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Waterpipe tobacco smoking among sexual minorities in the United States: Evidence from the National Adult Tobacco Survey (2012–2014)

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Abstract

Objective—The current study examined differences in waterpipe smoking (both lifetime and current) comparing sexual minority populations - those identifying with lesbian, gay, or bisexual identity - to their heterosexual counterparts using a nationally representative dataset.

Methods—The current study used pooled data from the 2012–2013 & 2013–2014 National Adult Tobacco Survey (NATS). Log-Poisson multivariable regression models were deployed to determine the prevalence of waterpipe smoking behavior among sexual minority individuals controlling for sociodemographic characteristics and stratified by current gender status.

Results—In fully-adjusted models assessing lifetime WTS, lesbian/gay and bisexual respondents reported higher prevalence of WTS compared to their heterosexual counterparts. This trend held true in gender-stratified models among gay men [gay men: PR 1.25, 95%CI [1.06, 1.47] and women ([lesbians: PR 1.38, 95%CI [1.12, 1.69] and bisexual women: 1.69, 95%CI [1.45, 1.97]). In fully-adjusted models assessing current WTS, lesbian/gay and bisexual respondents reported higher risk of WTS compared to their heterosexual counterparts. This trend held true in gender-stratified models, only for among gay men [gay men: PR 1.56, 95%CI [1.18, 2.05] and bisexual women: 2.38, 95%CI [1.84, 3.09]].

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Contributors

KSO & RGS conceptualized the data analysis. KSO & JM conducted the data analysis. KSO drafted the initial manuscript. AKM, RGS & WM provided substantive feedback on drafts of manuscript.

Conflict of interest

All authors have no conflict of interests to report.

Conclusions—Among the US general adult population, sexual minorities exhibited increased prevalence of current waterpipe smoking compared to their heterosexual counterparts. This pattern is also shaped by gender and variation of sexual orientation identification (e.g., lesbian/gay vs. bisexual). This warrants development of tailored interventions aimed at decreasing waterpipe smoking among sexual minority populations.

Keywords

Sexual minority; Gender; Bisexual; Waterpipe smoking; Disparities; National Adult Tobacco Survey (NATS)

1. Introduction

Smoking is an important risk factor when assessing population-level health of sexual minority populations and health disparities within sexual minority populations (Blosnich, Jarrett, & Horn, 2011; Ortiz, Duncan, Blosnich, Salloum, & Battle, 2015). Sexual minority typically refers to individuals whose sexual behavior (i.e., sexually engaged to those of the same-sex and/or gender), or identity (i.e., lesbian, gay, bisexual), or attraction (i.e., attracted to those of the same-sex and/or gender) differs from the majority of society and can include those who are transgender and/or genderqueer (Mayer et al., 2008). Several studies have established that sexual minority populations are at elevated risk of smoking compared to their heterosexual counterparts, which is exhibited throughout the life-course (Balsam, Beadnell, & Riggs, 2012; Corliss et al., 2013). Additionally, researchers have established differences in smoking patterns among sexual minority populations by gender; wherein for example, more recent research has established that sexual minority women are more likely to smoke compared to their sexual minority men counterparts (Emory et al., 2015; Gamarel et al., 2016; Operario et al., 2015).

Explanations for these disparities remain unclear, yet researchers have proposed several possible reasons, which include: persistent targeted marketing by the tobacco industry (Lee, Matthews, McCullen, & Melvin, 2014; Stevens, Carlson, & Hinman, 2004); pro-tobacco community norms (Offen, Smith, & Malone, 2008; Smith, Offen, & Malone, 2005); and discrimination (Blosnich & Horn, 2011) and stress (Lick, Durso, & Johnson, 2013). While rates of cigarette smoking are declining within the general population (Jamal et al., 2014; Jamal et al., 2015), rates of use of other types of tobacco products are on the rise. Studies assessing smoking disparities among sexual minority populations have focused largely on cigarette smoking and to a lesser extent have considered other forms of tobacco smoking (Blosnich, Lee, & Horn, 2013; Lee, Griffin, & Melvin, 2009). Despite the large evidence base supporting disparities in use of cigarettes based on sexual orientation, far less is known about other tobacco products such as waterpipe tobacco smoking (WTS; also known as hookah). An important gap in the literature is to determine if disparities extend to other tobacco products and whether the strong interaction between gender, sexual orientation and tobacco use also exist relative to WTS.

