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## Examining Smoking and Vaping Behaviors, Expectancies, and Cessation Outcomes Between Bisexual and Heterosexual Individuals

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### Abstract

Prior research indicates bisexual individuals have higher smoking and vaping rates and heightened vulnerability to negative health outcomes. Thus, we compared adult bisexual (n=294) and heterosexual (n=2412) participants enrolled in a smoking cessation trial on baseline smoking and vaping use behaviors, motivations, and expectancies/beliefs as well as follow-up smoking and vaping status. This is a secondary analysis of a large randomized controlled trial testing a smoking cessation intervention for dual users of combustible and electronic cigarettes (e-cigarettes) in the United States. Self-reported 7-day point prevalence smoking and vaping abstinence were collected at 3-, 12-, and 24-month assessments. Bisexual and heterosexual participants did not differ in sociodemographic variables or baseline smoking and vaping history and behavior. We found significant differences among bisexual and heterosexual individuals in smoking and vaping beliefs/expectancies. Specifically, bisexual participants expressed overall greater positive expectancies regarding smoking and vaping, such as smoking and vaping to reduce negative affect and stress. There were no differences in smoking at any follow-up assessment. Only at 3 months were bisexual individuals more likely to be abstinent from vaping and less likely to be dual users than heterosexual individuals. Despite similar smoking and vaping status over time, bisexual individuals reported greater positive expectancies regarding smoking and vaping. Our findings revealed few targets for tailoring cessation interventions to bisexual individuals; thus, it is possible that there may be greater utility in targeting the disparities in prevalence (i.e., via prevention efforts).

### Keywords

Sexual minority; bisexual; smoking; electronic cigarettes; vaping

## Introduction

Smoking prevalence rates have achieved historic lows in the United States, decreasing from 20.9% in 2005 to 14.0% in 2019.<sup>1</sup> However, the prevalence of smoking remains high among certain populations increasing their risk of disparities in smoking-related health outcomes.<sup>1</sup> One group especially affected by high smoking rates comprises lesbian, gay, and bisexual (LGB) individuals. Recent data show that 19.2% of LGB individuals smoke cigarettes compared to 13.8% of heterosexual individuals. Electronic cigarette (e-cigarette) use (i.e., vaping) is also disproportionately high among LGB individuals, with vaping rates more than double compared to heterosexual individuals (11.5% vs. 4.2%, respectively).<sup>2</sup> Thus, it is important to understand potential drivers of these differences, including differences in relevant psychological variables and in smoking and vaping cessation.

Despite the high smoking prevalence and multiple barriers (e.g., stigma, poor mental health) that may contribute to disparity in smoking rates, individuals who identify as LGB appear to be able to quit smoking at similar rates as heterosexual individuals. Studies comparing sexual minority and heterosexual participants enrolled in smoking cessation interventions have found similar smoking abstinence rates.<sup>3–6</sup> For example, Vogel et al.<sup>5</sup> randomized 500 young adults to [Smokefree.gov](https://www.smokefree.gov) or to a 90-day smoking cessation intervention conducted through Facebook that was tailored by readiness to quit. Smoking abstinence rates among participants who identified as sexual and gender minorities (SGM) (n = 135) did not differ from those who identified as non-SGM (n = 365) throughout the study period (8.6%–20.0% abstinence for SGM vs. 11.2%–21.6% for non-SGM, p=.83). Similarly, Heffner et al.,<sup>6</sup> in a study comparing two web-based smoking cessation interventions, found similar abstinence rates among individuals identifying as a sexual minority (n=253) compared to non-sexual minority individuals (n=2384) at 12 months (23.6% vs. 25.4%, p=.58, respectively). Overall, prior research is limited. Only these two studies had a sample size with sufficient power to detect significant differences,<sup>5,6</sup> one study included only male participants,<sup>3</sup> and another recruited only people under age 25.<sup>5</sup>

In addition to high smoking rates, sexual minority individuals are also more likely to use e-cigarettes.<sup>2,7–13</sup> Several studies found a high prevalence of vaping among LGB individuals,<sup>10,13–16</sup> but few have examined specific e-cigarette use behaviors or reasons for using e-cigarettes. Vaping is a phenomenon with increasing prevalence, particularly among smokers who want to quit smoking, but it is unknown the degree to which sexual minority individuals use e-cigarettes to quit smoking or as a substitute for combustible cigarettes where smoking is forbidden. Indeed, high rates of concurrent use of combustible cigarettes and e-cigarettes (i.e., dual use) have been found among sexual minority individuals.<sup>11,12,15</sup> Dual use of combustible and e-cigarettes can be a transitional period towards exclusive e-cigarette use or eventual nicotine abstinence. However, prolonged exposure to both products may also maintain nicotine dependence<sup>17</sup> and perhaps increase exposure to toxicants.<sup>18</sup> Thus, it is important to understand smoking and vaping behaviors and motivations among individuals who identify with a sexual orientation other than heterosexual to reduce potential disparities that may result from greater exposure to combustible and potentially electronic cigarettes.

