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Between and within sexual identity-group differences in asthma prevalence in the U.S.

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Contributors

DA served as the leading author, performed the statistical analyses, conducted the literature review, drafted the manuscript, and coordinated the writing of the manuscript. SHN discussed the findings, and NA conducted the literature review. HMM revised the first draft of the manuscript and coordinated the entire revision among the authors. All authors, including MA, EO, AJ, TP, and HMM, provided critical revisions to the manuscript.

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All the authors have disclosed no conflicts of interest.

Abstract

Background: Although prior studies have established the association of asthma with smoking and obesity, literature on difference-in-differences analyses involving sexual identity is sparse. Therefore, this study aimed to examine the between and within sexual identity-group differences in asthma prevalence among individuals who smoke and are obese.

Methods: We aggregated the 2017-2019 National Survey on Drug Use and Health (NSDUH) data on adults (N= 128,319) to perform weighted multivariable logistic regression analysis and marginal estimates and marginsplot to determine asthma prevalence by sexual identity and the status of smoking and obesity.

Results: About 66.38% of the study population reported having asthma. Among the individuals with asthma, 42.20% were obese, 10.15% were daily cigarette smokers, and 6.22% identified as bisexual persons. Lesbian/gay daily smokers (86%) or former smokers (75%) had a

higher probability of having asthma than bisexual (daily smokers= 78% *vs.* former smokers= 72%) and heterosexual (daily smokers= 68% *vs.* former smokers= 65%) persons. Within each sexual identity subgroup, daily smokers (68-86%) had the highest probability of asthma. Obese bisexual (73%) or lesbian/gay (72%) persons had higher probabilities of having asthma than heterosexual persons (69%). Obese (73%) or overweight (72%) bisexual (compared to normal weight= 70% or underweight= 51%) and obese (69%) or overweight (65%) heterosexual (compared to normal weight= 62% or underweight= 57%) persons had the highest probabilities of having asthma within their groups, whereas overweight persons (overweight= 81% *vs.* underweight= 79%, normal weight= 78%, and obese= 72%) had the highest probabilities within lesbian/gay persons.

Conclusion: Smoking and obesity show heightened odds for asthma, with significant odds for sexual minorities in asthma diagnosis relative to heterosexuals. These findings provide formative information for future longitudinal and experimental studies to explore these mechanisms of asthma risks among sexual and gender minorities.

Keywords: Asthma; Sexual and gender minorities; Smoking; Obesity

INTRODUCTION

Asthma is a chronic disease of the lungs with no known cure and a major cause of morbidity and mortality in the United States (U.S.).[1–3] It is characterized by repeated episodes of wheezing, breathlessness, chest tightness, and coughing. Between 2001 and 2019, the prevalence of asthma in the U.S. increased from 7.4% to 8% among adults aged ≥18 years, which implies the critical need for initiatives to curtail this trend.[1,4] Asthma can result in frequent emergency department (ED) visits, hospitalizations, and premature deaths. In 2018, about 1.6 million ED visits were asthma-related.[1,3,4] More than 11.4 million individuals with asthma reported having had one or more asthma episodes or attacks in 2017, while 3,524 deaths were associated with the disease.[1,3,4] The economic costs of asthma were estimated at $81.9 billion in 2013[3], and was projected at $963.5 billion in 20 years.[2]

Although limited, some literature suggest that people who either smoke cigarettes and/or are obese have elevated risks of impaired or irritated airways that trigger asthma.[5–15] Hence, people including sexual identity subgroups who smoke and/or are obese may have an elevated likelihood of developing asthma.[16–19] Cigarette smoking increases the risk of developing more severe pulmonary symptoms for asthma attacks and asthma-related mortality.[11–13] Similarly, obesity increases inflammatory cytokines or substances which impair lung functioning and airway changes that lead to asthma.[14,15] Previous studies have documented that sexual and gender minorities (SGM) such as lesbian or gay and bisexual [LGB] have elevated risks of asthma, smoking, and obesity than heterosexual persons across all racial/ethnic groups.[16–22] There is a dearth of literature on difference-in-differences in asthma among LGB and heterosexual persons by the status of cigarette smoking and obesity. In this regard, Veldhuis et al.[16] indicated in their systematic review of literature that there is unclear information about differences in asthma-

related factors among sexual identity subgroups and suggested the need for further research to highlight the differences, hence, this study. Also, the existing studies on the association between asthma and the status of cigarette smoking and obesity did not use nationally representative data[6,23] or include sexual minority groups.[24] This study used a nationally representative sample of adults aged ≥18 years to: (1) assess the prevalence of asthma among sexual identity subgroups; (2) examine the association between asthma and sexual identity; and (3) evaluate differences in asthma between and within sexual identity groups by cigarette smoking and obesity status.

