half of the HIV-positive men in this sample reported current cigarette smoking. However, consistent with past findings (Akhtar-Khaleel et al., 2016a), HIV-positive participants were not more likely to quit during follow-up, despite having better access to regular health care. This is concerning as PLWHA who smoke face worse clinical outcomes and triple the mortality rate compared with PLWHA who do not smoke (Helleberg et al., 2013). Results highlight the need for more cessation resources in this sub-population.

Among daily smokers at study enrollment, 41% reported cessation during any six-month period during a median of 2.5 years of follow-up. Furthermore, of those reporting cessation, 87% reported not smoking at their final study visit. Multivariable modeling revealed an increased likelihood of cigarette smoking cessation in participants with annual incomes \$60,000, who reported excellent health, and who did not drink alcohol. Initiation or reinitiation of daily smoking was relatively infrequent, with only 15% of individuals

reporting this outcome during any six-month period. Resumption or initiation of daily smoking was positively associated with use of GHB or crystal methamphetamine as well as receiving primary care via emergency rooms, and negatively associated with using alcohol and having a partner who did not use tobacco.

Studies in both the general public (Etcheverry and Agnew, 2008; Fisher et al., 1993; Hymowitz et al., 1997), and among sexual minorities (Greenwood et al., 2005; O’Cleirigh et al., 2015a) have found lower prevalence of cigarette smoking and higher rates of cessation in individuals with non-smoking partners. Our results are consistent with these findings and suggest that having a partner who uses tobacco daily or almost daily was both a barrier to cessation and a risk for (re)initiation, while having a non-smoking partner was found to be protective against (re)initiation. The support of a non-smoking partner and reduced exposure to cigarettes may contribute to the observed reductions in smoking (Fisher et al., 1993) and consequently, interventions to reduce smoking may benefit by including a supportive partner. Likewise, if both members of a couple smoke, interventions may be more effective if both partners are engaged in cessation together. Only a few studies have investigated the effects of couple- (LaChance et al., 2015) or family-based (Hubbard et al., 2016) cessation interventions and none have looked at same-sex partners who smoke. More research is necessary to determine the effectiveness of such interventions.

Among sexual minority individuals, excessive alcohol use has been associated with increased risk of smoking (e.g., Akhtar-Khaleel et al., 2016a; Balsam et al., 2012; Fredriksen-Goldsen et al., 2013). Consistent with this, we found that alcohol use reduced the likelihood of cessation. However, we also found that those who used alcohol were less likely to become daily smokers. While unexpected, this result is similar to findings among a sample of 1508 US adults, ages 34–44 years, which found that while increasing alcohol use was associated with initiation and progression to daily smoking, low levels of alcohol use were associated with reduced odds of daily smoking persistence (Kahler et al., 2008). While prevalence of alcohol dependence in the current sample was low, even heavy binge drinking was associated with less risk of (re)initiation; although, this effect was not seen for non-binge, frequent alcohol users. It is difficult to make clear conclusions regarding the relationship between alcohol and tobacco use from these results but it is possible that this relationship is different for GBMSM than for other men and the general population. However, given the association between alcohol use and reduced cessation, interventions which promote both reduced smoking and alcohol use and that consider improved health as a multifaceted dimension with many interrelated contributors may be more effective than problem-specific programming.

We did not find any association between transitions in smoking status and degree of involvement in the gay community (e.g., attending gay events, meetings, bars). Conflicting results have been previously reported with some suggesting more cessation attempts in GBMSM with a larger number of gay and bisexual friends, perhaps as a result of reduced minority stress (Greenwood et al., 2005). Others suggest increased smoking results from increased involvement in the community (Holloway et al., 2012), as much social interaction among GBMSM occurs in the context of bars and clubs where smoking may be more normalized.

In the present study, receiving the majority of primary care in an emergency room was also associated with increased likelihood of daily smoking initiation. Lack of access to cessation resources offered by a family doctor or regular physician could explain this link, considering that physician assistance often results in increased likelihood of successful long-term abstinence (Fisher et al., 1993). Increased cessation intervention by primary health care providers, including those in emergency rooms, could be called for. According to national surveys in the US, only 38.7% of emergency medicine physicians assess smokers' intention to quit, and only 26.1% refer patients who smoke to cessation programs, as opposed to 84.8% and 46.7% of primary care physicians, respectively (Tong et al., 2010). However, as this was not seen among HIV-positive men in this sample who were highly engaged in care, this may suggest that primary care physicians of HIV-positive men are less likely to discuss smoking cessation with these patients, or that these men are choosing to continue smoking in the face of other, and potentially more immediate, health concerns.