Prior research suggests sexual minorities are not a homogenous group and that there is a need to explore differences in tobacco use among sexual minority subgroups.<sup>7,14</sup> Indeed, studies have consistently found bisexual individuals, especially bisexual women,<sup>19</sup> have the highest rates of smoking<sup>8,20</sup> and dual use of combustible cigarettes and e-cigarettes.<sup>19</sup> Substance use could be a way of coping with the unique challenges this group faces. For example, disproportionately high rates of mental health problems are observed among bisexual individuals compared to heterosexual individuals and other sexual minority groups.<sup>21,22</sup> Additionally, bisexual individuals report frequent rejection from both the heterosexual population, and the lesbian/gay community, since they are often perceived as being in transition to, or in denial of, homosexuality and of having heterosexual privileges when having opposite sex partners.<sup>21–23</sup> Other factors that may contribute to increased feelings of stigma include misconceptions that bisexuality is associated with a higher likelihood of carrying sexually transmitted diseases, promiscuity, or disinterest in monogamous relationships.<sup>21,23</sup> Thus, bisexual individuals represent a highly vulnerable group that has received minimal attention as a consequence of aggregating data with other sexual minority groups,<sup>21</sup> and one that warrants immediate attention since they represent over 50% of the sexual minority population in the US.<sup>24</sup>

Although prior studies have found high smoking and vaping rates among bisexual individuals,<sup>9,10,13,19</sup> there is a lack of research examining differences among bisexual and heterosexual individuals in dual use patterns (e.g., frequency of use) or whether they have different motivations or expectations for their cigarette and e-cigarette use. Expectancies for both cigarette and e-cigarette use have been associated with likelihood of use and cessation in the general population.<sup>25,26</sup> Examining expectancies may help to explain higher rates of smoking and vaping among sexual minority individuals. Moreover, understanding whether there are differences in these variables could identify potential intervention targets and help to inform the design of interventions with the ultimate goal of reducing tobacco use in this vulnerable group.

To improve understanding, we conducted secondary analyses using data from a large randomized controlled trial testing a smoking cessation intervention for dual users. Based on prior research indicating bisexual individuals have the highest rates of smoking and vaping<sup>8,19,20</sup> and heightened vulnerability to negative health outcomes,<sup>22</sup> we compared bisexual and heterosexual participants on baseline smoking and vaping use behaviors, motivations, and expectancies. Furthermore, we analyzed whether sexual orientation (bisexual versus heterosexual) was associated with smoking, vaping, and dual use status at 3-, 12-, and 24-months post-baseline. Finally, given that studies have consistently found that smoking and dual use rates were higher among bisexual women,<sup>8,14,19,20</sup> we also explored differences by sex.

## Methods

### 2.1. Participants

Participants in the parent study were 2896 dual users of combustible and e-cigarettes in the United States recruited mainly through social media advertisements.<sup>27,28</sup> Eligible individuals were: (1) age ≥ 18 years; (2) smoking ≥ 1 combustible cigarette/week; (3) vaping ≥ 1 time/

week over the previous month; (4) not currently enrolled in a face-to-face smoking cessation intervention; (5) able to speak/read English. Participants did not need to be motivated to quit smoking for inclusion. Only one individual per street address was allowed.

## 2.2. Procedure

Recruitment was conducted between July, 2016 and June, 2017. Interested participants were contacted by phone and assessed for eligibility. Those meeting inclusion criteria and providing consent were sent a baseline questionnaire via postal mail or email. Once the baseline was returned and eligibility confirmed, they were enrolled and randomized to one of three study conditions: assessment only (ASSESS), smoking cessation self-help booklets (GENERIC), or smoking cessation self-help booklets targeted for vapers (eTARGET). Methodological details and primary outcomes of the parent study have been published elsewhere.<sup>27,28</sup> Briefly, the ASSESS condition was a surveillance-only control group in which participants did not receive any smoking cessation intervention. Participants in the GENERIC and eTARGET conditions received monthly self-help smoking cessation booklets for 18 months. These materials were geared towards smokers in general (GENERIC)<sup>29</sup> or targeted for individuals who smoked and vaped (eTARGET).<sup>30</sup> All participants were assessed every three months for 24 months and were compensated with \$10 and \$20 for alternating short and long assessments, respectively, and \$40 for the final survey at 24 months. Participants completing the final survey could receive a \$40 bonus if they completed at least seven assessments or a \$60 bonus if they completed all nine assessments. The Advarra Institutional Review Board approved the study protocol (Pro00015052).