1.1. Waterpipe tobacco smoking (WTS)

WTS typically refers to tobacco consumed via methods in which smoke passes through water before it is inhaled and is most commonly referred to as hookah smoking in the US (Maziak, Ward, Afifi Soweid, & Eissenberg, 2004). WTS has potentially similar deleterious effects on lung health as cigarette smoking (Raad et al., 2011), as well potential to negatively impact cardiovascular health outcomes (Layoun et al., 2014) and pulmonary functioning like cigarette smoking (Sibai et al., 2014). Novel biomedical research has revealed that WTS may result in worse lung functioning as a result from longer sustained volumes of inhaled smoke during a WTS session exposing individuals to similar types of carcinogens and toxic heavy metals found in cigarette smoke (Akl et al., 2010). Along with WTS demonstrating similar health risks as cigarette use, (Bou Fakhreddine, Kanj, & Kanj, 2014) WTS has also been linked to nicotine dependence (Cobb, Ward, Maziak, Shihadeh, & Eissenberg, 2010). Although evidence highlights the negative health effects of WTS, the general perception of WTS is that it is less harmful than cigarettes (Rezk-Hanna, Macabasco-O'Connell, & Woo, 2014).

Researchers have been concerned with the uptake of WTS in the U.S. One area of concern has centered on assessing WTS behaviors in terms of social desirability and acceptance; wherein researchers have emphasized WTS' relationship to social rituals and the uptake in social settings such as clubs (Carroll et al., 2014; Kassem et al., 2014). Connections between social settings facilitating greater uptake of WTS in the general population, might even raise further concern for sexual minority populations. Tobacco disparities scholars, who focus on sexual minority populations, have written extensively about the long socio-historical relationship between targeted tobacco advertisements and social venues frequented by sexual minorities (Lee et al., 2009).

1.2. Sexual minorities & WTS smoking prevalence

Recent results from the National Adult Tobacco Survey (NATS) have revealed that sexual minority populations demonstrate a higher prevalence of WTS (Agaku, King, & Dube, 2014; King, Dube, & Tynan, 2012). For example, King et al.'s study (2012) highlighted that LGBT respondents revealed a significantly higher prevalence (6.1%) of current WTS than their heterosexual counterparts (1.5%). Using NATS data, Salloum et al. (2015) also showed that 21% of LGBT respondents had *lifetime* WTS, compared to 9.8% of heterosexual respondents, translating into statistically higher odds of *lifetime* WTS. A limitation with this study is that it grouped all sexual minorities together, wherein health scientists studying sexual minority populations have identified the need to separate lesbian/gay populations from their bisexual counterparts (Institute of Medicine, 2011).

Bisexual populations have exhibited very differing patterns of health outcomes and behaviors than their lesbian/gay counterparts. Specifically in relation to smoking behaviors, studies have established that bisexual populations are more likely to smoke compared to their lesbian/gay counterparts (Fredriksen-Goldsen, Kim, Barkan, Muraco, & Hoy-Ellis, 2013; Gamarel et al., 2016). However previous studies have yet to capture: 1) whether higher WTS prevalence rates among sexual minority populations translates into higher prevalence profiles among sexual minority subpopulations in multivariate modeling (e.g.,

lesbian/gays separated from their bisexual counterparts) compared to their heterosexual counterparts; 2) if such prevalence profiles varies based upon *current* or *lifetime* WTS; 3) if these prevalence profiles differ by gender; and lastly, 4) how cigarette smoking status impacts WTS behaviors.

1.3. Study purpose, goals & hypotheses

With the increase in hookah bars nationally, and the well-established connections between smoking, bars, and sexual minorities (Matthews et al., 2014; Matthews, Hotton, DuBois, Fingerhut, & Kuhns, 2011) there might exist similar relationships between WTS and smoking among sexual minorities (Kates et al., 2016).

To fill this important gap in the literature, we used data from a nationally representative sample of US-based adults to evaluate whether sexual minority subpopulations are at higher risk of current WTS compared to their heterosexual counterparts, stratifying based on gender. We aimed to explore these differences taking into consideration current smoking status and sociodemographic characteristics. Based on past research, we hypothesized that sexual minority adults will exhibit higher prevalence of WTS compared to their heterosexual counterparts, and this relationship will vary by both gender and sexual orientation. Specifically, we hypothesized that bisexuals exhibit higher prevalence of WTS compared to both their heterosexual and lesbian/gay counterparts. Additionally, we expected this relationship to be even more exacerbated when comparing bisexual women to lesbian and heterosexually-identified women.

