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## Tobacco use among lesbian, gay, bisexual and transgender young adults varies by sexual and gender identity

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## ABSTRACT

**Background:** Research shows that tobacco products are disproportionately used by sexual and gender minorities, known collectively as those who are lesbian, gay, bisexual, and transgender (LGBT). While usage varies within this population by identity, differences in tobacco use patterns are not well understood. The present study uses evaluation data for This Free Life, a tobacco public education campaign from the FDA, to examine differences in tobacco use among LGBT young adults by subgroups based on sex at birth, gender and sexual identity.

**Methods:** Data are from 4,057 18–24 LGBT young adults who completed the baseline *This Free Life* evaluation survey in 2016. Multivariable logistic regression models examined differences in tobacco use (cigarettes, cigars, hookah and electronic nicotine products) and poly use (2+ of any product, 2+ combustibles, at least one combustible and one noncombustible) between LGBT subgroups (cisgender gay males, cisgender bisexual males, cisgender lesbian/gay females, cisgender bisexual females and gender minorities).

**Results:** Sexual minority females were more likely than gay males to use any tobacco product, electronic nicotine products and hookah. Cisgender bisexuals were more likely than gay males and gender minorities to use electronic nicotine products. Cisgender bisexual males were less likely than all other groups to use cigarettes. Cisgender sexual minority females were more likely than gender minorities to engage in poly use.

**Conclusions:** Findings suggest that sexual minority females are more likely to use tobacco than other subgroups. More research can help campaign developers better understand reasons for intragroup differences in tobacco use among LGBT subgroups.

## 1. Introduction

National data on adult populations show that tobacco use is more prevalent among sexual and gender minorities (SGM), also known as LGBT, which includes lesbian, gay, bisexual, transgender and queer individuals, relative to their non-LGBT counterparts, including heterosexual and cisgender (whose gender identity aligns with their sex assigned at birth (American Psychological Association, 2015)) individuals (Buchting et al., 2017; Ganz et al., 2018; Gerend et al., 2017; Hoffman et al., 2018; Jamal et al., 2018; Kasza et al., 2017; McCabe et al., 2018; Mirbolouk et al., 2018; National Cancer Institute, 2017; Nayak et al., 2017; Ortiz et al., 2017; Phillips et al., 2017; Schuler et al., 2018; Wheldon et al., 2018).

Data from the 2016 National Health Interview Survey (NHIS), a

nationally representative, annual survey of adults in the United States (U.S.), found that 20.5% of lesbian/gay/bisexual (LGB) adults were current cigarette smokers compared to 15.3% of straight adults (Jamal et al., 2018). Another national study found that past 30-day cigarette, cigar and e-cigarette use was more prevalent among transgender adults compared to cisgender adults (Buchting et al., 2017). Among LGBT individuals, research suggests that tobacco use and tobacco use disorder are especially high among young adults (Ganz et al., 2018; McCabe et al., 2018; Rath et al., 2013; Rice et al., 2019; Wheldon et al., 2018).

Although studies have found a high prevalence of poly use (e.g., current use of more than one tobacco product) among the general young adult population (Johnson et al., 2018; Rath et al., 2012; Richardson et al., 2014; Soneji et al., 2016), findings on tobacco poly use among LGBT young adults are scant and mixed (Fallin-Bennett

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et al., 2017; Jones and Cunningham-Williams, 2016; Kalkhoran et al., 2016; Thrul et al., 2016). There are currently no data on poly use among transgender individuals. Depending on the combination of products used and frequency of use, poly users may be exposed to greater harm (Choi et al., 2017; Goniewicz et al., 2018), increased risk for nicotine addiction (Soneji et al., 2016) and other problematic behaviors, such as binge drinking, compared to single product users (Cavazos-Rehg et al., 2014; Kram et al., 2014; Soneji et al., 2016; Wetter et al., 2002). Use of two or more combustible products is particularly worrying, as these products are responsible for the majority of tobacco-related morbidity and mortality in the US (Abrams et al., 2018; U.S. Department of Health and Human Services, 2014).

Within the LGBT population, patterns of tobacco use vary based on gender, age and sexual identity (Drope et al., 2018; Emory et al., 2016; Hoffman et al., 2018; Jamal et al., 2018; Johnson et al., 2016; Kasza et al., 2017; Lunn et al., 2017; McCabe et al., 2018; Ortiz et al., 2017; Schuler et al., 2018; Wheldon et al., 2018). For example, controlling for sociodemographic characteristics and current cigarette use, pooled data from the 2012–2013 and 2013–2014 National Adult Tobacco Survey (NATS) found that among women, gay/lesbian and bisexual respondents exhibited higher prevalence of lifetime hookah use than those who were straight, while only bisexual women reported higher ratios of current hookah use. Among men, gay respondents but not bisexual respondents had higher prevalence ratios of lifetime and current hookah use than their heterosexual peers (Ortiz et al., 2017).

Although studies have examined intragroup differences in tobacco use among LGBT individuals, research is limited for a number of reasons. Estimates of individuals who identify as LGBT are small, with data showing that lesbian, gay and bisexual individuals and transgender individuals make up about 3.5% and 0.3% of the US population, respectively (Gonzales and Henning-Smith, 2017; Meyer et al., 2017). Therefore, national datasets often do not have sufficient sample size and statistical power to examine within-group differences among this population (Sell, 2017). One solution to this challenge is to oversample LGBT individuals in health survey research (Sell, 2017) and to develop research that explicitly focuses on LGBT subpopulations and doesn't collapse LGBT individuals into a monolithic category (Coulter et al., 2014). Using data from the evaluation of *This Free Life*, a public education campaign from the Food and Drug Administration's (FDA) Center for Tobacco Products that aims to address tobacco use disparities faced by LGBT young adults, this study examines the prevalence of tobacco use (ever, past 30-day and poly use) among LGBT young adults by LGBT subgroup (sex at birth, gender and sexual identity). This in-depth examination of intragroup differences will help to identify high-risk subgroups within the LGBT population and may inform more targeted public education and policy interventions to reduce tobacco use among this population.