## 2.3. Measures

**Sociodemographic information.**—The baseline questionnaire included items to assess sociodemographic variables: biological sex, marital status, education, income, ethnicity, and race. Sexual orientation was measured with the question “which of the following best represents your current sexual orientation?” with response options: “lesbian,” “gay,” “bisexual,” “questioning,” “straight,” “prefer not to answer,” “other.” For the purpose of this study, those who reported being lesbian ( $n=66$ ), gay ( $n=48$ ), questioning ( $n=12$ ), prefer not to answer ( $n=16$ ), or other ( $n=26$ ) were not included in the analyses. Gender identity was assessed as: “male,” “female,” “male to female transgender,” “female to male transgender,” “prefer not to answer,” or “other.” Given the study focus on sexual orientation rather than gender identity, and due to the small representation of gender minority individuals in the sample ( $n=17$ ), only participants who identified as male or female were retained in the analyses ( $N=2,706$ ).

**Smoking variables.**—At baseline, we assessed years of daily smoking prior to initiating vaping, and we measured nicotine dependence and motivation to quit smoking using the Fagerström Test for Nicotine Dependence (FTND)<sup>31</sup> and the Contemplation Ladder,<sup>32</sup> respectively. The following response options were provided for reporting the number of cigarettes per day before vaping onset and at baseline: 5; 6–10; 11–15; 16–20; 21–30; 31. Responses were re-coded using the midpoint of each range with a code of 35 for the last option, with the re-coded values treated as a continuous measure for analyses.

**Vaping variables.**—Vaping history was measured by asking how many months ago they started using e-cigarettes, with the following response options: <1; 1–6; 7–12; 13–24; >24 months. Based on its distribution, this item was dichotomized as ≤24 months or >24 months. Frequency of vaping was categorized as daily/non-daily use. Number of vaping sessions per day included response options: 0; 1–4; 5–9; 10–14; 15–19; 20–29; 30; and “continuous.” The midpoint range was used to re-code participants’ answers, with a value of 35 and 40 for the last two categories, respectively. The following options were used to assess the most important reason participants reported for starting vaping: “to use them when I can’t smoke cigarettes (e.g., inside a restaurant),” “to help me quit smoking tobacco cigarettes,” “to help me cut down the amount of tobacco cigarettes I smoke,” “because of health concerns associated with tobacco cigarettes,” “I was curious about them,” “recommendations from family/friends,” “other.” Finally, participants were asked whether they were currently using e-cigarettes to quit smoking.

**Smoking and vaping expectancies.**—Sixteen items assessed positive and negative expectancies of smoking and vaping from 1 (strongly disagree) to 7 (strongly agree). Following prior research,<sup>25</sup> we included nine items from the Smoking Consequences Questionnaire-Adult<sup>33</sup> (i.e., negative affect reduction, stimulation enhancement, health risk, taste/sensorimotor manipulation, social facilitation, weight control, craving reduction, negative physical feelings, and negative social impression) and seven additional items to assess expectancies regarding craving, withdrawal, stress reduction, satisfaction, addiction, convenience, and cost. Items were slightly modified to measure vaping expectancies by replacing the words referring to cigarettes/smoking with e-cigarettes/vaping. Positive and negative expectancies scores were obtained by combining the 9 items measuring positive expectancies (i.e., satisfaction, craving reduction, negative affect reduction, convenience, taste, weight control, social facilitation, stimulation, stress reduction) and the 7 items measuring negative expectancies (i.e., addiction, craving, withdrawal, cost, health risks, negative physical feelings, negative social impression). Mean replacement was used when missing data were less than 30% for a participant in each particular scale.

**Smoking, vaping, and dual use status.**—Participants were considered abstinent from smoking or vaping at the 3-, 12-, and 24-months follow-ups based on self-reported not smoking or vaping in the previous 7 days. Those self-reporting any smoking and vaping in the previous 7 days at the 3-, 12-, and 24-months assessments were considered dual users.

## 2.4. Statistical Analyses

Participants’ demographic, smoking, and vaping variables were summarized using descriptive statistics. Differences between heterosexual and bisexual participants were first analyzed using chi square and *t*-tests for categorical and continuous variables, respectively. Cramer’s *V* (0.2 small, 0.3–0.5 medium, and 0.6 large) and Cohen’s *d* (0.2–0.4 small, 0.5–0.7 medium, and 0.8 large) effect sizes are also included.<sup>34</sup> Given the self-selected nature of the sample, all group differences in current and past smoking and vaping behavior and smoking and vaping expectancy variables were analyzed using regression analyses that included sociodemographic variables that differed by group ( $p < .05$ ).

For smoking, vaping, and dual use status 3-, 12-, and 24-months post-baseline, logistic regression analyses compared heterosexual and bisexual participants in a model controlling for study condition and sociodemographic variables that differed by group. Furthermore, smoking outcomes analyses were conducted for each follow-up assessment first including responders only, and then using an intent-to-treat (ITT) approach with missing imputed as smoking. We did not conduct ITT analyses for vaping because it has not yet been established that individuals missing from follow up are more likely to be vaping.

