Demographic, Behavioral, and Social Characteristics Associated With Smoking and Vaping Among Men Who Have Sex With Men in San Francisco

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Abstract
Tobacco use is the leading lifestyle-related cause of death in the United States. We analyzed correlates of smoking and vaping tobacco in the National HIV Behavioral Surveillance (NHBS) among men who have sex with men (MSM) in San Francisco in 2014 (n = 410) using multivariable logistic regression models. We found that more than two in five MSM (41%) smoked or vaped. Smoking was greater for men of color (46% vs. 35% ; p = .02); those with annual income below $50,000 (47% vs. 34%; p = .01); those without a college education (51% vs. 30%; p < .01); and the uninsured (55% vs. 38%; p = .04). In multivariable analyses, greater odds of smoking were observed among men living with HIV (adjusted odds ratio [aOR] = 1.7; 95% CI [1.00, 2.8]); men who reported cocaine use (aOR = 3.1; 95% CI [1.9, 5.0]), and men who reported greater number of alcohol drinks on a drinking day (aOR = 1.2; 95% CI [1.05, 1.29]). Lower odds of smoking were observed for men who completed college (aOR = 0.57; 95% CI [0.36, 0.88]). Greater odds of vaping were observed among men who reported meth use (aOR = 3.01; 95% CI [1.65, 5.50]). Lower odds of vaping were observed among men who completed college (aOR = 0.55; 95% CI [0.32, 0.98]). In conclusion, the prevalence of smoking and vaping among MSM is extremely high, particularly HIV-positive MSM. MSM who smoked and vaped were more likely to be racial and ethnic minorities, have lower socioeconomic status, and report more substance and alcohol use. These findings highlight the need to develop strategies effectively addressing the high rates of cigarette smoking and vaping among MSM, particularly among minority MSM and MSM living with HIV.

Keywords
tobacco use, behavioral issues, gay health issues, gender issues, sexual orientation, epidemiology of men’s health, general health, wellness, drug use behavioral issues, alcohol use, behavioral issues

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Compared to the general population, rates of tobacco use, primarily smoking cigarettes, are higher among men who have sex with men (MSM), who comprise the majority of new HIV infections in the United States. Recent data from the National Health Interview Survey indicated that the current prevalence of smoking was 27.2% among MSM and 22.3% among heterosexual men (Agagu, King, Dube, Centers for Disease Control and Prevention [CDC], 2014). In the Multicenter AIDS Cohort Study of MSM from Los Angeles, Chicago, Pittsburg, and Washington, DC, 11% of the participants were classified as persistent light smokers, while 23.1% were classified as persistent heavy smokers (Akhtar-Khaleel et al., 2016). In the California Health Interview Survey, smoking was statistically significantly higher for MSM (21% for gay men, 29% for bisexual men), compared to heterosexual men (19%; Max, Stark, Sung, & Offen, 2016). In the same study, gay smokers were also more likely to be daily smokers than heterosexual smokers (Max et al., 2016).

Electronic cigarettes for tobacco use (i.e., “vaping”) have been commercially available for over a decade and are increasingly popular, including among MSM; yet few studies have evaluated the prevalence and correlates of cigarette smoking and vaping in this population. A national online survey of 17,522 U.S. adults in 2013 reported that the lifetime prevalence of e-cigarettes is 15%; prevalence of current use (within the past 30 days) was 5% (Huang, Kim, Vera, & Emery, 2016). While there is a paucity of data available on smoking prevalence among MSM, no surveillance data exist on vaping among MSM, thereby limiting research directions.