METHODS

Study design

This study utilized aggregated de-identified public-use data for 2017, 2018, and the 2019 National Survey on Drug Use and Health (NSDUH) to perform the analyses. The NSDUH is an annual cross-sectional survey in the U.S. supported by the Substance Abuse and Mental Health Service Administration (SAMHSA), and it uses a complex, multistage area probability sample of U.S. civilian, noninstitutionalized population in each of the 50 states and the District of Columbia. Details of the construction of the samples and survey questions and survey administration can be found in the Center for Behavioral Health Statistics and Quality[25] and SAMHSA.[26] The aggregated data for the three surveys for this study consist of 168,725 individuals aged 12 years or older. However, our analysis was restricted to 128,319 adults aged 18 years or older to assess asthma risk factors among adults. This study was limited to a secondary analysis of the NSDUH de-identified data and, therefore, did not require a review from the authors' Institutional Review Board.

Measures

The outcome variable is current asthma status and was assessed by asking participants to indicate whether they have ever been told by a doctor or other health care professional that they had asthma (yes/no). Those who reported that they have had asthma before were further asked whether they still have asthma (yes/no). Combining these two questions, the current asthma status was obtained and categorized as "0" (not currently having asthma) and "1" (currently having asthma).

This study examined two main exposure variables: 1) cigarette smoking status and 2) obesity status. Cigarette smoking status was ascertained by asking the participants whether they had ever smoked at least 100 cigarettes in their lifetime (yes/no). Participants were further asked if they smoke daily in the past month. Combining these two questions, the participants were categorized into three: daily smoker, former smoker, and never smoker.[27,28] While daily smokers were those who have ever smoked at least 100 cigarettes in their lifetime and now smoke daily in the past month, former smokers were those who have ever smoked at least 100 cigarettes in their lifetime but had quit smoking at the time of the interview. Never smokers were those who have smoked less than 100 cigarettes in their lifetime and had not smoked in the past month.

Obesity status was categorized based on the participants' body mass index (BMI). Based on the scale by the U.S. Centers for Disease Control and Prevention (CDC), the participants were categorized into four groups; normal weight (BMI is 18.5 to <25), underweight (BMI is less than 18.5), overweight (BMI is 25.0 to <30), and obese (BMI is 30.0 or higher).[17,29]

Based on existing literature[17,30,31], self-reported sociodemographic characteristics were adjusted for in the analyses. These sociodemographic variables include age (18–25, 26–34, 35–49, 50-64, 65≥), sex (male/female), sexual identity (heterosexual, lesbian or gay, and bisexual),

race/ethnicity (non-Hispanic White, non-Hispanic Black/African American, Hispanic, and Other race [non-Hispanic Native American/Alaskan Native, non-Hispanic Asian American, non-Hispanic Native Hawaiian/Other Pacific Islander, and non-Hispanic more than one race]), level of education completed (Twelfth grade or less grade, High School diploma/GED, some college credit but no degree, Associate's degree, and college graduate or higher), total family income (<$20,000; $20,000 to $49,999; $50,000–$74,999; and ≥ $75,000), and whether the respondent lived in a large metro, small metro, or non-metro/county metro. These variables were analyzed as categorical variables in this current study.

Statistical analyses

We performed descriptive analyses to describe the weighted percentages of the participants' sociodemographic characteristics, and the prevalence of current asthma, cigarette smoking, and obesity (see Table 1). We also conducted bivariate analyses to determine the association between current asthma and sociodemographic characteristics, cigarette smoking, and obesity using chi-square tests (see Table 1). The significant variables at the bivariate analysis level ($p<0.05$) were entered into the weighted multivariable logistic regression model (see Table 2). We further examined the interaction between cigarette smoking and sexual identity and found a significant result ($p=0.001$); in Figure 1, using marginal estimates/predicted values and marginsplot, we examined differences in current asthma between and within cigarette smoking and sexual identity. Additionally, we found a significant interaction ($p<0.001$) between obesity status and sexual identity, and we, therefore, used marginal estimates and marginsplot to determine the differences in current asthma between and within obesity status and sexual identity (see Figure 2). The marginal estimates/predicted values and marginsplot helped to determine the