2. Methods

2.1. Sample

As population health scientists have acknowledged (Institute of Medicine, 2011), obtaining large enough samples of sexual minority populations within nationally representative datasets can be challenging. One approach has been to pool data across several waves of cross-sectional data, which is the approach we have taken considering the relatively small number of sexual minorities in one wave of the NATS. Thus, this allowed us to create a large enough sample size to produce confidence in our results. We pooled two waves of data from the NATS (2012–2013 and 2013–2014). NATS is a stratified, national landline and cellular telephone survey of non-institutionalized US adults aged 18 years residing in all 50 U.S. states and the District of Columbia. Respondent selection varied by phone type. Both survey administration questionnaires were comprised of a series of questions pertaining to general health, cigarette smoking, other tobacco use and respondent sociodemographic characteristics. The sample, from pooling the datasets, included: 60,192 respondents (2012–2013) and 75,233 respondents (2013–2014). Broken down by telephone type by year: 45,022 (landline phones) and 15,170 (cellular phones) in the 2012–2013 administration and 52,594 (landline phones) and 22,639 (cellular phones) in the 2013–2014 administration. More detailed description about the survey methodology can be found elsewhere (Hu, 2016).

2.2. Measures

2.2.1. Outcome variable—We assessed prevalence of *current* WTS using the following question: “Do you smoke tobacco in a hookah: every day, some days, rarely, or not at all?” Respondents were categorized in a binary dichotomous measure of ‘yes/no’ and if respondents indicated anything other than “not at all” they were characterized as ‘yes’. *Lifetime* (or ever-use) WTS was measured using the following question: “Have you ever smoked tobacco in a hookah in your entire life?” This measure was dichotomized (yes/no) whereas if respondents indicated anything other than “not at all” they were characterized as ‘yes’.

2.2.2. Predictor variable—Sexual orientation was determined using the following question: “Do you consider yourself to be ...?” Response categories used in the analysis included: heterosexual, or straight; gay or lesbian; and bisexual. We chose to drop respondents identifying as transgender because of the small sample size in the pooled dataset ($n = 59$) who self-identified as meeting criteria for current WTS. The instability of this small cell size prevented confidence in results from regression models including the transgender population. Furthermore, we additionally excluded those who reported “Don’t Know” ($n = 132$) in response to the question gathering information on self-identified sexual orientation.

2.2.3. Covariates—We adjusted for several covariates known to be associated with WTS and/or current cigarette smoking status, which included: current gender (do you currently believe yourself to be: male/female); educational attainment (less than high school diploma, GED, or equivalent; high school diploma, GED, or equivalent; some college, no degree; post high school certification or diploma, or associate degree; bachelor’s degree; master’s, professional, or doctoral degree); race/ethnicity (non-Hispanic white; non-Hispanic Black; Asian; Hispanic; and other); age (18–24 years old; 25–34 years old; 35–44 years old; 45–54 years old; 55–64 years old; and 65 years old); annual household income (< \$20,000; \$20,000 to < \$30,000; \$30,000 to < \$40,000; \$40,000 to < \$50,000; \$50,000 to < \$60,000; \$60,000 to < \$70,000; \$70,000 to < \$100,000; \$100,000 to < \$150,000; \$150,000); marital status (married; living with a partner; divorced; widowed; and separated; single, never married and not now living with a partner). Current cigarette smoking status was assessed through respondents identifying they had smoked 100 cigarettes in their lifetime and reported smoking “every day” or “some days” at the time of interview. This measure was a binary dichotomous variable (yes/no).

2.2.4. Data analyses—We used *chi-square* tests to assess bivariate relationships for categorical variables to compare waterpipe smokers to non-waterpipe smokers. All bivariate analyses were unweighted. Regression models were conducted to assess current WTS, with sexual orientation as the primary predictor. We further conducted gender-stratified models, recognizing how the literature has established differences in terms of smoking behavior by gender; thus, allowing us to assess whether such patterns of cigarette smoking extends to WTS. This resulted in two sets of models for each outcome: 1) models assessing *current/lifetime* WTS (an unadjusted model, a model adjusted for sociodemographic characteristics, and a model adjusted for sociodemographic characteristics and current cigarette smoking status); and 2) gender-stratified models (unadjusted models, models adjusted for

sociodemographic characteristics, models adjusted for sociodemographic characteristics and current cigarette smoking status). We utilized listwise deletion among covariates as has been the convention among analyses using NATS and missing data among covariates did not contribute to the prediction of smoking status (King et al., 2012).