## 2. Methods

### 2.1. Dataset and population

In May of 2016, the FDA launched *This Free Life*—a large-scale public education campaign among LGBT young adults aged 18–24 (US Food and Drug Administration, 2017). *This Free Life* reaches LGBT young adults with content to change tobacco-related knowledge, attitudes and beliefs in LGBT communities in 12 markets via digital channels including social media, out-of-home advertising such as billboards, print media, and events.

### 2.2. Procedures

LGBT young adults (N = 4,057) were recruited to complete an eligibility screening survey in 24 US designated market areas (DMAs) (12 campaign-targeted treatment DMAs and 12 control DMAs with minimal exposure to the campaign) between February and May 2016

via two recruitment modes: (1) in-person intercept at LGBT social venues such as bars and clubs and (2) online recruitment via Facebook and Instagram advertisements. More information on recruitment methods used is available elsewhere (Guillory et al., 2018). Eligible participants spoke English, were aged 18–24, self-identified as LGBT, and lived in one of the 24 DMAs. If the screening survey determined that an individual was eligible, and if they provided consent, they could proceed to complete the main instrument online. This study used data from the baseline eligibility screening survey and main baseline survey, which was conducted before the launch of the *This Free Life* campaign. The baseline survey instrument assessed demographics; tobacco product use; cigarette smoking susceptibility; alcohol use; tobacco-related knowledge, attitudes, and beliefs; media use; participation in LGBT culture; and LGBT identity centrality.

### 2.3. Measures

All demographic questions in the survey included “don't know” and “prefer not to answer” as answer choices, and all tobacco-related questions included “prefer not to answer” as answer choices. These responses were recoded as missing for the analyses.

#### 2.3.1. Tobacco use

Respondents were asked whether they had ever used any of the following products: cigarettes, smokeless tobacco (including chewing tobacco, snuff, snus or dip), cigars (including cigars, cigarillos, or little cigars), hookah and electronic nicotine products (including e-cigarettes, e-cigs, vapor pens, or e-hookahs). Answer choices were “yes” and “no.” Past 30-day use of each product was assessed among those who indicated having ever used the product with the following question: “During the past 30 days, on how many days did you smoke/use [product]?” Answer choices included “0 days,” “1 to 2 days,” “3 to 5 days,” “6 to 9 days,” “10 to 19 days,” “20 to 29 days,” or “all 30 days.” Those who selected “1 to 2 days” or greater were categorized as a past 30-day user of the respective product. Those who selected “0 days” were coded as non-past-30-day users. Any tobacco use was defined as use of cigarettes, cigar products, hookah, smokeless tobacco or electronic nicotine products. Additionally, those who reported that they were never users of a product were coded as non-past-30-day users of the respective product. Respondents who skipped the ever use or past 30-day use question or selected “prefer not to answer” to ever use questions were coded as missing for that variable.

Any poly use was defined as past 30-day use of at least two tobacco products. Poly use of two combustible products was defined as past 30-day use of at least two of the following products: cigarettes, cigars and hookah. Combustible and noncombustible poly use was defined as past 30-day use of at least one combustible product (cigarettes, cigars or hookah) and at least one noncombustible product (smokeless tobacco or electronic nicotine product). Poly use of two noncombustible products was not assessed due to the low prevalence of past 30-day smokeless tobacco use in the sample (n = 145).

#### 2.3.2. LGBT identity

LGBT identity was defined based on responses to a series of questions in the study screener. These measures were informed by national surveys and recommendations from the Gender Identity in the U.S. Surveillance (GENIUSS) (Centers for Disease Control and Prevention, 2016; Grant et al., 2010; The GenIUSS Group, 2014). See Table 1 for study definitions of LGBT subgroups.

Respondents were assigned to one of the following six categories based on responses to these questions: cisgender gay males, cisgender bisexual males, cisgender lesbian/gay females, cisgender bisexual females, gender minorities, and cisgender other sexual minorities. Cisgender other sexual minorities (n = 152) were excluded from the analyses in this study since sample size limitations did not allow for these individuals to be split by gender (male or female).

**Table 1**  
Study definitions of gender and sexual identity.

Survey Items	Answer Choices
1) What is your current gender identity?	a) Male b) Female c) Trans male/trans man d) Trans female/trans woman e) Genderqueer/gender non-conforming f) Different identity
2) What sex were you assigned at birth, or on your original birth certificate?	a) Male b) Female
3) Which of the following best represents how you think of yourself? <sup>i</sup>	a) [Lesbian or] Gay b) Straight, that is, not [lesbian or] gay c) Bisexual d) Something else e) I don't know the answer
4) What do you mean by something else? <sup>ii</sup>	a) You are not straight, but identify with another label such as queer, trisexual, omnisexual, or pansexual b) You are transgender, transsexual, or gender variant c) You have not figured out or are in the process of figuring out your sexuality d) You do not think of yourself as having sexuality e) You do not use labels to identify yourself f) You mean something else
5) What do you mean by don't know? <sup>iii</sup>	a) You don't understand the words b) You understand the words, but you have not figured out or are in the process of figuring out your sexuality c) You mean something else