Finally, all the previous analyses were also conducted separately by sex (see Supplementary Materials).

All analyses were conducted using IBM SPSS, version 26.0 statistical package.

## Results

### 3.1. Sociodemographic and Smoking and Vaping Characteristics

As reported in Table 1, 294 individuals (10.2% of original sample) identified as bisexual. Compared to heterosexual participants ( $n=2,412$ ), bisexual participants were younger, more likely to be female, and to have an annual household income lower than \$30K. Bisexual individuals had a shorter history of smoking, smoked fewer cigarettes per day, and were less likely to be currently using e-cigarettes to quit smoking than heterosexual individuals, however statistical significance disappeared when controlling for age, sex, and income.

Comparisons by sex are presented in Supplementary Tables 1 and 4.

### 3.2. Smoking and Vaping Expectancies

Bisexual individuals reported greater overall positive cigarette expectancies (Table 2). On specific items, bisexual individuals expressed greater positive expectancies regarding satisfaction, craving reduction, negative affect reduction, convenience, weight control, social facilitation, stimulation, and stress reduction. However, effect sizes were small (Cohen's  $d < .40$ ). Regarding e-cigarettes, bisexual participants also reported greater positive expectancies than heterosexual participants. Although they reported e-cigarettes were expensive, they expressed greater positive expectancies regarding satisfaction, negative affect reduction, convenience, taste, weight control, social facilitation, and stress reduction (Cohen's  $d < .30$ ). When controlling for covariates (sex, age, and income), the following cigarette expectancies remained significant: overall positive expectancies, negative affect reduction, convenience, and stress reduction. Regarding e-cigarettes, when controlling for covariates, the following expectancies remained significant: overall positive expectancies, satisfaction, craving reduction, cost, negative affect reduction, taste, social facilitation, health risks, and stress reduction.

Results by sex showed similar results as in the general sample when comparing bisexual and heterosexual men in expectancies for smoking, with the exception that bisexual men were significantly more likely than heterosexual men to endorse the addictiveness of cigarettes expectancy (Supplementary Table 5). However, among women no significant differences were found by sexual orientation when controlling for covariates. Regarding

vaping expectancies, the significant adjusted group differences were no longer significant for men other than enjoyment of people and overall positive expectancies. For women, similar results as with the general sample were found when comparing the two sexual orientation groups, with the few exceptions noted in Supplementary Table 2.

### 3.3. Smoking and Vaping Status at 3-, 12-, and 24-Months Follow-ups

Bisexual and heterosexual individuals had a similar percentage of missing surveys at the three assessment points (27.9% vs. 32.0%; 46.5% vs. 45.9%; and 44.2% vs. 41.8% for heterosexual vs. bisexual participants at 3, 12, and 24 months, respectively). When conducting comparisons by sex, bisexual women were more likely to be non-responders at all assessment points (16.2% vs. 28.5%; 30.6% vs. 40.1%; 29.2% vs. 37.2% for heterosexual and bisexual women at 3, 12, and 24 months, respectively), whereas no significant differences were found among men (33.1% vs. 40.2%; 53.6% vs. 59.8%; 50.9% vs. 52.9% for heterosexual and bisexual men at 3, 12, and 24 months, respectively).

Among responders only, bisexual and heterosexual participants did not differ in self-reported 7-day point prevalence smoking abstinence at any time point, both with and without controlling for covariates (study condition, age, sex, and income). Similar results for smoking abstinence were obtained when using ITT (Table 3). Regarding vaping status, bisexual individuals were more likely than heterosexual individuals to be abstinent from vaping only at 3 months even when controlling for study condition, sex, age, and income. No significant differences were found in vaping status between the two groups at 12 or 24 months. Similarly, dual use was significantly lower among bisexual participants only at 3 months (Table 3). Comparisons by sex showed no significant differences in men (Supplementary Table 6), but among women, those who identified as bisexual were more likely to smoke and to be dual users at 3 months (Supplementary Table 3).

## Discussion

To our knowledge, this is the first study to compare heterosexual and bisexual dual users of combustible and e-cigarettes in smoking and vaping characteristics, expectancies, and smoking and vaping behavior over time. Although study recruitment strategies were not designed specifically to attract sexual minorities, an unexpected overrepresentation of this population was found in our sample, with over 15% ( $n=462$ ) of participants identifying with a sexual orientation other than heterosexual. This may be explained by the high smoking and vaping rates that have consistently been observed in the LGB community.<sup>2</sup> Overall, findings showed similar smoking and vaping characteristics between bisexual and heterosexual participants. Bisexual participants reported greater positive expectancies regarding both smoking and vaping; however, rates of smoking, vaping, and dual use were similar over time, with the exception of lower vaping and dual use rates among bisexual individuals at 3 months.