Our total analytic sample was ($N = 99,521$), with ($n = 3250$) self-identified sexual minorities (lesbian/gay, bisexual with transgendered persons excluded) and ($n = 96,271$) self-identified heterosexuals. We employed Log-Poisson regression models for binary outcomes in which results were exponentiated to prevalence ratios (PRs) (Localio, Margolis, & Berlin, 2007), with corresponding 95% confidence intervals and p-values. Using PRs allowed us to ensure that we were also not likely to overestimate the effect, recognizing both the relatively small number of sexual minorities and our outcome measure of interest (Behrens, Taeger, Wellmann, & Keil, 2004; Zou, 2004). It also should be noted that we computed Log-Binomial models, recognizing the rare occurrence of both sexual minorities and WTS in general, and the results of these were not qualitatively different in terms of direction and strength (Schmidt & Kohlmann, 2008). Stata 13.0 was utilized for all analyses in which we employed Stata's GLM package (for the binomial family with robust standard error estimates) for all Log-Poisson regression models (StataCorp, 2013). All regression analyses were weighted using national weights provided within each dataset. Following guidelines outlined by the CDC, we added the weights together from each wave and divided by the total number of years ($n = 2$).

2.3. Results

Table 1 provides descriptive statistics by WTS status. Roughly 1.5% of bisexuals identified being current WTS status and roughly 2.4% of heterosexually identified respondents reported current WTS status. Among current WTS individuals, those reporting at least some college experience reported the highest percentage of current WTS status. In our bivariate analyses comparing sociodemographic characteristics based upon current WTS, all sociodemographic measures were statistically different when comparing current WTS to those reporting no history of WTS (all at the $p < 0.001$ level).

Table 2 provides results of the prevalence ratios for *lifetime* WTS by sexual orientation in. In models adjusted for sociodemographic characteristics, lesbian/gay (aPR = 1.31, 95% CI [1.71–1.46]) and bisexual (aPR = 1.72, 95% CI [1.54–1.92]) respondents had a significantly higher prevalence ratios of *lifetime* WTS compared to their heterosexual identified peers; all at the $p < 0.001$ levels. In models adjusted for sociodemographic characteristics and current cigarette smoking status, both lesbian/gay (aPR = 1.28, 95% CI [1.12–1.46]) and bisexual (aPR = 1.59, 95% CI [1.40–1.82]) respondents remained to exhibit a significantly higher prevalence ratios of *lifetime* WTS compared to their heterosexual identified peers.

Now turning to models stratified by gender, in models adjusted for sociodemographic characteristics, again both gay men (aPR = 1.24, 95% CI [1.08, 1.41]) and bisexual men (aPR = 1.24, 95% CI [1.02, 1.49]) respondents exhibited a significantly higher prevalence ratios of *lifetime* WTS compared to their heterosexual identified peers. Interestingly in this model the statistical strength was stronger among gay men rather than among bisexual men. In models adjusted for sociodemographic characteristics and current cigarette smoking

status, only gay men (aPR = 1.25, 95% CI [1.06, 1.47]) exhibited statistically higher prevalence ratios of *lifetime* WTS status when comparing them to their heterosexual identified peers. Among women, in models adjusted for sociodemographic characteristics, both lesbian (aPR = 1.51, 95% CI [1.25, 1.82]) and bisexual women (aPR = 1.94, 95% CI [1.70, 2.22]) respondents exhibited a significantly higher prevalence ratios of *lifetime* WTS compared to their heterosexual identified peers. In models adjusted for sociodemographic characteristics and current cigarette smoking status, unlike sexual minority men, both lesbian (aPR = 1.38, 95% CI [1.12–1.69]) and bisexual women (aPR = 1.69, 95% CI [1.45–1.97]) exhibited significantly higher prevalence ratios of *lifetime* WTS compared to their heterosexual identified peers.

Table 3 provides results of the prevalence ratios of *current* WTS by sexual orientation. In unadjusted models, lesbian/gay (PR = 2.60, 95% CI [2.09, 3.23]) and bisexual (PR = 4.23, 95% CI [3.44, 5.21]) respondents had a significantly higher risk of WTS compared to their heterosexual identified peers; all at the $p < 0.001$ levels. In models adjusted for sociodemographic characteristics, lesbian/gay (aPR = 1.58, 95% CI [1.29, 1.93]) and bisexual (aPR = 2.34, 95% CI [1.92, 2.86]) respondents exhibited a significantly higher prevalence ratios of *current* WTS compared to their heterosexual identified peers; all at the $p < 0.001$ levels. In models adjusted for sociodemographic characteristics and current cigarette smoking status, both lesbian/gay (aPR = 1.40, 95% CI [1.08, 1.83]) and bisexual (aPR = 2.30, 95% CI [1.84, 2.89]) respondents remained to exhibit a significantly higher prevalence of *current* WTS compared to their heterosexual identified peers. It should be noted that statistical significance was stronger for bisexuals than for lesbian/gay respondents.