Gender and Sexual Identity Category Definitions

Cisgender Lesbian or Gay Female	<ul style="list-style-type: none"> <li>● “Female” to “What sex were you assigned at birth, on your original birth certificate?” AND</li> <li>● “Female” to “What is your current gender identity?” AND</li> </ul>
Cisgender Gay Male	<ul style="list-style-type: none"> <li>● “Lesbian or Gay” to “Which of the following best represents how you think of yourself?”</li> <li>● “Male” to “What sex were you assigned at birth, on your original birth certificate?” AND</li> <li>● “Male” to “What is your current gender identity?” AND</li> </ul>
Cisgender Bisexual Female	<ul style="list-style-type: none"> <li>● “Gay” to “Which of the following best represents how you think of yourself?”</li> <li>● “Female” to “What sex were you assigned at birth, on your original birth certificate?” AND</li> <li>● “Female” to “What is your current gender identity?” AND</li> </ul>
Cisgender Bisexual Male	<ul style="list-style-type: none"> <li>● “Bisexual” to “Which of the following best represents how you think of yourself?”</li> <li>● “Male” to “What sex were you assigned at birth, on your original birth certificate?” AND</li> <li>● “Male” to “What is your current gender identity?” AND</li> </ul>
Gender Minorities	<ul style="list-style-type: none"> <li>● “Bisexual” to “Which of the following best represents how you think of yourself?”</li> <li>● “Trans male/Trans man,” “Trans female/Trans woman,” “Genderqueer/Gender non-conforming,” or “Different identity,” to “What is your current gender identity?” OR</li> <li>● “Something else” to “Which of the following best represents how you think of yourself?” and “You are transgender, transsexual, or gender variant” to “What do you mean by something else?” and “What is your current gender identity” is not “female,” “male,” or “prefer not to answer.”</li> <li>● “Male” to “What sex were you assigned at birth, on your original birth certificate?” AND</li> <li>● “Female” to “What is your current gender identity?” OR</li> <li>● “Female” to “What sex were you assigned at birth, on your original birth certificate?” AND</li> <li>● “Male” to “What is your current gender identity?”</li> </ul>
Cisgender Other Sexual Identity <sup>iv</sup>	<ul style="list-style-type: none"> <li>● Cisgender male (“Male” to “What sex were you assigned at birth, on your original birth certificate?” and “Male” to “What is your current gender identity?”) OR</li> <li>● Cisgender female (“Female” to “What sex were you assigned at birth, on your original birth certificate?” and “Female” to “What is your current gender identity?”) AND</li> <li>● “Something else” to “Which of the following best represents how you think of yourself?” OR</li> <li>● “Something else” to “Which of the following best represents how you think of yourself?” and “You are not straight, but identify with another label such as queer, trisexual, omnisexual, or pansexual,” “You have not figured out or are in the process of figuring out your sexuality,” “You do not think of yourself as having sexuality,” “You do not use labels to identify yourself,” or “You mean something else,” to “What do you mean by something else?” OR</li> <li>● “I don't know the answer” “Which of the following best represents how you think of yourself?” and “You understand the words, but you have not figured out or are in the process of figuring out your sexuality,” “You mean something else” to “What do you mean by don't know?”</li> </ul>

<sup>i</sup>Question 3 did not include “lesbian” for respondents who identified as male or trans male/trans man.

<sup>ii</sup> Question 4 was only asked of those who selected “something else” for Question 3.

<sup>iii</sup> Question 5 was only asked of those who selected “I don't know the answer” for Question 3.

<sup>iv</sup> This category was not included in analyses for this study.

### 2.3.3. Covariates

Sociodemographic covariates were age, race/ethnicity (non-Hispanic, white; non-Hispanic, black; non-Hispanic, other; and Hispanic), educational attainment (some high school or less, high school or General Equivalency Diploma (GED), some college and college graduate and higher), current student status, and household annual income (less than \$35k, \$35k–\$74.9k, \$75k–\$99.9k and \$100k+). Recruitment source (in-person intercept LGBT social venues vs. online recruitment via Facebook and Instagram advertisements) was also included as a covariate.

### 2.4. Statistical analyses

Overall sample characteristics, tobacco use behavior and other variables were examined using descriptive statistics and are presented with 95% confidence intervals. Bivariate associations between LGBT subgroups and these variables were examined using chi-square tests. To assess the association between LGBT identity and key outcomes, multivariable logistic regression models were used to estimate the odds of past 30-day use of any tobacco product, each tobacco product and poly use (two or more of any products, two or more combustible products and one or more combustible/one or more noncombustible product). Multivariable models controlled for sociodemographic characteristics (age, educational attainment, student status, race/ethnicity and annual household income) and source of interview. Cisgender gay males were selected as the reference group because they were the largest subgroup in the sample (Vittinghoff et al., 2011). Post-hoc, adjusted Wald statistics were used to examine intragroup differences for each outcome among respondents. All data are unweighted. Analyses were conducted using Stata SE 15.1 (StataCorp, 2017). The final analytic sample for this paper included 3898 individuals.

### 3. Results

Table 2 describes sample characteristics. The most prevalent LGBT subgroups in the sample were cisgender, gay males (45.0%) and cisgender lesbian/gay females (21.7%). The majority of the sample was white, non-Hispanic (45.3%) and Hispanic (30.1%), completed at least some college (51.4%) and reported an annual household income of less than \$35,000 (62.9%). The majority of the sample reported ever tobacco product use (89.8%) and were ever users of cigarettes (79.9%), hookah (72.3%), cigars (57.7%) and electronic nicotine products (55.1%). A total of 61.0% of the sample had used any tobacco product in the past 30 days; the tobacco products with the highest past 30-day use prevalence were cigarettes (46.8%) followed by electronic nicotine products (25.6%), hookah (23.3%), cigars (22.0%) and smokeless tobacco (3.8%). About one-third of the sample had used at least two tobacco products in the past 30 days (34.6%). In bivariate analyses, respondents of different LGBT identities differed on all sociodemographic and tobacco use variables (except for poly use of at least one combustible and one noncombustible), as well as interview source.