Baseline differences in smoking and vaping characteristics between the two groups were explained by sociodemographic variables. For example, bisexual individuals were significantly younger than heterosexual individuals and had lower income, which accounts for their shorter smoking histories and lower smoking rates. Most bisexual and heterosexual

dual users initiated vaping to quit or to reduce their combustible cigarette smoking, consistent with the literature among the general population.<sup>35</sup>

Compared to heterosexual participants, those who identified as bisexual reported greater positive expectancies for smoking and vaping. This finding may help explain the disproportionately high rates of smoking and vaping observed among bisexual individuals. Bisexual participants were more likely to endorse combustible and electronic cigarettes as methods of coping with anxiety and stress. This finding is consistent with prior research suggesting bisexual individuals may be using tobacco as a coping mechanism to deal with high levels of negative affect.<sup>36</sup>

Bisexual individuals also expressed greater positive e-cigarette expectancies than heterosexual individuals. This finding is consistent with recent studies suggesting sexual minority individuals hold more positive attitudes towards e-cigarettes, including satisfaction from vaping, safety, and efficacy for smoking cessation.<sup>15,37</sup> These findings help elucidate potential mechanisms (i.e., greater positive expectancies) that may contribute to higher prevalence of e-cigarette use within the LGB community and provide information that could guide public health messaging to this population and the development of vaping cessation programs.

Overall, we observed similar rates of smoking cessation between heterosexual and bisexual participants. This suggests sexual orientation per se is not responsible for smoking and vaping outcomes, and other factors, such as age, sex, or income, were driving differences observed at baseline. Other studies have also failed to find significant differences in smoking abstinence rates between heterosexual and sexual minority individuals.<sup>3-6,38</sup> These results raise important questions regarding need for targeting or tailoring interventions specific for sexual minorities. Access to targeted/tailored interventions for LGB smokers may make interventions more attractive and increase engagement and acceptability. However, the only two RCTs testing targeted/tailored interventions found mixed results.<sup>39,40</sup> Thus, research is needed to test the efficacy of targeted interventions for this group. Notably, targeted interventions to date have focused on the LGB population as a homogenous group; thus, it remains an unanswered question whether bisexual individuals would benefit from interventions targeted specifically for their unique challenges such as smoking to cope with feelings of stigma and discrimination, to facilitate group belonging, or to deal with sexual identity perception management.<sup>41</sup>

Differences in vaping and dual use status were observed at 3 months in the general sample, with bisexual participants being less likely to vape or dual use than heterosexual participants. These differences could be related to the fact that bisexual individuals were not as interested in using e-cigarettes to quit smoking as heterosexual individuals, so they may have lost interest and quit vaping earlier. However, because these differences were not maintained over time and because we did not control for multiple comparisons, this finding should be interpreted with caution.

Finally, the results comparing bisexual and heterosexual men and women were similar to the whole sample with the exception of higher smoking and dual use rates among



bisexual women only at 3 months. Despite several studies indicating the high prevalence of smoking and vaping among bisexual women, only Heffner et al.<sup>6</sup> compared smoking cessation outcomes over time by gender. Their results did not reveal differences between sexual minority and non-sexual minority women in smoking abstinence rates. We do not wish to over-interpret differences found at only one follow-up point with responders only. It is possible that gender and sexual minority differences in missing data may have contributed to this finding.

There are some limitations of this study. First, due to small subsample sizes, we were unable to compare differences among sexual minority subgroups other than bisexual individuals (e.g., gay, lesbian). However, given that over half of sexual minority individuals in the US identify as bisexual<sup>24</sup> and that they represent the highest risk sexual minority,<sup>21,22</sup> data from this population are particularly meaningful. Second, the sample was racially homogeneous (89.1% white) and we did not address the intersection of multiple social inequalities (e.g., race, income). Third, given the exploratory nature of the analysis, we did not control for multiple comparisons. Finally, effect sizes were generally small. Despite this, our study analyzed the largest sample of bisexual individuals who were dual users of combustible and e-cigarettes and were followed for two years. Although participants were enrolled in a clinical trial, it is noteworthy with respect to generalizability that they were not recruited explicitly for smoking cessation, but rather for a study measuring attitudes and behaviors regarding combustible cigarettes and e-cigarettes. Thus, participants were not necessarily seeking treatment at the time of enrollment, and baseline measures were collected prior to randomization to treatment arms. Finally, the study provides data characterizing vaping, a phenomenon with increasing prevalence in the general population, but especially among sexual minority individuals, and that had not been described previously in this population.

## Conclusions

Despite much higher smoking and vaping prevalence among sexual minorities, bisexual dual users of combustible cigarettes and e-cigarettes have similar smoking and vaping characteristics, as well as motivations for smoking and vaping as compared to heterosexual individuals. A notable exception was that bisexual individuals reported greater positive expectancies regarding both smoking and vaping. However, with respect to smoking behavior, the present results indicate that bisexual individuals were as likely to quit smoking as heterosexual individuals. Our findings revealed few targets for tailoring cessation interventions to bisexual individuals; thus, it is possible that there may be greater utility in targeting the disparities in prevalence (i.e., via prevention efforts).