Table 3 also provides results of the prevalence ratios of *current* WTS by sexual orientation, further stratified by gender. In models adjusted for sociodemographic characteristics, again both gay men (aPR = 1.61, 95% CI [1.28, 2.02]) and bisexual men (aPR = 1.52, 95% CI [1.05, 2.21]) respondents exhibited a significantly higher prevalence ratio of *current* WTS compared to their heterosexual identified peers. Interestingly in this model the statistical strength was stronger among gay men rather than among bisexual men. In models adjusted for sociodemographic characteristics and current cigarette smoking status, only gay men (aPR = 1.56, 95% CI [1.18, 2.05]) exhibited statistically higher prevalence ratio of WTS status when comparing them to their heterosexual identified peers.

Among women in models adjusted for sociodemographic characteristics, only bisexual women (aPR = 2.68, 95% CI [2.11, 3.39]) exhibited a significantly higher prevalence of *current* WTS compared to their heterosexual identified peers. In models adjusted for sociodemographic characteristics and current cigarette smoking status, unlike sexual minority men, only bisexual women (aPR = 2.38, 95% CI [1.84, 3.09]) exhibited significantly higher prevalence of *current* WTS compared to their heterosexual identified peers.

3. Discussion

Although cigarette smoking prevalence is decreasing nationally, increasing prevalence of other forms of tobacco use such as WTS is extremely concerning and warranting public health attention. The current study analyses revealed that sexual minority populations are at

increased risk of engaging in using WTS. Specifically, gay men and bisexual women exhibited increased prevalence of WTS in fully adjusted models. These findings indicate that for sexual minority women, bisexual women exhibited increased prevalence of WTS even when considering those having indicated current cigarette smoking status. On the inverse, gay men exhibited increased prevalence of WTS when considering those having indicated a current general smoking status. Salloum et al. (2015) demonstrated increased prevalence of WTS among sexual minority populations and indeed our findings confirm that such prevalence estimates translate into higher prevalence ratios of WTS, compared to their heterosexually self-identified counterparts, in regression modeling. Our study highlights the need for the systematic inclusion of sexual orientation and gender identity measures in nationally representative datasets, particularly to produce better understanding of the varied smoking behaviors among sexual minority populations (Institute of Medicine, 2011; Lee, Blosnich, & Melvin, 2012). Our findings that WTS varies by sexual orientation, and simultaneously by gender identity, mirrors findings among recent studies evaluating cigarette smoking differences. Some have hypothesized that experiences of victimization and/or heightened social discrimination may be key factors contributing to deleterious health behaviors like smoking and may help explain the gendered differences found within sexual minority populations.

For example, our study demonstrates that differences based on gender are present when considering sexual minority populations' WTS behaviors. Furthermore, our study also demonstrates that WTS usage among sexual minorities is also varied in terms of those identifying as lesbian/gay versus those identifying as bisexual. Therefore, large population-based epidemiological studies seeking to assessing new forms of smoking and tobacco use, should seek to include diverse measures that capture heterogeneity within the population based upon sexual orientation. Furthermore, such studies should also consider heterogeneity within sexual minority populations, as our study findings demonstrate varied WTS usage based upon gender and within-group variation based upon different sexual orientation identifications (i.e., lesbian/gay vs. bisexual).

Research has consistently demonstrated higher risk of deleterious health behaviors among sexual minority populations when compared to their heterosexual counterparts, particularly sexual minority women. This includes hazardous drinking (McCabe, Hughes, Bostwick, West, & Boyd, 2009), illicit drug use (Corliss, Grella, Mays, & Cochran, 2006), current cigarette smoking status (Rosario et al., 2013) and now WTS. Thus, our findings illustrate a need to consider WTS among sexual minority populations for tobacco cessation efforts aimed at decreasing disparities in smoking among sexual minority populations. Researchers seeking to utilize interventions aimed at decreasing smoking behavior among sexual minority populations should also consider WTS as another form of smoking that warrants possible new trajectories for intervention research and science.