Table 3 presents results from the multivariable logistic regression models and adjusted Wald tests examining the association between LGBT subgroup and use of cigarettes, cigar products, hookah and electronic nicotine products. Compared to cisgender gay males, odds of ever tobacco use were higher among lesbian/gay females (adjusted odds ratio (aOR): 1.77, 95% confidence interval (95% CI) (1.26–2.47)) and cisgender bisexual females (aOR: 1.45, 95% CI (1.03, 2.05)) and odds of any past 30-day tobacco use were higher for cisgender lesbian/gay females (aOR: 1.36, 95% CI (1.13–1.64)), cisgender bisexual females (aOR: 1.23, 95% CI (1.00–1.51)) and gender minorities (aOR: 1.32, 95% CI (1.01–1.73)). Cisgender bisexual males had lower odds of past 30-day cigarette smoking (aOR: 0.68, 95% CI (0.49–0.93)), and cisgender lesbian/gay females had higher odds of past 30-day cigar use (aOR: 1.24, 95% CI (1.01–1.53)) compared to cisgender gay males. There were no differences in ever cigarette use among subgroups

compared to cisgender gay males, but odds of ever cigar use were higher for cisgender lesbian/gay females (aOR: 1.49, 95% CI (1.24, 1.79)) and cisgender bisexual females (aOR: 1.50, 95% CI (1.22, 1.84)). Cisgender lesbian/gay females and cisgender bisexual females had higher odds of ever (aOR: 1.46, 95% CI (1.18, 1.79); aOR: 1.83, 95% CI (1.43, 2.33)) and past 30-day hookah (aOR: 1.29, 95% CI (1.05–1.58) and aOR: 1.38, 95% CI (1.10–1.73)) use compared with cisgender gay males. Compared to cisgender gay males, cisgender lesbian/gay females (aOR: 1.26, 95% (1.05, 1.51)) and cisgender bisexual females (aOR: 1.49, 95% (1.21, 1.82)) reported greater odds of ever electronic nicotine product use, and cisgender lesbian/gay females (aOR: 1.25, 95% CI (1.02–1.53)), cisgender bisexual females (aOR: 1.36, 95% CI (1.09–1.70)) and cisgender bisexual males (aOR: 1.48, 95% CI (1.06–2.07)) had higher odds of past 30-day electronic nicotine product use. Adjusted Wald tests showed differences in odds ratios across outcomes among LGBT subgroups. For example, the odds of past 30-day cigarette smoking were higher for cisgender lesbian/gay females compared to cisgender bisexual males ( $p < 0.05$ ).

Table 4 presents results from the multivariable logistic regression models examining the association between LGBT subgroup and different patterns of past 30-day poly use. Compared to cisgender gay males, odds of any past 30-day poly use were higher among cisgender bisexual females (aOR: 1.24, 95% CI (1.01–1.52)). Adjusted Wald tests showed differences in odds of any poly use among LGBT subgroups. For example, gender minorities reported lower odds of any poly use compared to cisgender lesbian/gay females and cisgender bisexual females ( $p < .05$ ). There were no differences in odds of poly use of two or more combustible products between cisgender gay males and other groups. However, Wald tests showed differences in odds of poly use of two combustible products between other groups; cisgender lesbian/gay females reported higher odds of use compared to gender minorities ( $p < 0.05$ ). There were no differences in poly use of at least one combustible and one noncombustible tobacco poly use among LGBT subgroups.

### 4. Discussion

The findings from this study confirm that tobacco use is high among LGBT young adults and that heterogeneous patterns of tobacco use exist among this population based on sexual and gender identity. Except for smokeless tobacco, a product with low overall prevalence of use in the U.S. (Phillips et al., 2017), the majority of respondents reported ever use of each tobacco product. Past 30-day use was also high, with almost half the sample reporting past 30-day use of cigarettes. These estimates are higher than other recent studies of LGBT young adults (Ganz et al., 2018; Schuler et al., 2018). For example, one study using national data from 2013 to 2014 found that among young adults (ages 18–24), 47.49% of lesbian/gay women, 57.36% of bisexual women, 44.70% of gay men and 36.47% of bisexual men were current tobacco users (Wheldon et al., 2018). Higher tobacco use prevalence in our study is likely due to differences in sampling methods; respondents for this study were recruited in part via in-person intercept at social venues such as bars (Guillory et al., 2018). Cigarette and alcohol co-use are common among young adult bar patrons (Jiang and Ling, 2013), and therefore these individuals may be more likely to exhibit risky behaviors compared to the general population.

Our study also found that cigarette use was disproportionately high among gender minorities compared to cisgender bisexual males but that use of other tobacco products was lower compared to other LGBT subgroups. For example, gender minorities were less likely to be past 30-day users of cigar products compared to cisgender lesbian/gay females and were less likely to be electronic nicotine product users compared to cisgender female and male bisexuals. This finding suggests that tobacco control interventions that target gender minorities may want to focus on cigarettes as opposed to other tobacco products; however, more research is needed to inform the development of