Finally, compared with those in excellent health, those who reported very good, good, or fair health were less likely to quit smoking. Several explanations for this are possible. First, it is likely that those who have recently quit smoking feel better about their health than those who continue to smoke. Second, it is possible that those in excellent health are more proactive about maintaining their health and thus engage in healthier activities and habits. Third, this is likely a bidirectional relationship as those who smoke more and for longer periods may report greater dependency or addiction and may experience poor health as the result of smoking-related illness. As such, smoking cessation interventions may benefit from a more holistic approach that emphasizes health and well-being in general, and cessation of smoking as one way to improve health outcomes.

Results of this study need to be considered within the context of several limitations. First, we excluded about 15% of study visits due to illogical responses reported by participants who indicated no tobacco use ever after having previously reported tobacco use at an earlier study visit. Second, the number of data points we had to analyze decreased over time. As enrollment occurred over 2 years, those who enrolled earlier had completed more visits at the time of data analysis. While this limited the number of data points for analysis, particularly for the later study visits, it is unlikely that it changed the relationships we observed between the transitions in smoking status. Finally, some individuals dropped out of the study and those who did may have been at greater risk for continuing or resuming to smoke; never smokers were the most likely to be retained in the study while former smokers were most likely to drop out.

5. Conclusions

Smoking prevalence was high in our sample of GBMSM, particularly among PLWHA and patterns of smoking use were dynamic. Smoking cessation programs need to be culturally relevant for GBMSM, should consider the needs and elevated risk of HIV-positive individuals, and should consider couple interventions for those with regular partners. Access to regular primary care should also be promoted for GBMSM and cessation programs should be specially targeted towards people living with HIV. Finally, holistic programming which addresses smoking cessation as one component of improved health and well-being, and

which draws on the strengths of GBMSM as individuals and within a larger community and social context, should be explored.

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Highlights

- 28.8% of human immunodeficiency virus (HIV)-negative and 33.1% of HIV-positive men who have sex with men (MSM) were daily smokers
- 62.4% of bisexual men were daily smokers
- MSM who made >\$60,000 and who were in excellent health were the most likely to quit
- MSM with a partner who smokes were less likely to quit and more likely to restart
- HIV-positive MSM were more likely to smoke but not more likely to quit

Characteristics of participants at study enrollment classified on the basis of smoking status

Table 1

Characteristic	Overall		Never Smokers		Former Smokers		Non-daily Smokers		Daily Smokers		p-value
	N	RDS %	n	RDS %	n	RDS %	n	RDS %	n	RDS %	
	774	21.0	245	29.9	151	17.7	188	31.5			<.0001
Age group (years)											
< 30	289	25.0	77	23.0	80	28.0	50	24.1			
30-44	256	17.2	82	30.6	51	16.9	68	35.3			
45+	229	20.5	86	37.2	20	6.2	70	36.1			
Sexual Identity											<.0001
Gay	655	24.3	217	31.7	123	17.4	137	26.6			
Bisexual	73	4.9	17	21.6	12	11.1	40	62.4			
Other	46	10.6	11	22.2	16	39.9	11	27.3			
Race/Ethnicity											<.0001
White	585	19.9	183	29.2	111	16.9	152	34.0			
Asian	74	51.0	27	34.3	5	4.1	9	10.5			
Aboriginal	50	3.8	13	27.1	15	31.4	18	37.6			
Latino	35	21.0	13	43.3	11	24.9	4	10.8			
Other	30	17.3	9	17.4	9	16.1	5	49.2			
Education											<.0001
High School	179	13.9	45	23.9	32	10.9	73	51.3			
> High School	595	24.0	200	32.4	119	20.7	115	23.0			
Annual Income (CAD)											<.0001
< \$30,000	485	17.6	145	26.6	107	20.0	135	35.8			
\$30,000-59,999	200	26.9	71	37.5	31	12.6	41	23.0			
\$60,000	89	33.8	29	38.0	13	11.4	12	16.9			
Being Out as "Gay"											<.0001
No	72	31.6	21	32.6	15	19.7	11	16.1			
Yes	611	23.2	200	31.0	119	17.8	132	28.0			
Not Gay-identified	91	4.3	24	23.0	17	16.1	45	56.6			