Future research should seek to uncover further sociodemographic variations among sexual minority populations and their relationship to WTS. For example, it has been demonstrated that racial/ethnic sexual minorities are at decreased risk of current smoking status. However, it is not understood whether such trend exists relative to WTS. Unfortunately NATS had a relatively small sample of racial/ethnic minorities that were also sexual minorities making it

difficult to assess such relationship with accuracy. Additionally, future research should consider dynamics such as sociocultural influences on WTS usage like spirituality, and structural stigma which have been all shown to impact current smoking (Hatzenbuehler, Jun, Corliss, & Austin, 2014) status although no current research has been able to establish such links to WTS. Considering the dynamics between sexual minority populations and socio-historical tobacco targeting advertisement, future research might also consider whether current WTS is influenced by proximity to similarly targeted social venues. Unfortunately, the NATS dataset did not include assessments of such dynamics for consideration in the current study. Additionally, researchers should seek to understand other sociodemographic influences in the relationship between WTS behaviors among sexual minority populations (e.g., racial differences); especially with considerations of victimization and/or societal discrimination. Racial minorities in the U.S. have historically endured high levels of several forms of discrimination, including racial discrimination (Lewis, Cogburn, & Williams, 2015; Williams & Mohammed, 2013a, 2013b). Thus, it could be hypothesized that such exposure to societal discrimination in multiple forms would result in greater uptake of WTS behaviors among those at the nexus of holding racially stigmatized and sexual minority statuses. Again, unfortunately the NATS dataset does not include a large enough sample to stratify groups by race, sexual orientation, and gender simultaneously when considering WTS behaviors. However, other potential available data sources (e.g., Population Assessment of Tobacco & Health [PATH]) (Hyland et al., 2016) might facilitate more granular analyses.

3.1. Study Limitations

Although this study utilized a nationally representative sample to describe WTS among sexual minorities, it has three noteworthy limitations. First, as a result of a relatively small sample size of transgender persons within the NATS we were unable to ascertain prevalence estimates for this underserved population. Second, tobacco-use researchers focused on sexual minority populations have called for better longitudinal studies that can facilitate stronger understanding of temporal patterning. For example, studies seeking to better understand the association between social environments (e.g., bars, social clubs, or neighborhood environments) and WTS usage among sexual minority populations, might be interested in understanding temporal patterning in relation to whether social environments amplify WTS usage. Third, the current study was unable to assess, or control for, information regarding frequency and recency of WTS. Measures within the pooled dataset did exist; however, stratification by sexual orientation produced too small cell sizes for confidence in point estimates resulting from regression models. Nonetheless, the current study is the first assessment to capture sociodemographic variations among sexual minority populations and WTS using a nationally representative sample; namely variations by gender and sexual orientation identification simultaneously.

4. Conclusion

Sexual minority populations are not monolithic and WTS is not similarly experienced among sexual minority populations as evidenced from our study findings. Using data from the NATS, we found the lesbian, gay and bisexual (LGB) population is not a homogenous group with respect to WTS and that differences exist when considering variations in WTS

by gender. Future research and smoking cessation efforts should consider these dynamics when considering development of LGB-specific content, particularly in terms of developing smoking cessation efforts aimed at decreasing WTS among sexual minority populations. A recent review of WTS smoking cessation included only three studies, none of which included assessment of any dimension of sexual minority status (e.g., sexual orientation/identity, behavior, attraction) (Wasim Maziak et al., 2015). Moreover, a limitation identified among those studies included in the systematic review highlighted the need for WTS smoking cessation efforts to consider group smoking cessation efforts as an attempt to introduce assessments of dimensions of the social use of waterpipe (Wasim Maziak et al., 2015). Such efforts, that simultaneously consider sexual minority status, might prove useful for decreasing WTS among sexual minority populations. In summation, inclusion of sexual minority status could potentially help improve design and content of WTS cessation interventions and help facilitate intervention efforts aimed at decreasing WTS at population levels.

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HIGH LIGHTS

- We found that lesbian/gay and bisexual respondents reported higher prevalence of lifetime waterpipe smoking (WTS)
- Furthermore in gender-stratified models, we found that bisexual women reported the highest prevalence of lifetime WTS
- In assessing current WTS, lesbian/gay and bisexual respondents reported higher prevalence of WTS compared to their heterosexual counterparts
- Additionally, in gender-stratified models assessing current WTS, bisexual women reported the highest prevalence of current WTS followed by gay men.

Table 1

Sociodemographic characteristics of sexual minorities by water pipe tobacco smoking status: National Adult Tobacco Survey, 2012–2014 (N = 99,521).