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## Declaration of Competing Interests

Dr. Thomas H. Brandon has received research funding and medications from Pfizer, Inc., in previous studies and serves on the Advisory Board of Hava Health, Inc. All other co-authors report no conflicts of interest.

## Data Availability Statement

The data that support the findings of this study are available from the corresponding author, UM, upon reasonable request.

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Table 1.

## Demographic Variables and Smoking and Vaping Characteristics at Baseline

	N	All	Heterosexual Participants (n = 2412)	Bisexual Participants (n = 294)	T-Test/ $\chi^2$	Unadjusted p-Value	V or d <sup>l</sup>	Beta or AOR	Adjusted p-Value
<b>Demographic Variables</b>									
Sex (female)	2706	950 (35.1%)	743 (30.8%)	207 (70.4%)	180.418	<.001	0.26	N/A	N/A
Age	2706	30.0 (11.3)	30.5 (11.5)	26.0 (8.8)	8.056	<.001	0.44	N/A	N/A
<b>Race</b>									
White	2689	2397 (89.1%)	2145 (89.6%)	252 (85.7%)	5.176	.08	0.04	N/A	N/A
Black		73 (2.7%)	65 (2.7%)	8 (2.7%)					
Other		219 (8.1%)	185 (7.7%)	34 (11.6%)					
Ethnicity (Hispanic/Latino)	2706	223 (8.2%)	194 (8.0%)	29 (9.9%)	1.149	.28	0.02	N/A	N/A
Marital status (married or cohabitating)	2706	936 (34.6%)	845 (35.0%)	91 (31.0%)	1.929	.17	0.03	N/A	N/A
Education (>high school)	2706	1413 (52.2%)	1248 (51.7%)	165 (56.1%)	2.016	.16	0.03	N/A	N/A
Annual income (<\$30K)	2694	1517 (56.3%)	1321 (55.0%)	196 (67.4%)	16.173	<.001	0.08	N/A	N/A
<b>Smoking Characteristics</b>									
Years smoking before vaping	2692	13.1 (10.9)	13.4 (11.0)	10.3 (9.5)	5.222	<.001	0.30	0.02	.08
Cigarettes per day before vaping	2705	19.4 (8.9)	19.6 (8.9)	17.8 (8.9)	3.290	.001	0.20	0.02	.40
Cigarettes per day	2704	11.2 (8.0)	11.2 (8.1)	10.7 (7.7)	1.113	.27	0.06	0.00	.99
Nicotine dependence (0–10)	2706	3.6 (2.4)	3.6 (2.4)	3.6 (2.4)	0.501	.62	0.00	-0.00	.86
Motivation to quit smoking <sup>2</sup> (0–10)	2474	5.7 (2.4)	5.8 (2.4)	5.5 (2.3)	1.432	.15	0.13	0.01	.60
<b>Vaping Characteristics</b>									
Months vaping (>24 months ago)	2705	1200 (44.4%)	1070 (44.4%)	130 (44.2%)	0.003	.96	0.00	1.22	.13
Daily e-cigarette use	2691	1897 (70.5%)	1693 (70.6%)	204 (69.6%)	0.120	.73	0.01	1.14	.35
Vaping sessions per day	2701	27.4 (14.7)	27.3 (14.7)	27.6 (15.2)	-0.342	.73	0.02	0.03	.19
<b>Most important reason to start vaping</b>									
To quit smoking	2682	1242 (46.3%)	1115 (46.6%)	127 (43.6%)	7.518	.28	0.05	Ref.	Ref.
To cut down combustible cigarettes		597 (22.3%)	532 (22.3%)	65 (22.3%)				1.14	.45
Health concerns		326 (12.2%)	298 (12.5%)	28 (9.6%)				1.21	.41
To use them when cannot smoke		249 (9.3%)	214 (9.0%)	35 (12.0%)				0.75	.18

	All		Heterosexual Participants (n = 2412)		Bisexual Participants (n = 294)		Unadjusted		Adjusted	
	N	n (%) / M (SD)	n (%) / M (SD)	n (%) / M (SD)	n (%) / M (SD)	T-Test/ $\chi^2$	V or d <sup>1</sup>	Beta or AOR	p-Value	
Curiosity		131 (4.9%)	114 (4.8%)	17 (5.8%)				0.91	.76	
Recommendations from others		68 (2.5%)	57 (2.4%)	11 (3.8%)				1.08	.85	
Other		69 (2.6%)	61 (2.6%)	8 (2.7%)				0.92	.84	
Currently vaping to quit smoking (yes)	2691	2017 (75.0%)	1815 (75.7%)	202 (68.9%)	6.330	.012	0.05	0.85	.26	

Notes:

1) Cramer's V or Cohen's d.