Characteristic	Overall		Never Smokers		Former Smokers		Non-daily Smokers		Daily Smokers		p-value
	N	n	RDS %	n	RDS %	n	RDS %	n	RDS %		
Partner Status											.003
No Regular Partner	477	113	20.3	146	29.3	96	16.5	122	33.9		
Regular Partner	164	46	28.4	52	25.9	27	17.6	39	28.1		
Common Law	89	19	13.4	28	29.8	19	22.9	23	33.9		
Married	44	12	19.7	19	53.8	9	20.8	4	5.7		
Self-reported HIV Status											0.004
Negative	492	129	20.5	153	30.6	104	20.1	106	28.8		
Positive	218	44	21.6	79	33.5	30	11.8	65	33.1		
Unknown	64	17	22.2	13	13.4	17	19.0	17	45.3		
Current Health											<.0001
Excellent/Very Good	435	124	25.8	156	36.2	83	17.9	72	20.1		
Good	243	48	17.5	63	22.7	54	20.7	78	39.1		
Fair/Poor	96	18	12.2	26	24.1	14	10.5	38	53.2		
Ever Diagnosed with...											
Cardiovascular disease	127	20	13.7	51	39.1	17	9.7	39	37.6		0.001
Respiratory Disease	112	18	12.8	36	32.9	20	15.5	38	38.7		0.053
Depression	285	50	16.7	93	33.3	53	14.8	89	35.3		0.011
Anxiety/Panic	200	33	11.8	68	35.2	38	14.6	61	38.3		<0.001
Bipolar	48	4	3.9	15	28.5	9	12.2	20	55.5		<0.001
Alcohol use disorder	56	3	5.0	16	35.1	10	20.2	27	39.7		0.026
Substance use disorder	100	9	10.6	24	24.1	19	12.5	48	52.9		<0.001
HADS Anxiety score											0.085
Normal/Borderline (0-10)	573	152	22.7	185	29.0	107	18.8	129	29.5		
Abnormal (11+)	192	37	15.7	56	32.5	44	16.2	55	35.7		
HADS Depression Score											<0.001
Normal/Borderline (0-10)	723	180	21.4	228	30.3	149	19.1	166	29.2		
Abnormal (11+)	42	9	11.6	13	23.9	2	1.8	18	62.7		<0.001
Partner Tobacco Use											

Characteristic	Overall		Never Smokers		Former Smokers		Non-daily Smokers		Daily Smokers		p-value
	N	RDS %	n	RDS %	n	RDS %	n	RDS %	n	RDS %	
No current partner	453	23.0	119	29.2	140	16.0	87	107	31.8		
No tobacco use	205	22.1	59	28.5	84	19.7	38	24	18.5		
Less than daily	44	19.4	7	6.9	12	29.1	14	11	23.0		
Daily or almost daily	72	6.2	5		9	15.5	12	46	71.3		
Participant Drinker Type											<.0001
Non drinker	108	20.2	24	32.2	36	5.1	11	37	42.5		
Social	178	30.4	61	27.4	54	10.8	21	42	31.5		
Binge	380	18.9	85	30.8	121	24.8	101	73	25.5		
Heavy Binge	58	7.3	5	22.3	16	26.4	13	24	44.0		
Non-Binge Frequent	44	24.2	14	35.3	16	7.9	5	9	32.6		
Cannabis Use											<.0001
Never Used	127	55.9	69	22.7	27	3.2	9	22	18.2		
Used in past 3 months	426	12.0	59	25.8	138	22.1	104	125	40.1		
Used 3–6 months ago	47	13.1	10	35.5	19	23.6	10	8	27.8		
Used more than 6 months ago	174	19.9	52	47.0	61	15.2	28	33	18.0		
Any Substance Use, Past 6 months											
Cocaine	200	7.2	21	23.2	43	26.2	64	72	43.4		<0.0001
Ecstasy	197	11.8	34	20.1	46	23.3	56	61	44.7		<0.0001
Ketamine	105	9.4	13	17.9	24	19.5	23	45	53.2		<0.0001
GHB	147	16.7	33	22.9	30	20.1	34	50	40.3		0.028
Crystal	154	12.6	22	23.1	38	16.0	29	65	48.3		<0.0001
Crack	74	5.9	4	21.7	15	4.7	10	45	67.8		<0.0001
Speed	46	17.6	5	7.5	7	20.5	13	21	54.5		<0.0001