**Table 2**  
Sample demographic and substance use characteristics.

	Total (n = 3898)	Cisgender Male Gay (n = 1821)	Cisgender Male Bisexual (n = 217)	Cisgender Female Lesbian/gay (n = 879)	Cisgender Female Bisexual (n = 639)	Gender Minority (n = 342)	P-value
<b>Total</b>	100.0%	45.0%	5.4%	21.7%	15.8%	8.4%	
<i>Demographics</i>							
<b>Age, mean (SD)</b>	21.6 (1.9)	21.7 (1.8)	21.6 (1.8)	21.7 (1.8)	21.1 (1.9)	21.2 (1.9)	< 0.001
<b>Race/Ethnicity, n (%)</b>							< 0.001
White, non-Hispanic	1765 (45.3)	794 (43.6)	87 (40.1)	383 (43.6)	316 (49.4)	185 (54.1)	
Black, non-Hispanic	397 (10.2)	154 (8.5)	27 (12.4)	118 (13.4)	75 (11.7)	23 (6.7)	
Hispanic	1174 (30.1)	599 (32.9)	83 (38.2)	261 (29.7)	162 (25.3)	69 (20.2)	
Other, non-Hispanic	562 (14.4)	274 (15.0)	20 (9.2)	117 (13.3)	86 (13.5)	65 (19.0)	
<b>Education, n (%)</b>							< 0.001
High school graduate/GED or less	1005 (26.3)	400 (22.7)	60 (27.9)	263 (30.1)	177 (28.0)	105 (31.5)	
Some college	1965 (51.4)	893 (50.6)	108 (50.2)	440 (50.3)	351 (55.4)	173 (51.9)	
College graduate +	849 (22.2)	470 (26.7)	47 (21.9)	172 (19.7)	105 (16.6)	55 (16.5)	
<b>Household Annual Income, n (%)</b>							< 0.001
Less than \$35k	2186 (62.9)	910 (55.3)	131 (69.7)	522 (66.4)	393 (70.0)	230 (77.2)	
\$35k–\$74.9k	783 (22.5)	457 (27.8)	34 (18.1)	171 (21.8)	84 (15.0)	37 (12.4)	
\$75k +	508 (14.6)	277 (16.8)	23 (12.2)	93 (11.8)	84 (15.0)	31 (10.4)	
<b>Current Student, n (%)</b>	1673 (44.3)	784 (44.9)	95 (44.4)	324 (37.6)	324 (51.6)	146 (44.8)	< 0.001
<i>Tobacco Use</i>							
<b>Recruitment Source, n (%)</b>							< 0.001
Social media	1608 (41.2)	630 (34.6)	48 (22.1)	430 (48.9)	321 (50.2)	179 (52.3)	
Intercept survey	2290 (58.7)	1191 (65.4)	169 (77.9)	449 (51.1)	318 (49.8)	163 (47.7)	
<b>Ever Use, n (%)</b>							< 0.001
Any tobacco use <sup>‡</sup>	3452 (89.8)	1566 (87.8)	189 (87.9)	818 (93.4)	577 (90.7)	302 (89.9)	< 0.001
Cigarettes	3070 (79.9)	1393 (78.2)	163 (75.8)	724 (82.6)	516 (81.1)	274 (82.3)	< 0.05
Hookah	2749 (72.3)	1225 (70.3)	158 (73.8)	654 (74.7)	489 (76.9)	223 (67.2)	< 0.01
Cigar products <sup>†</sup>	2194 (57.7)	945 (54.2)	125 (58.4)	559 (63.8)	385 (60.6)	180 (54.4)	< 0.001
Electronic nicotine products <sup>‡</sup>	2097 (55.1)	890 (51.1)	118 (55.1)	509 (58.1)	386 (60.7)	194 (57.7)	< 0.001
Smokeless tobacco <sup>‡</sup>	521 (13.7)	253 (14.5)	35 (16.3)	130 (14.8)	58 (9.1)	45 (13.6)	< 0.01
<b>Past 30-Day Use, n (%)</b>							< 0.001
Any tobacco use <sup>‡</sup>	2347 (61.0)	1027 (57.6)	121 (56.3)	585 (66.8)	398 (62.6)	216 (64.3)	< 0.001
Cigarettes	1759 (46.8)	805 (45.9)	79 (37.4)	425 (49.8)	283 (45.9)	167 (51.1)	< 0.05
Electronic nicotine products <sup>‡</sup>	972 (25.6)	390 (22.4)	64 (29.9)	250 (28.5)	187 (29.4)	81 (24.2)	< 0.01
Hookah	884 (23.3)	380 (21.8)	46 (21.5)	225 (25.7)	169 (26.6)	64 (19.3)	< 0.05
Cigar products <sup>†</sup>	836 (22.0)	359 (20.6)	44 (20.6)	236 (26.9)	134 (21.1)	63 (19.0)	< 0.01
Smokeless Tobacco <sup>‡</sup>	145 (3.8)	96 (5.5)	4 (1.9)	30 (3.4)	6 (0.09)	9 (2.7)	< 0.001
<b>Past 30-Day Poly Use, n (%)</b>							< 0.01
Any poly use <sup>§</sup>	1332 (34.6)	577 (32.4)	71 (33.0)	342 (39.0)	238 (37.4)	104 (30.9)	< 0.01
Two combustible products <sup>¶</sup>	985 (25.6)	436 (24.5)	46 (21.4)	259 (29.6)	169 (26.6)	75 (22.4)	< 0.01
Combustible + noncombustible products <sup>¶</sup>	891 (23.4)	377 (21.6)	57 (26.5)	225 (25.7)	160 (25.2)	72 (21.5)	0.104

Notes: SD = standard deviation; GED = General Equivalency Diploma; E-cigarette = electronic cigarette. P-values obtained from Pearson’s chi-square tests.  
<sup>†</sup>Includes traditional cigars, cigarillos and little cigars; <sup>‡</sup>Includes chewing tobacco, snuff, snus and dip; <sup>‡</sup>Includes e-cigarettes, e-cigs, vapor pens, or e-hookahs.  
<sup>§</sup>Any poly use defined as past 30-day use of two or more tobacco products; <sup>¶</sup>Combustible products include cigarettes, cigar products and hookah; <sup>¶</sup>Noncombustible products include smokeless tobacco and electronic nicotine products.  
<sup>‡</sup>Includes use of cigarettes, cigar products, hookah, smokeless tobacco or electronic nicotine products.  
Missingness for demographics: Household annual income (n = 421, 10.8%); education (n = 74, 1.9%); student (n = 124, 3.2%).  
Missingness for tobacco ever use: Any product (n = 52, 1.3%); cigarettes (n = 57, 1.5%); cigars (n = 98, 2.5%); hookah (n = 98, 2.5%); smokeless (n = 96, 2.5%); electronic nicotine products (n = 95, 2.4%).  
Missingness for past 30-day tobacco use: Any product (n = 53, 1.4%); cigarettes (n = 136, 3.5%); cigars (n = 98, 2.5%); hookah (n = 101, 2.6%); smokeless (n = 101, 2.6%); electronic nicotine products (n = 97, 2.5%); any poly use (n = 53, 1.4%); two combustible products (n = 54, 1.4%); combustible + non-combustible products (n = 94, 2.4%).

tobacco control messages for this population.