2) The higher percentage missing for Contemplation Ladder is due to an error in data collection using electronic surveys, which was corrected after approximately 400 had completed the baseline survey online.

**Table 2.** Comparison between Heterosexual and Bisexual Individuals in Baseline Smoking and Vaping Expectancies

	N	Heterosexual Participants		Bisexual Participants		Unadjusted			Adjusted	
		All	M (SD)	M (SD)	M (SD)	T-Test/ $\chi^2$	p-Value	Cohen's d	Beta	p-Value
<b>Smoking Expectancies (range 1–7)</b>										
Cigarettes are satisfying	2705	5.34 (1.56)	5.32 (1.56)	5.53 (1.54)	-2.209	.03	0.13	0.00	.87	
Cigarettes are addictive	2705	6.40 (1.32)	6.38 (1.34)	6.49 (1.13)	-1.534	.13	0.08	0.04	.09	
I experience cravings for cigarettes	2701	5.77 (1.41)	5.76 (1.42)	5.83 (1.39)	-0.772	.44	0.00	0.00	.97	
If I go too long without a cigarette, I start feeling bad	2701	4.56 (1.87)	4.54 (1.87)	4.73 (1.87)	-1.721	.09	0.11	0.01	.69	
Smoking satisfies my nicotine cravings	2702	5.81 (1.45)	5.79 (1.46)	5.98 (1.33)	-2.315	.02	0.14	0.03	.10	
Cigarettes are expensive	2704	6.46 (1.23)	6.44 (1.25)	6.55 (1.08)	-1.584	.11	0.17	0.03	.13	
Cigarettes help me deal with anxiety or worry	2705	5.83 (1.49)	5.77 (1.52)	6.25 (1.11)	-6.630	<.001	0.38	0.05	<.01	
Cigarettes are convenient to use	2704	4.87 (1.89)	4.85 (1.89)	5.10 (1.82)	-2.135	.03	0.11	0.04	.04	
Cigarettes taste good	2703	3.60 (1.95)	3.58 (1.94)	3.77 (2.03)	-1.558	.12	0.10	0.02	.25	
Smoking controls my appetite	2704	3.97 (1.90)	3.94 (1.90)	4.22 (1.88)	-2.384	.02	0.16	0.02	.34	
Smoking helps me enjoy people more	2705	3.90 (1.94)	3.86 (1.93)	4.23 (2.00)	-3.128	<.01	0.15	0.02	.37	
Smoking is hazardous to my health	2706	6.55 (1.10)	6.55 (1.11)	6.57 (1.04)	-0.380	.70	0.00	0.01	.53	
Smoking a cigarette energizes me	2704	3.98 (1.75)	3.94 (1.75)	4.25 (1.72)	-2.868	<.01	0.23	0.04	.06	
Smoking irritates my mouth and throat	2702	4.22 (1.84)	4.23 (1.84)	4.16 (1.89)	0.558	.58	0.00	-0.01	.69	
Cigarettes are good for dealing with stress	2701	5.44 (1.63)	5.40 (1.64)	5.79 (1.52)	-4.108	<.001	0.26	0.04	.04	
People think less of me if they see me smoking	2706	4.73 (1.68)	4.71 (1.68)	4.89 (1.68)	-1.753	.08	0.12	0.02	.43	
Positive Expectancies score (range 9–63)	2706	42.75 (9.33)	42.45 (9.35)	45.13 (8.86)	-4.652	<.001	0.29	0.05	.01	
Negative Expectancies score (range 7–49)	2706	38.68 (6.26)	38.61 (6.35)	39.24 (5.48)	-1.817	.07	0.10	0.02	.32	
<b>Vaping Expectancies (range 1–7)</b>										
E-cigarettes are satisfying	2706	5.98 (1.31)	5.96 (1.32)	6.16 (1.17)	-2.479	.01	0.16	0.07	<.01	
E-cigarettes are addictive	2706	3.98 (1.78)	3.97 (1.78)	4.06 (1.81)	-0.767	.44	0.06	0.01	.48	
I experience cravings for e-cigarettes	2702	4.14 (1.87)	4.12 (1.86)	4.32 (1.92)	-1.675	.09	0.11	0.03	.17	
If I go too long without an e-cigarette, I start feeling bad	2702	2.93 (1.89)	2.91 (1.88)	3.10 (1.96)	-1.629	.10	0.10	0.03	.19	