RDS = respondent-driven sampling; CAD = Canadian dollars; HADS = Hospital Anxiety and Depression Scale; GHB = Gamma-Hydroxybutyrate

Table 2

Longitudinal Relative Distribution of Smoking Groups

Visit	Total		Never Smoker		Former Smoker		Current Non-Daily		Current Daily	
	n	Crude %	N	Crude %	n	Crude %	n	Crude %	n	Crude %
1	698	100	179	26	218	31	137	20	164	23
2	518	100	134	31	179	21	98	23	107	25
3	485	100	123	32	182	20	84	22	96	25
4	435	100	99	29	179	26	77	22	80	23
5	414	100	91	28	175	25	73	23	75	23
6	317	100	69	28	143	30	48	19	57	23
7	163	100	40	30	70	31	29	22	24	18

Table 3

Univariable and multivariable mixed effects modelling of factors associated with smoking cessation.

	Univariable		Multivariable	
	RR	95% CI	aRR	95% CI
Race/Ethnicity			Not Selected	
White	Ref			
Asian	2.20	1.25, 3.86		
Aboriginal	1.24	0.70, 2.22		
Latino	0.77	0.28, 2.13		
Other	0.95	0.38, 2.37		
Annual Income (CAD)				
< \$30,000	Ref		Ref	
\$30,000–59,999	0.94	0.63, 1.42	0.97	0.64, 1.47
\$60,000	1.71	1.01, 2.89	1.80	1.06, 3.07
Self-reported HIV Status			Not Selected	
Negative	Ref			
Positive	1.20	0.82, 1.75		
Unknown	1.96	0.47, 8.13		
Regular Partner			Not Selected	
No Regular Partner	Ref			
Regular Partner	1.12	0.75, 1.67		
Common Law	0.53	0.28, 1.00		
Married	1.25	0.59, 2.63		
Relationship Open			Not Selected	
Monogamous/Married	Ref			
(Partially) open	0.47	0.27, 0.82		
No Regular Partner	0.76	0.51, 1.14		
Current Health				
Excellent	Ref		Ref	
Very Good	0.44	0.27, 0.72	0.46	0.28, 0.76
Good	0.47	0.30, 0.76	0.52	0.32, 0.84
Fair	0.39	0.21, 0.74	0.40	0.21, 0.76
Poor	0.20	0.03, 1.51	0.24	0.03, 1.78
Partner Tobacco Use				
No current partner	Ref		Ref	
No	1.29	0.88, 1.90	1.29	0.87, 1.92
Less than daily	1.04	0.55, 1.98	1.16	0.61, 2.21
Daily or almost daily	0.42	0.21, 0.84	0.47	0.23, 0.95
Drinker Type				
Non-drinker	Ref		Ref	

	Univariable		Multivariable	
	RR	95% CI	aRR	95% CI
Social	0.37	0.22, 0.64	0.38	0.22, 0.67
Binge	0.46	0.30, 0.71	0.48	0.30, 0.76
Heavy Binge	0.33	0.14, 0.75	0.40	0.17, 0.93
Non-binge Frequent	0.52	0.24, 1.12	0.58	0.26, 1.29
Cannabis Use			Not Selected	
No, never	Ref			
Yes, <3 months ago	0.63	0.44, 0.91		
Yes, 3–6 months ago	0.79	0.42, 1.48		
ASSIST Risk			Not Selected	
Low (0–3)	Ref			
Moderate/High (4+)	0.64	0.45, 0.92		
Cocaine Use			Not Selected	
No	Ref			
Yes	0.55	0.36, 0.83		
Ecstasy Use				
No	Ref		Ref	
Yes	0.56	0.37, 0.87	0.63	0.40, 1.00

RR = relative risk; CI = confidence interval; Ref = referent category; CAD = Canadian dollars; ASSIST = Alcohol, Smoking and Substance Involvement Screening Test

Note: Only factors with univariable significance $p < 0.20$ were tested in the multivariable model.