This is the first study to look at intragroup differences in tobacco poly use among LGBT young adults. This fills a key gap in the literature, since existing studies of LGBT tobacco use have focused on comparing LGBT adults with heterosexual adults, who have lower rates of tobacco use than their LGBT counterparts (Kalkhoran et al., 2016; Li et al., 2018; Nayak et al., 2017; Phillips et al., 2017; Wheldon et al., 2018). Odds of any poly use were greater among cisgender lesbian/gay females and cisgender bisexual females compared to gender minorities; cisgender bisexual females also had higher odds of any poly use compared to cisgender gay males. Odds of use of two or more combustible products were greater for cisgender female lesbian/gay respondents compared to gender minorities. These findings regarding elevated poly use of two or more combustibles among cisgender lesbian/gay females are concerning given that the majority of tobacco-related morbidity and mortality is due to combustible products such as cigarettes, cigars and

hookah (U.S. Department of Health and Human Services, 2014). Systematic reviews show that cigar and hookah smoking carry at least the same health risks as cigarette smoking (Chang et al., 2015; Primack et al., 2016), meaning that poly users of these products, in particular cisgender lesbian/gay females, may be exposed to elevated levels of toxicants compared to single combustible product users depending on the frequency and intensity of product use. Research is needed to understand reasons for and specific patterns of poly use of combustible products among cisgender lesbian/gay females so that tobacco education efforts can be tailored to effectively message to this population (Cavazos-Rehg et al., 2014; Kram et al., 2014; Soneji et al., 2016; Wetter et al., 2002).

Our study found that among LGBT young adults, tobacco use was higher among cisgender females compared to cisgender males and gender minorities. Of particular concern are the elevated levels of cigarette, cigar and hookah use given the dangers of combustible tobacco

**Table 3**  
Multivariable logistic regression models of sexual and gender identity associated with ever and past 30-day tobacco use.

	Any Tobacco Product <sup>‡</sup>			Cigarettes			Electronic Nicotine Products <sup>‡</sup>			Hookah			Cigar Products <sup>‡</sup>		
	aOR (95% CI)			aOR (95% CI)			aOR (95% CI)			aOR (95% CI)			aOR (95% CI)		
	Ever use	Past 30-day use	Reference	Ever use	Past 30-day use	Reference	Ever use	Past 30-day use	Reference	Ever use	Past 30-day use	Reference	Ever use	Past 30-day use	Reference
Cisgender Male Gay	0.86 (0.53, 1.40) <sup>c</sup>	0.91 (0.67–1.24) <sup>c</sup>	0.77 (0.53, 1.11) <sup>c,de</sup>	0.77 (0.53, 1.11) <sup>c,de</sup>	0.68 (0.49, 0.93) <sup>a,c,d,e</sup>	0.68 (0.49, 0.93) <sup>a,c,d,e</sup>	1.11 (0.82, 1.52)	1.48 (1.06, 2.07) <sup>a,e</sup>	1.48 (1.06, 2.07) <sup>a,e</sup>	1.10 (0.77, 1.58) <sup>d</sup>	1.01 (0.71, 1.46)	1.13 (0.83, 1.55)	1.01 (0.71, 1.46)	0.97 (0.67, 1.42)	
Cisgender Female Bisexual	1.77 (1.26, 2.47) <sup>a,b</sup>	1.36 (1.13–1.64) <sup>a,b</sup>	1.20 (0.95, 1.51) <sup>b</sup>	1.20 (0.95, 1.51) <sup>b</sup>	1.10 (0.92, 1.32) <sup>b</sup>	1.10 (0.92, 1.32) <sup>b</sup>	1.26 (1.05, 1.51) <sup>a</sup>	1.25 (1.02, 1.53) <sup>a</sup>	1.25 (1.02, 1.53) <sup>a</sup>	1.46 (1.18, 1.79) <sup>a,e</sup>	1.29 (1.05, 1.58) <sup>a,e</sup>	1.49 (1.24, 1.79) <sup>a,e</sup>	1.29 (1.05, 1.58) <sup>a,e</sup>	1.24 (1.01, 1.53) <sup>a,e</sup>	
Cisgender Female Lesbian or Gay Bisexual	1.45 (1.03, 2.05) <sup>a</sup>	1.23 (1.00–1.51) <sup>a</sup>	1.29 (1.00, 1.68) <sup>b</sup>	1.29 (1.00, 1.68) <sup>b</sup>	1.02 (0.83, 1.25) <sup>b</sup>	1.02 (0.83, 1.25) <sup>b</sup>	1.49 (1.21, 1.82) <sup>a</sup>	1.36 (1.09, 1.70) <sup>a,e</sup>	1.36 (1.09, 1.70) <sup>a,e</sup>	1.83 (1.43, 2.33) <sup>a,b,e</sup>	1.38 (1.10, 1.73) <sup>a,e</sup>	1.50 (1.22, 1.84) <sup>a,e</sup>	1.38 (1.10, 1.73) <sup>a,e</sup>	1.04 (0.82, 1.33)	
Gender Minority	1.44 (0.91, 2.27)	1.32 (1.01–1.73) <sup>a</sup>	1.30 (0.92, 1.83) <sup>b</sup>	1.30 (0.92, 1.83) <sup>b</sup>	1.19 (0.92, 1.55) <sup>b</sup>	1.19 (0.92, 1.55) <sup>b</sup>	1.24 (0.95, 1.61)	0.96 (0.71, 1.30) <sup>b,d</sup>	0.96 (0.71, 1.30) <sup>b,d</sup>	1.00 (0.75, 1.34) <sup>c,d</sup>	0.86 (0.63, 1.19) <sup>c,d</sup>	1.06 (0.82, 1.37) <sup>c,d</sup>	0.86 (0.63, 1.19) <sup>c,d</sup>	0.85 (0.61, 1.18) <sup>f</sup>	

aOR = adjusted odds ratio; CI = confidence interval.