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Using e-cigarettes satisfies my nicotine cravings	2702	5.60 (1.53)	5.59 (1.53)	5.67 (1.48)	-0.868	.39	0.07	0.05	.03
E-cigarettes are expensive	2706	4.42 (1.88)	4.38 (1.87)	4.82 (1.93)	-3.801	<.001	0.21	0.05	.02
E-cigarettes help me deal with anxiety or worry	2703	4.96 (1.74)	4.92 (1.74)	5.31 (1.70)	-3.642	<.001	0.24	0.05	.01
E-cigarettes are convenient to use	2705	6.07 (1.37)	6.05 (1.38)	6.26 (1.27)	-2.579	.01	0.15	0.03	.15
E-cigarettes taste good	2705	6.54 (0.99)	6.52 (1.02)	6.73 (0.68)	-4.586	<.001	0.23	0.06	.01
E-cigarettes control my appetite	2705	3.74 (1.85)	3.71 (1.85)	3.94 (1.86)	-2.015	.04	0.11	0.03	.16
E-cigarettes help me enjoy people more	2702	4.16 (1.92)	4.10 (1.93)	4.59 (1.82)	-4.069	<.001	0.27	0.06	.01
E-cigarettes are hazardous to my health	2704	2.89 (1.70)	2.90 (1.71)	2.79 (1.64)	1.090	.28	0.06	-0.05	.03
E-cigarettes energize me	2704	3.62 (1.68)	3.60 (1.68)	3.79 (1.71)	-1.833	.07	0.12	0.03	.16
E-cigarettes irritate my mouth and throat	2705	2.47 (1.71)	2.47 (1.70)	2.48 (1.76)	-0.112	.91	0.00	-0.01	.48
E-cigarettes are good for dealing with stress	2703	4.94 (1.71)	4.90 (1.72)	5.20 (1.64)	-2.856	<.01	0.18	0.05	.02
People think less of me if they see me using e-cigarettes	2705	3.01 (1.74)	3.03 (1.74)	2.88 (1.75)	1.383	.17	0.06	-0.02	.45
Positive Expectancies score (range 9–63)	2705	45.61 (9.26)	45.36 (9.25)	47.64 (9.04)	-4.001	<.001	0.24	0.07	<.01
Negative Expectancies score (range 7–49)	2705	23.85 (7.35)	23.78 (7.32)	24.44 (7.54)	-1.447	.15	0.08	0.01	.54

Notes:

1) P-value and Cohen's d are for the group comparison while not controlling for covariates.

2) Beta and P-value are for group difference from regression model controlling for sex, age, and income.



Smoking Abstinence, Vaping Abstinence, and Dual Use Status for Heterosexual and Bisexual Individuals at 3, 12, and 24 Months among Responders only and ITT

**Table 3.**

	Heterosexuals	Bisexuals	OR	Unadjusted			Adjusted		
				95% CI	p-Value	AOR	95% CI	p-Value	
<b>Smoking Abstinence (7 day pp, RO)</b>									
3 months (N = 1939)	285 (16.4%)	35 (17.5%)	1.08	0.74–1.59	.69	1.19	0.79–1.79	.41	
12 months (N = 1448)	481 (37.3%)	63 (39.9%)	1.12	0.80–1.56	.53	1.08	0.75–1.55	.68	
24 months (N = 1514)	656 (48.8%)	86 (50.3%)	1.06	0.77–1.46	.72	1.03	0.74–1.45	.86	
<b>Vaping Abstinence (7 day pp, RO)</b>									
3 months (N = 1936)	180 (10.4%)	38 (19.1%)	2.04	1.39–3.00	<0.001	1.56	1.03–2.37	.04	
12 months (N = 1444)	309 (24.0%)	38 (23.9%)	0.99	0.67–1.46	.97	0.74	0.49–1.11	.15	
24 months (N = 1516)	440 (32.7%)	59 (34.5%)	1.08	0.78–1.52	.64	0.85	0.60–1.23	.39	
<b>Dual Use Status (RO)</b>									
3 months (N = 1936)	1284 (73.9%)	129 (64.8%)	0.65	0.48–0.89	<.01	0.70	0.50–0.97	.03	
12 months (N = 1442)	586 (45.6%)	70 (44.3%)	0.95	0.68–1.32	.75	1.16	0.81–1.66	.42	
24 months (N = 1514)	434 (32.3%)	57 (33.3%)	1.05	0.75–1.47	.79	1.23	0.86–1.77	.25	
<b>Smoking Abstinence (7 day pp, ITT)</b>									
3 months (N = 2706)	285 (11.8%)	35 (11.9%)	1.01	0.69–1.47	.96	1.09	0.73–1.62	.68	
12 months (N = 2706)	481 (19.9%)	63 (21.4%)	1.10	0.81–1.47	.55	1.03	0.75–1.42	.84	
24 months (N = 2706)	656 (27.2%)	86 (29.3%)	1.11	0.85–1.45	.46	1.07	0.80–1.42	.67	

Abbreviations: 7 day pp=7-day point-prevalence; RO=responders only; AOR=adjusted odd ratio for study condition, sex, age, and income; CI=confidence interval; ITT=Intent to treat