In the San Francisco Bay Area, comprehensive tobacco control policies have helped reduce smoking prevalence among the general population—indeed, the three major cities in this region (San Francisco, Oakland, and San Jose) have the second highest grade possible for their tobacco control policies (American Lung Association, 2018). Nevertheless, few studies have evaluated the prevalence of smoking and vaping among MSM in this region (Greenwood et al., 2005; Max et al., 2016; Tang et al., 2004). Pooled data from two studies in San Francisco reported that sexual orientation and gender identity (SOGI) minorities, including MSM, are able to abstain from smoking at the same rates as non-SOGI smokers after receiving nicotine replacement therapy and extended treatment (Grady et al., 2014). Because available data suggest that MSM have high prevalence of smoking and yet have similar success rates as the general population when provided treatment, studies that aim to identify MSM smokers and vapers who may benefit from interventions are greatly needed.

To address these gaps in the literature, the prevalence of cigarette smoking and vaping was assessed in the local San Francisco MSM National HIV Behavioral Surveillance (NHBS) survey, a national behavioral surveillance study among persons at high risk for HIV infection or transmission (MacKellar et al., 2007). The present study describes the prevalence of smoking and vaping among MSM and examines the demographic, behavioral, and social characteristics associated with these behaviors from the NHBS.

**Methods**

**Study Design**

Data from MSM in this study were obtained during implementation of NHBS in San Francisco in 2014. NHBS is a CDC-led collaboration of 20 health jurisdictions in the United States, which samples MSM, injection drug users (IDUs), and high-risk heterosexuals on a 3-year cycle (Gallagher, Sullivan, Lansky, & Onorato, 2007). NHBS utilizes time–location sampling to obtain relatively large quasi-probability samples of MSM (MacKellar et al., 2007). Eligibility criteria for this cycle of the study were (a) age 18 years and over, (b) resident of the San Francisco Metropolitan Statistical Area, and (c) self-identifying as male who ever had sex with another man. Men who were determined to be eligible were asked to complete an interviewer-administered electronic survey on tablet computers and then test for HIV. All men who participated gave their written informed consent to participate. Men received $50 for their participation. NHBS is conducted entirely anonymously. This study has institutional review board (IRB) approval (IRB # 13-12697) from the University of California, San Francisco.

**Measures**

The behavioral survey contains measures on demographics, sexual behavior, substances that are commonly used by MSM (e.g., methamphetamine, cocaine, ecstasy, and marijuana), alcohol use, smoking and vaping, and self-reported sexually transmitted infections. The Patient Health Questionnaire-9 (PHQ-9) assessed depressive symptoms. Frequency of smoking or vaping in the past 12 months was assessed via two items “Do you smoke cigarettes or use electronic cigarettes (e-cigarettes) (cigarettes only, e-cigarettes only, both, neither)?” and “How often did you use e-cigarettes (once a month or less, about once a week, several times a week, about once a day, several times a day)?”

**Data Analysis**

In this exploratory analysis, the bivariable demographic, behavioral, and clinical correlates of smoking and vaping were evaluated using Fisher’s exact and Wilcoxon rank-sum tests, as appropriate. Cohen’s $d$ was also calculated for bivariable analyses effect sizes. Variables chosen were either factors previously reported to be associated
with smoking or hypothesized potential predictors of smoking (Agaku et al., 2014; Akhtar-Khaleel et al., 2016; Shariati et al., 2017). The multivariable analyses used a model-building algorithm suggested by Hosmer and Lemeshow in which predictors in the bivariate analyses with a \( p \) value <.25 were included in the multivariable analysis and used a stepwise backward elimination approach to fit the most parsimonious model (Bursac, Gauss, Williams, & Hosmer, 2008; Hosmer & Lemeshow, 2000). All analyses were conducted in STATA version 14.1 (College Station, TX).

**Results**

**Sample Characteristics**

A total of 411 MSM were recruited and they agreed to participate in the study. Age was evenly distributed across age strata with the exceptions of 51 years and older (\( n = 85; 21\% \)) and under 21 years (\( n = 1; 0.2\% \); Table 1). By race/ethnicity, 6% of the sample was Asian (\( n = 23 \)), 6% Black (\( n = 25 \)), 56% White (\( n = 229 \)), 26% Latino (\( n = 106 \)), and 6% other (\( n = 26 \)) race/ethnicity. A majority had a college degree or higher education (\( n = 219; 53\% \)); 15% had a high school education or less (\( n = 61 \)). Demographically the sample is comparable to previous NHBS rounds of MSM in San Francisco (Raymond et al., 2013). One hundred (24%) self-reported being HIV-positive or tested HIV positive in the study.