Table 4

Univariable and multivariable analysis of initiation or reinitiation of daily smoking

	Univariable		Multivariable	
	RR	95% CI	aRR	95% CI
Sexual Identity			Not Selected	
Gay	Ref			
Bisexual	3.28	1.50, 7.15		
Other	2.13	0.99, 4.60		
Education			Not Selected	
High School	Ref			
> High School	0.42	0.23, 0.77		
Annual Income (CAD)			Not Selected	
< \$30,000	Ref			
\$30,000–59,999	0.80	0.46, 1.38		
\$60,000	0.36	0.14, 0.96		
Self-reported HIV Status			Not Selected	
Negative	Ref			
Positive	2.57	1.53, 4.30		
Unknown	1.72	0.21, 13.95		
Relationship Open			Not Selected	
Monogamous/Married	Ref			
(Partially) open	1.28	0.55, 2.99		
No Regular Partner	2.02	1.01, 4.04		
Being Out as "Gay"			Not Selected	
No	Ref			
Yes	2.35	0.54, 10.22		
Not Gay-identified	5.98	1.24, 28.85		
Partner Tobacco Use				
No current partner	Ref		Ref	
No	0.34	0.17, 0.68	0.34	0.16, 0.72
Less than daily	1.23	0.52, 2.90	1.28	0.53, 3.06
Daily or almost daily	2.63	1.29, 5.37	2.12	1.03, 4.36
Primary care received in Emergency room				
No	Ref		Ref	
Yes	2.71	0.96, 7.64	3.23	1.11, 9.37
Ever diagnosed with a substance use disorder			Not Selected	
No	Ref			
Yes	2.74	1.40, 5.34		
Participant Drinker Type				
Non-drinker	Ref		Ref	

	Univariable		Multivariable	
	RR	95% CI	aRR	95% CI
Social	0.60	0.30, 1.20	0.45	0.22, 0.92
Binge	0.46	0.24, 0.89	0.39	0.20, 0.77
Heavy Binge	0.35	0.09, 1.31	0.17	0.05, 0.67
Non-binge Frequent	0.17	0.02, 1.33	0.18	0.02, 1.41
Cannabis Use			Not Selected	
No, never	Ref			
Yes, in the past 3 months	2.12	1.26, 3.58		
Yes, 3–6 months ago	0.48	0.11, 2.10		
Cannabis use frequency in past 3 months				
< Monthly	Ref		Ref	
None	0.69	0.30, 1.60	0.83	0.34, 2.03
Monthly	1.28	0.45, 3.64	1.32	0.44, 3.94
Weekly	2.23	0.83, 6.01	3.27	1.17, 9.20
> Weekly	2.16	0.75, 6.21	2.97	1.00, 8.79
Daily or almost daily	1.83	0.72, 4.68	1.67	0.62, 4.50
ASSIST Risk			Not Selected	
Low (0–3)	Ref			
Moderate/High (4+)	2.35	1.43, 3.84		
Any Ketamine Use, P6M			Not Selected	
No	Ref			
Yes	2.55	1.40, 4.65		
Any GHB Use, P6M				
No	Ref		Ref	
Yes	3.50	2.03, 6.02	2.03	1.01, 4.06
Any Crystal Methamphetamine Use, P6M				
No	Ref		Ref	
Yes	4.49	2.64, 7.62	2.26	1.13, 4.50
Any Crack Use, P6M			Not Selected	
No	Ref			
Yes	3.53	1.47, 8.49		
Any Speed Use, P6M			Not Selected	
No	Ref			
Yes	3.57	1.41, 9.05		

RR = relative risk; CI = confidence interval; Ref = referent category; CAD = Canadian dollars; ASSIST = Alcohol, Smoking and Substance Involvement Screening Test; P6M = past 6 months; GHB = gamma-hydroxybutyrate

Note: Only factors with univariable significance $p < 0.20$ were tested in the multivariable model.