	Water Pipe Tobacco Smoker n = 2397 (4.07%) SE [95%CI]	Non-Smoker of Water Pipe Tobacco n = 97,124 (95.93%) SE [95%CI]	p value
Sexual orientation			
Heterosexual	2137 (3.6%) 0.099 [3.41, 3.8]	93,979 (92.6%) 0.131 [92.4, 92.9]	0.000
Gay/Lesbian	121 (0.2%) 0.023 [0.161, 0.252]	1904 (1.88%) 0.061 [1.76, 2.0]	
Bisexual	1241 (1.42%) 0.057 [1.31, 1.53]	139 (0.202%) 0.030 [0.213, 0.333]	
Race/Ethnicity			0.000
White	1513 (2.39%) 0.080 [2.24, 2.56]	75,887 (66%) 0.225 [65.6, 66.5]	
Black	210 (0.371%) 0.032 [0.313, 0.438]	7345 (10.3%) 0.150 [10, 10.6]	
Hispanic	332 (0.694%) 0.047 [0.607, 0.793]	6136 (11.2%) 0.171 [10.9, 11.5]	
Other	342 (0.608%) 0.042 [0.53, 0.697]	7756 (8.38%) 0.130 [8.13, 8.63]	
Gender			0.000
Male	1455 (2.43%) 0.081 [2.27, 2.59]	42,389 (46.8%) 0.225 [46.3, 47.2]	
Female	942 (1.64%) 0.069 [1.51, 1.78]	54,735 (49.2%) 0.224 [48.7, 49.6]	
Educational attainment			0.000
Less than high school Diploma	108 (0.321%) 0.040 [0.251, 0.411]	5865 (10.6%) 0.177 [10.2, 10.9]	
High School Diploma GED, or Equivalent	611 (1.32%) 0.066 [1.19, 1.45]	20,322 (25.8%) 0.208 [25.4, 26.2]	
Some College, or less than bachelor's Degree	791 (1.46%) 0.063 [1.34, 1.58]	28,375 (30.8%) 0.204 [30.4, 31.2]	
Bachelor's Degree	621 (0.72%) 0.035 [0.655, 0.791]	23,321 (17.1%) 0.140 [16.9, 17.4]	
Postgraduate Degree	264 (0.245%) 0.019 [0.21, 0.285]	18,974 (11.4%) 0.107 [11.2, 11.6]	
Unknown	2 (0.0063%) 0.005 [0.0012, 0.0337]	267 (0.276%) 0.025 [0.231, 0.329]	
Current smoking status			0.000
Yes	1122 (1.98%) 0.076 [1.83, 2.13]	42,965 (42%) 0.221 [41.6, 42.4]	
No	1275 (2.09%) 0.075 [1.95, 2.24]	54,159 (53.9%) 0.224 [53.5, 54.4]	
Marital status			0.000
Married	394 (0.574%) 0.037 [0.507, 0.65]	50,969 (50.4%) 0.222 [49.9, 50.8]	
Living with a Partner	400 (0.676%) 0.043 [0.596, 0.766]	5544 (7.7%) 0.136 [7.44, 7.97]	
Divorced	98 (0.158%) 0.023 [0.12, 0.21]	12,329 (10.3%) 0.129 [10, 10.5]	

	Water Pipe Tobacco Smoker n = 2397 (4.07%) SE [95%CI]	Non-Smoker of Water Pipe Tobacco n = 97,124 (95.93%) SE [95%CI]	p value
Widowed	11 (0.0155%) 0.007 [0.0065, 0.0368]	10,990 (6.14%) 0.082 [5.98, 6.3]	0.000
Separated	49 (0.107%) 0.020 [0.075, 0.153]	1864 (2.45%) 0.077 [2.31, 2.61]	
Single, Never Married and Not Living with a Partner	1445 (2.54%) 0.085 [2.37, 2.71]	15,428 (19%) 0.195 [18.6, 19.4]	
Annual household income			0.000
Less than \$20,000	246 (0.418%) 0.035 [0.355, 0.492]	10,666 (11.1%) 0.148 [10.8, 11.4]	0.000
\$20,000 to Less than \$30,000	199 (0.372%) 0.034 [0.31, 0.445]	8999 (9.41%) 0.140 [9.14, 9.68]	
\$30,000 to Less than \$40,000	277 (0.477%) 0.037 [0.41, 0.554]	10,009 (10.5%) 0.143 [10.2, 10.8]	
\$40,000 to Less than \$50,000	349 (0.619%) 0.043 [0.541, 0.709]	11,381 (11.6%) 0.147 [11.3, 11.9]	
\$50,000 to Less than \$70,000	402 (0.653%) 0.041 [0.577, 0.74]	15,763 (15.4%) 0.162 [15.1, 15.7]	
\$70,000 to Less than \$100,000	416 (0.68%) 0.046 [0.596, 0.775]	16,683 (16%) 0.157 [15.7, 16.3]	
\$100,000 to Less than \$150,000	273 (0.45%) 0.035 [0.386, 0.524]	13,259 (12.6%) 0.138 [12.3, 12.9]	
\$150,000 or More	235 (0.397%) 0.032 [0.339, 0.466]	10,364 (9.24%) 0.116 [9.01, 9.47]	
Age			0.000
18–24 years old	1331 (2.5%) 0.086 [2.34, 2.68]	5356 (10.5%) 0.169 [10.2, 10.9]	0.000
25–34 years old	742 (1.15%) 0.054 [1.04, 1.26]	10,991 (17.3%) 0.189 [16.9, 17.6]	
35–44 years old	179 (0.274%) 0.027 [16.9, 17.6]	12,790 (17.3%) 0.179 [17, 17.7]	
45–54 years old	91 (0.113%) 0.016 [0.0859, 0.148]	18,071 (19.5%) 0.173 [19.2, 19.8]	
55–64 years old	34 (0.0247%) 0.006 [0.0155, 0.0393]	22,616 (16.4%) 0.137 [16.1, 16.6]	
65 years old	20 (0.009%) 0.003 [0.00451, 0.0181]	27,300 (15%) 0.177 [14.7, 15.2]	