**Smoking and Vaping Prevalence**

More than two in five MSM (41%) smoked cigarettes or vaped in the past 12 months. Smoking or vaping was more common among HIV-positive MSM (47%) compared to HIV-negative MSM (37%). Smoking alone was more common among HIV-positive MSM (47%) compared to HIV-negative MSM (37%). Finally, 17% of MSM reported vaping (17% HIV negative, 16% HIV positive). The majority of MSM who vaped also smoked (96%).

| Education | n  | %   |
|-----------|----|-----|
| HS or less | 61 | 14.8|
| Some college | 131 | 31.9|
| Bachelors | 128 | 31.1|
| Any post grad | 91 | 22.1|

| Race/ethnicity | n  | %   |
|----------------|----|-----|
| Asian | 23 | 5.6|
| Black | 25 | 6.1|
| White | 229 | 55.9|
| Latino | 106 | 25.9|
| Other | 26 | 6.3|

| Sexual orientation | n  | %   |
|--------------------|----|-----|
| Straight | 4 | 1|
| Gay | 382 | 93.2|
| Bisexual | 24 | 5.9|

| HIV positive | n  | %   |
|--------------|----|-----|
| 100 | 24.3|

Note. HS = high school; MSM = men who have sex with men.

**Means/Proportion Differences Between Smoking and Nonsmoking MSM**

MSM who smoked cigarettes were more likely to be men of color (46% vs. 35%; \( p = .03 \)); have income below $50,000 per year (47% vs. 34%; \( p = .01 \); \( d = 0.27 \)); have less than a college education (51% vs. 30%; \( p < .01 \); \( d = 0.43 \)); be uninsured (55% vs. 38%; \( p = .04 \); \( d = 0.21 \)); report any noninjection drug use (45% vs. 29%; \( p < .01 \); \( d = 0.32 \)); use marijuana (45% vs. 34%; \( p = .02 \); \( d = 0.23 \)); use methamphetamine (60% vs. 37%; \( p < .01 \); \( d = 0.32 \)); use powdered cocaine (63% vs. 28%; \( p < .01 \); \( d = 0.72 \)); use ecstasy (54% vs. 35%; \( p < .01 \); \( d = 0.34 \)); use alcohol (46% vs. 29%; \( p < .01 \); \( d = 0.34 \)); and binge-drink (49% vs. 28%; \( p = .04 \); \( d = 0.45 \)), compared to nonsmoking MSM.

MSM who smoked cigarettes, on average, were significantly younger (mean 35.1 [SD = 10.4] vs. 41.3 [SD = 13.3]; \( p < .001 \); \( d = 0.51 \)); reported more drinking days (mean 13.7 [SD = 9.7] vs. 10.3 [SD = 9.5]; \( p < .001 \); \( d = 0.36 \)), and reported greater number of drinks on drinking days (mean 3.9 [SD = 2.7] vs. 2.6 [SD = 1.9]; \( p < .001 \); \( d = 0.54 \)), compared to nonsmokers. Finally, MSM who smoked cigarettes reported greater depressive symptoms in PHQ-9 (mean 6.1 [SD = 5.2] vs. 4.7 [SD = 4.4]; \( p < .001 \); \( d = 0.29 \)), compared to nonsmoking MSM.