All models controlled for age, education, student status, race/ethnicity, income and source.

<sup>‡</sup>Includes use of cigarettes, cigar products, hookah, smokeless tobacco or electronic nicotine products.

<sup>†</sup>Includes traditional cigars, cigarillos and little cigars; <sup>‡</sup>Includes e-cigarettes, e-cigs, vapor pens, or e-hookahs.

a: Significant (p < 0.05) compared with cisgender male gay (reference).

b: Significant (p < 0.05) compared with cisgender male bisexual.

c: Significant (p < 0.05) compared with cisgender female lesbian or gay.

d: Significant (p < 0.05) compared with cisgender female bisexual.

e: Significant (p < 0.05) compared with gender minority.

Note: Models without superscripts indicate non-statistically significant comparisons.

Missingness for tobacco ever use: Any product (n = 52, 1.3%); cigarettes (n = 57, 1.5%); cigars (n = 98, 2.5%); hookah (n = 98, 2.5%); smokeless (n = 96, 2.5%); electronic nicotine products (n = 95, 2.4%).

Missingness for past 30-day tobacco use: Any product (n = 53, 1.4%); cigarettes (n = 136, 3.5%); cigars (n = 98, 2.5%); hookah (n = 101, 2.6%); smokeless (n = 101, 2.6%); electronic nicotine products (n = 97, 2.5%);

any poly use (n = 53, 1.4%); two combustible products (n = 54, 1.4%); combustible + noncombustible products (n = 94, 2.4%).

**Table 4**  
Multivariable logistic regression models of sexual and gender identity associated with past 30-day poly use.

	Any Poly use <sup>§</sup> aOR (95% CI)	Two Combustible Products <sup>¶</sup> aOR (95% CI)	Combustible & Noncombustible Product <sup>¶</sup> aOR (95% CI)
Cisgender Male Gay	Reference	Reference	Reference
Cisgender Male Bisexual	0.99 (0.72, 1.37)	0.85 (0.59, 1.22)	1.27 (0.90, 1.80)
Cisgender Female Lesbian or Gay	1.19 (0.99, 1.43) <sup>c</sup>	1.20 (0.99, 1.47) <sup>c</sup>	1.10 (0.90, 1.36)
Cisgender Female Bisexual	1.24 (1.01, 1.52) <sup>a,c</sup>	1.13 (0.90, 1.41)	1.15 (0.91, 1.44)
Gender Minority	0.83 (0.63, 1.10) <sup>c,d</sup>	0.81 (0.59, 1.10) <sup>c</sup>	0.85 (0.62, 1.16)

aOR = adjusted odds ratio; CI = confidence interval.

<sup>§</sup>Any poly use defined as past 30-day use of two or more tobacco products; <sup>¶</sup>Combustible products include cigarettes, cigar products and hookah; <sup>¶</sup>Noncombustible products include smokeless tobacco and electronic nicotine products.

All models controlled for age, education, student status, race/ethnicity, income and source.

a: Significant ( $p < 0.05$ ) compared with cisgender male gay (reference).

b: Significant ( $p < 0.05$ ) compared with cisgender male bisexual.

c: Significant ( $p < 0.05$ ) compared with cisgender female lesbian or gay.

d: Significant ( $p < 0.05$ ) compared with cisgender female bisexual.

e: Significant ( $p < 0.05$ ) compared with gender minority.

Note: Models without superscripts indicate non-statistically significant comparisons.

Missingness for past 30-day tobacco use: Any poly use ( $n = 55$ , 1.4%); two combustible products ( $n = 56$ , 1.4%); combustible + noncombustible products ( $n = 96$ , 2.4%).

product use compared to noncombustible products like electronic nicotine products and smokeless tobacco (Glasser et al., 2015; U.S. Department of Health and Human Services, 2014). These findings are consistent with studies showing that sexual minority females are at elevated risk for tobacco use (Emory et al., 2016; Parnes et al., 2017; Schuler et al., 2018). This could be for a number of reasons. First, research suggests that lesbian/gay females initiate cigarette smoking earlier than straight women, while initiation doesn't differ between gay and straight men (Johnson et al., 2016). Early initiation of cigarette smoking is associated with nicotine dependence in young adulthood, particularly for females (Lanza and Vasilenko, 2015), which could explain high prevalence of tobacco use among lesbian/gay females in this study. A recent study found that past-month nicotine dependence was more prevalent among sexual minority female young adults compared to their male counterparts (Schuler et al., 2019). Several studies of adolescents also found that substance use was higher among sexual minority females, suggesting that the disparity observed in our study begins early in life (Caputi, 2018; Corliss et al., 2010; Marshal et al., 2008). Additionally, sexual minority women progress to daily smoking sooner than most other groups (Johnson et al., 2016); this could be a reflection of higher levels of smoking risk factors, such as peer smoking and mental health problems (Hu et al., 2006), which could account for disproportionately high rates of tobacco use. Contrary to other studies that have found bisexual females to be at higher risk for tobacco use compared to lesbian/gay females (Emory et al., 2016; Schuler et al., 2018), we did not find differences in prevalence of tobacco use between lesbian/gay and bisexual females. More research to better understand risk and protective factors for tobacco use among sexual minority females would be useful to inform future tobacco education efforts.

The sample in the present study has several key strengths. First, this study utilizes one of the largest known samples of LGBT young adults to-date, which allowed for intragroup comparisons of tobacco use by LGBT subgroup rather than comparing tobacco use of cisgender, heterosexual males and females with that of LGBT adults (either as a combined category of all LGBT adults or individual LGBT subgroups) as many previous studies have done due to insufficient LGBT subgroup samples (Kalkhoran et al., 2016; Li et al., 2018; Nayak et al., 2017; Phillips et al., 2017). This study also includes one of the largest samples of gender minorities to date, which allowed for the comparison of tobacco use and tobacco poly use between gender minorities and other LGBT subgroups, which previous studies have been unable to make due to low population prevalence of gender minorities and therefore insufficient samples sizes (Gonzales and Henning-Smith, 2017; Meyer et al., 2017; Sell, 2017).