Adjusted prevalence ratios of lifetime waterpipe tobacco smoking comparing sexual minorities to heterosexuals: National Adult Tobacco Survey, 2012–2013 and 2013–2014 (N = 99,521).

Overall			
	Model 1 aPR [95%CI]	Model 2 aPR [95%CI]	Model 3 aPR [95%CI]
Sexual Orientation			
Heterosexual	REF	REF	REF
Lesbian/Gay	2.02 ^{***} [1.81–2.27]	1.31 ^{***} [1.71–1.46]	1.28 ^{***} [1.12–1.46]
Bisexual	2.60 ^{***} [2.32–2.91]	1.72 ^{***} [1.54–1.92]	1.59 ^{***} [1.40–1.82]
Men			
			Women
Model 1	Model 2	Model 3	Model 1
			Model 3
Sexual Orientation			
Heterosexual	REF	REF	REF
Lesbian			
Gay	1.74 ^{***} [1.51–1.99]	1.24 ^{**} [1.08–1.41]	1.25 ^{**} [1.06–1.47]
Bisexual	2.22 ^{***} [1.33–2.02]	1.24 [*] [1.02–1.49]	1.17 [0.92–1.50]
			3.68 ^{***} [3.21–4.21]
			1.94 ^{***} [1.70–2.22]
			1.69 ^{***} [1.45–1.97]
			1.38 ^{***} [1.12–1.69]

Model 3 - adjusted for both sociodemographic characteristics and current smoking status.

P < 0.001, significance tests between those reporting smoking versus those reporting not smoking.

Table 3

Adjusted prevalence ratios of current waterpipe tobacco smoking comparing sexual minorities to heterosexuals: National Adult Tobacco Survey, 2012–2013 and 2013–2014 (N = 99,521).

Overall			
	Model 1 aPR [95%CI]	Model 2 aPR [95%CI]	Model 3 aPR [95%CI]
Sexual Orientation			
Heterosexual	REF	REF	REF
Lesbian/Gay	2.60 *** [2.09–3.23]	1.58 *** [1.29–1.93]	1.40 * [1.08–1.83]
Bisexual	4.23 *** [3.44–5.21]	2.34 *** [1.92–2.86]	2.30 *** [1.84–2.89]
Men			
			Women
	Model 1	Model 2	Model 1
Sexual Orientation			
Heterosexual	REF	REF	REF
Lesbian			2.56 *** [1.70–3.86]
Gay	2.35 *** [1.82–3.04]	1.61 *** [1.28–2.02]	1.56 ** [1.18–2.05]
Bisexual	2.22 *** [1.50–3.28]	1.52 * [1.05–2.21]	1.65 [0.98–2.78]
			6.51 *** [5.10–8.33]
			2.68 *** [2.11–3.39]
			2.38 *** [1.84–3.09]

Note: aPR = adjusted prevalence ratio; CI = confidence interval.

Model 1 - unadjusted models.

Model 2 - adjusted for sociodemographic characteristics (age, educational attainment, income, gender (only in aggregate models), relationship status and race/ethnicity).

Model 3 - adjusted for both sociodemographic characteristics and current smoking status.

* P < 0.05;

** P < 0.01;

*** P < 0.001, significance tests between those reporting smoking versus those reporting not smoking.