**Means/Proportion Differences Between Vaping and Non-Vaping in MSM**

MSM who vaped were more likely to have less than a college education (21% vs. 12%; \( p = .014 \); \( d = 0.43 \)); use powdered cocaine (26% vs. 11%; \( p < .001 \); \( d = 0.72 \)); use ecstasy (24% vs. 14%; \( p < .02 \); \( d = 0.34 \)), and use heroin (67% vs. 16%; \( p < .001 \); \( d = 0.14 \)) than non-vapers. MSM who vaped, on average, were significantly younger...
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Table 2. Multivariable Logistic Regression for Cigarette Smoking Among San Francisco Bay Area Men Who Have Sex With Men (N = 411).

| Characteristics                      | aOR   | 95% CI        | p value |
|--------------------------------------|-------|---------------|---------|
| HIV status                           |       |               |         |
| Positive                             | 1.66  | [1.00, 2.75]  | .048    |
| Negative/unknown (ref)               |       |               |         |
| Depressive symptoms                  |       |               |         |
| No (ref)                             |       |               |         |
| Yes                                  | 1.04  | [0.99, 1.09]  | .122    |
| Education                            |       |               |         |
| Less than college                    |       |               |         |
| College and above                    | 0.57  | [0.36, 0.88]  | .012    |
| Number of alcohol drinks on a drinking day |       |               |         |
| No (ref)                             |       |               |         |
| Yes                                  | 3.11  | [1.93, 4.99]  | <.001   |
| (for each additional drink)          | 1.16  | [1.05, 1.29]  | .006    |

Note. aOR = adjusted odds ratio.

Table 3. Multivariable Logistic Regression for Vaping Among San Francisco Bay Area Men Who Have Sex With Men (N = 411).

| Characteristics                      | aOR   | 95% CI        | p value |
|--------------------------------------|-------|---------------|---------|
| HIV status                           |       |               |         |
| Positive                             | 0.91  | [0.48, 1.70]  | .758    |
| Negative/unknown (ref)               |       |               |         |
| Race/ethnicity                       |       |               |         |
| White                                |       |               |         |
| Non-White                            | 0.83  | [0.47, 1.45]  | .511    |
| Education                            |       |               |         |
| Less than college                    |       |               |         |
| College and above                    | 0.56  | [0.32, 0.98]  | .044    |
| Marijuana use (past year)            |       |               |         |
| No (ref)                             |       |               |         |
| Yes                                  | 0.66  | [0.37, 1.20]  | .175    |
| Methamphetamine use (past year)      |       |               |         |
| No (ref)                             |       |               |         |
| Yes                                  | 3.01  | [1.65, 5.50]  | <.001   |

Note. aOR = adjusted odds ratio.

(mean 33.4 [SD = 9.4] vs. 40.9 [SD = 12.8]; p < .001; d = 0.51) and reported greater number of drinks on drinking days (mean 3.9 [SD = 2.6] vs. 3.0 [SD = 2.2]; p < .001; d = 0.54). Finally, MSM who vaped reported greater depressive symptoms in PHQ-9 (mean 6.3 [SD = 4.7] vs. 5.1 [SD = 4.7]; p < .001; d = 0.30), compared to non-vaping MSM.

Multivariable Logistic Regression Analyses

In multivariable analysis for smoking, the following covariates were included in the model: HIV status, depressive symptoms, education, cocaine use, and number of alcohol drinks on a drinking day. In this model, those who were HIV positive had significantly greater odds of smoking (adjusted odds ratio [aOR]: 1.7; 95% CI [1.00, 2.8]; p = .048) compared to those who are HIV negative. Additionally, those who reported cocaine use had greater odds of smoking (aOR 3.1; 95% CI [1.9, 5.0]; p < .01), compared to those who did not. Greater number of alcohol drinks on a drinking day was also associated with greater odds of smoking (aOR 1.2; 95% CI [1.05, 1.29]; p < .01). Finally, those who completed at least college education had lower odds of smoking (aOR 0.57; 95% CI [0.36, 0.88]; p = .012), compared to those who did not complete college (see Table 2). The covariate for depressive symptoms was not statistically significant (aOR 1.04; 95% CI [0.99, 1.09]; p = .122).