Tobacco use risk variation by LGBT subgroup may stem from diverse life experiences as a member of different and perhaps multiple (gender, ethno-racial, and sexual) minority groups. One potential factor is minority stress (Gruskin et al., 2008; Hatzenbuehler et al., 2014): chronic stress that stems from experiencing stigmatization and discrimination (Blondeel et al., 2016; Cochran et al., 2016; Grant et al., 2010) due to possessing a disadvantaged minority status. Those with multiple minority identities and those who are more marginalized may have more chronic stress and unique, simultaneous experiences with sexism, racism, heterosexism, biphobia or transphobia (Flanders et al., 2015; Greene, 2000; Herek, 2002; Israel and Mohr, 2004; Kim and Fredriksen-Goldsen, 2012; Parnes et al., 2017; Szymanski and Meyer, 2008). The sample size in our study did not allow for further stratification by race/ethnicity, but future studies could examine how race and ethnicity intersect with sexual and gender identities to create inequities in tobacco use behaviors (Yette and Ahern, 2018).

Another potential tobacco use risk factor is exposure to tobacco marketing, which has targeted the LGBT community using LGBT print media, bar and club events, and sponsorship of Pride events and LGBT organizations in the U.S. since the early 1990's (Dilley et al., 2008; Offen et al., 2008; Smith et al., 2005; Smith and Malone, 2003; Stevens et al., 2004; Washington, 2002). LGBT adults were more likely than non-LGBT peers to be exposed to tobacco media on digital and social media (Emory et al., 2018), and research suggests that exposure to and engagement with tobacco marketing may differ by LGBT subgroup. Research shows that LGBT subgroups that utilize social media more often and/or attend LGBT social venues like bars and clubs have elevated levels of exposure to tobacco marketing (Fallin et al., 2014; Leibel et al., 2011; Youatt et al., 2015). A recent study of youth from the Population Assessment of Tobacco and Health study found that a greater prevalence of sexual minority females reported engaging with online tobacco marketing in the past year compared with other respondents (Soneji et al., 2019).

In addition to explicit targeting by the tobacco industry, certain subgroups may have higher awareness of and receptivity to tobacco marketing based on where these groups socialize and the relevance of tobacco marketing content. Gendered tobacco marketing may appeal to LGBT subgroups based on where they express their identity on the masculinity-femininity spectrum. Tobacco marketing has been tailored to masculine men (e.g., the Marlboro Man) and liberated women (e.g., Virginia Slims) (Toll and Ling, 2005) in a way that helps to (1) shape modern masculinity (Cortese and Ling, 2011) and (2) define smoking cigarettes as a way to express female independence or modernity (Toll and Ling, 2005) or sexuality (Bottorff et al., 2014). However, only

limited research has examined differences in tobacco marketing exposure or receptivity by LGBT subgroup or their gender expression.

This study has limitations. First, there are many challenges associated with measuring sexual and gender identity. The terminology used to describe sexual and gender identity has changed over time (Stepleman et al., 2017) and continues to evolve, which can make it difficult to study LGBT subgroups in a meaningful way. For example, 31 respondents in our study selected “different identity” when asked about their current gender identity. These respondents were then asked to specify their different gender identity with a write-in response; some examples included “gender fluid,” “demigirl” and “bi-gendered,” demonstrating that gender identity varies widely and cannot necessarily be limited to a few categories. Additionally, gender and sexual identities can be in flux and can change over time during young adulthood (Dickson et al., 2003; Institute of Medicine, 2015), an important period of development during the life course (Institute of Medicine, 2015), making it especially difficult to study this population using survey data. However, these limitations are relevant to all research on LGBT individuals, not just our study.

Limited sample size did not allow us to further categorize gender minority respondents (i.e., differences in sexual identity among transgender respondents, differences between male-to-female transgender vs. gender non-conforming transgender and female-to-male transgender), meaning we were unable to examine intragroup differences in tobacco use among transgender respondents. This is important, since research suggests that there is variation in substance use behavior among gender minorities (Gonzalez et al., 2017). There are also limitations to our study as a result of our study design and recruitment procedures. Our sample was recruited via social media and intercept surveys rather than via probability-based sampling, and therefore our findings may not generalize to all LGBT young adults. Lastly, as mentioned earlier, many respondents were recruited at social venues, such as bars (Guillory et al., 2018), and may be more likely to exhibit tobacco use behaviors compared to the general population, potentially threatening external validity.

Most national health studies do not oversample for LGBT individuals, meaning that sample sizes for LGBT respondents tend to be very small due to the low number of LGBT individuals in the U.S. relative to non-LGBT individuals (Patterson et al., 2017). Our study is unique in that only LGBT young adults were included, allowing for robust LGBT subgroup analyses and an in-depth exploration of tobacco use, and is one of the largest known samples to-date of this population (Guillory et al., 2018). Our findings underscore differing tobacco use risk profiles based on sexual and gender identity and highlight an important reason to avoid treating LGBT individuals as a monolith (Emory et al., 2016; Waters, 2013). Moving forward, health researchers could use consistent survey questions and categorizations to ensure that the same constructs related to sexual and gender identity are being measured, which would allow data to be compared and linked across studies to examine complex health issues related to LGBT individuals (Filiault and Drummond, 2009; Patterson et al., 2017; Stepleman et al., 2017). Furthermore, more research can be done to understand reasons for intragroup differences in tobacco use among LGBT subgroups. Education efforts to reduce smoking behavior by LGBT subgroup, particularly among sexual minority women, may help reduce the burden of tobacco use on this population.

## Contributors

JD conceptualized the manuscript. JD, OG and LH developed the analysis plan. OG analyzed the data. JD, OG, LH and JG drafted the initial manuscript. All authors were involved in the interpretation of results, editing the manuscript and have read and approved the final manuscript for submission.

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