In multivariable analyses for vaping, the following variables were included in the model: HIV status, race/ethnicity, education, marijuana use, and methamphetamine use. In this model, those who reported methamphetamine use had greater odds of vaping (aOR 3.01; 95% CI [1.65, 5.50]; p < .001), compared to those who did not. Finally, those who completed at least college education had lower odds of smoking (aOR 0.55; 95% CI [0.32, 0.98]; p = .044), compared to those who did not complete college (see Table 3). The covariates for HIV status (aOR 0.91; 95% CI [0.48, 1.70]; p = .758) and race/ethnicity (aOR 0.83; 95% CI [0.47, 1.45]; p = .511) were not statistically significant.
Discussion

This study sought to examine the prevalence of cigarette and e-cigarette smoking among MSM and identified this prevalence to be extremely high, particularly among HIV-positive MSM. In this study, 41% of MSM smoked overall, while the prevalence of smoking was 47% among MSM living with HIV. These findings are consistent with high prevalence of smoking reported among MSM (21% for gay men, 29% for bisexual men) in California more broadly (Max et al., 2016; Tang et al., 2004). It is also notable that compared to the MSM in California, the smoking prevalence identified among MSM in San Francisco was much greater, despite the comprehensive and highly graded tobacco control policies in the major cities in this region (American Lung Association, 2018). Therefore, more targeted approaches may be needed in addition to current tobacco control policies to sufficiently address the high smoking rates identified among MSM in this region.

This study also identified that MSM who smoked were more likely to be racial and ethnic minorities, have lower socioeconomic status, and report more substance and alcohol use. These findings highlight the significant health disparities that persist among MSM subgroups with respect to smoking. The results from our study build on prior findings by identifying subgroups of MSM with higher burden of smoking and vaping, which to date has not been fully examined within a recent MSM sample (Max et al., 2016; Tang et al., 2004).

Given the high morbidity and mortality associated with tobacco use, the findings of this study highlight the urgent need to develop strategies effectively addressing the high rates of cigarette smoking and vaping among MSM. In particular, additional efforts to develop and target interventions among minority MSM, MSM living with HIV, and substance-using MSM may be needed to address the high burden of smoking in these subpopulations. As noted, studies suggest that the treatment outcomes among SOGI minorities are similar in nicotine treatment, compared to nonminorities. Hence, targeting and increasing access to evidence-based interventions for MSM who smoke should be prioritized in order to alleviate the disparities in smoking and vaping observed in this study (Grady et al., 2014).

Although vaping is a relatively new phenomenon, it is practiced by a significant proportion of MSM, and almost all of the MSM who vape in the present study also report smoking. Currently, the potential utility of vaping in smoking cessation remains inconclusive and an area of active research (Camenga & Tindle, 2018). If vaping is identified to be equally harmful, tobacco interventions must address vaping and target younger MSM who are more likely to vape. However, if vaping is reported to reduce harm from tobacco, research may be needed to determine if it is possible to get smokers to switch more exclusively to vaping.

There are a number of limitations to this analysis. First, the measure for smoking and vaping was based on self-report and did not include nuanced measures on patterns of use. Social desirability bias could have come into play as this was an interviewer-administered survey and men may have underreported their risk behaviors due to this bias. Recall bias may have also affected the data because participants were asked to recount behaviors from the past 12 months. Additionally, our study may not have measured all the relevant health conditions that may be associated with our exposures and outcomes of interest. Hence, another limitation to our analyses is the potential for unmeasured confounders. Finally, the sampling approach by design only samples MSM who attend venues known to be frequented by MSM. MSM who never attend such venues are excluded, which may limit the generalizability of these findings.

Conclusions

This study expands the understanding of smoking and vaping among MSM and points to important health disparities, particularly among MSM of color, people living with HIV, and men with lower educational attainment. Taken together, these findings underscore the important need to target interventions to MSM broadly, but also the importance of developing culturally tailored interventions for MSM subgroups who smoke and vape in disproportionately higher rates.

Declaration of Conflicting Interests

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