interaction effects on asthma by providing between and within-group effects on asthma status.[32–34] Our statistical analyses were weighted using the NSDUH survey weight to achieve nationally representative estimates and interpretations. Weighting and clustering effects such as unequal probabilities of sampling, non-response, and post-stratification adjustments are achieved using the survey weight. We also used the NSDUH nesting variables to capture explicit stratification and to ascertain clustering with the data, as well as to obtain accurate variance estimates.[25] We used the NSDUH imputed variables when applicable to our study and based on the NSDUH statistical analytical recommendations for subpopulation analysis to establish accurate estimates and associations.[25] All statistical analyses were conducted at 2-tailed, an alpha level of 0.05, 95% confidence intervals (95% CIs), and adjusted odds ratios (AORs). The data were analyzed with STATA/SE, version 16.1.[35]

RESULTS

Descriptive and bivariate statistics

Table 1 shows that the majority of the population was within ages 35-49 (23.83%), females (58.76%), non-Hispanic Whites (65.14%), heterosexuals (91.42%), had college graduate or higher degrees (30.31%), $75,000 or more (40.03%), and resided in a large metropolitan area (56.28%). Important proportions of the population had current asthma (66.38%), were obese (39.20%), and were daily smokers (9.31). The majority of the population proportions who had current asthma were within ages 35-49 (24.11%) and 50-64 (24.05%), females (66.03%), non-Hispanic Whites (65.84%), heterosexual (90.62%), had college graduate or higher degree (28.62%), earned $75,000 or more (38.19%), and reside in a large metropolitan area (55%). Significant proportions of the population who had current asthma were obese (42.20%) and daily

cigarette smokers (10.15%). The bivariate analysis results show that age, sex, race/ethnicity, sexual identity, education, total family income, county metropolitan area, obesity status, and cigarette smoking status were associated with current asthma status.

Multivariable logistic regression analysis

As shown in Table 2, the weighted multivariable logistic regression analysis results showed that being obese was associated with higher odds (OR= 1.34, 95% CI= 1.15, 1.56) of having current asthma compared to normal weight. Being a daily smoker was associated with higher odds (OR= 1.17, 95% CI= 1.01, 1.37) of having current asthma. Individuals who were within ages 35-49 (OR= 1.51, 95% CI= 1.32, 1.73), 50-64 (OR= 1.82, 95% CI= 1.45, 2.28), and 65 or older (OR= 1.88, 95% CI= 1.53, 2.31) had higher odds of having current asthma compared to individuals aged 18-25 years. Compared to females, males had lower odds (OR= 0.42, 95% CI= 0.37, 0.47) of having current asthma. Non-Hispanic Black/African Americans had higher odds (OR= 1.19, 95% CI= 1.01, 1.41) while Hispanics had lower odds (OR= 0.80, 95% CI= 0.69, 0.93) of having current asthma compared to non-Hispanic Whites. Lesbians or gays (OR= 1.86, 95% CI= 1.29, 2.68) and bisexuals (OR= 1.33, 95% CI= 1.10, 1.62) had higher odds of having current asthma compared to heterosexuals. Individuals who had completed twelfth grade or less grade (OR= 1.86, 95% CI= 1.44, 2.39) and high school diploma/GED (OR= 1.30, 95% CI= 1.07, 1.57) versus college graduate or higher had higher odds of having current asthma. Those who had total family income of $20,000 - $49,999 (OR= 0.78, 95% CI= 0.66, 0.91), $50,000 - $74,999 (OR= 0.80, 95% CI= 0.65, 0.97), and $75,000 or more (OR= 0.80, 95% CI= 0.66, 0.96) had lower odds of having current asthma compared to those who had less than $20,000.

Between and within-group analysis

Figure 1 presents the differences in current asthma between and within cigarette smoking and sexual identity groups. Individuals who self-identified as lesbians/gays and were daily cigarette smokers (86%) had the highest probability of having current asthma compared to bisexual (78%) and heterosexual (68%) persons who were also daily cigarette smokers. Lesbian/gay persons who were former cigarette smokers (75%) had the highest probability of having current asthma compared to bisexual (72%) and heterosexual (65%) persons who were also former cigarette smokers. The probability of having current asthma was higher for lesbian/gay persons who were daily cigarette smokers (86%) than for lesbian/gay persons who were former smokers (75%) and non-smokers (77%). Bisexual persons who were daily smokers (78%) had a higher probability of having current asthma than bisexual persons who were former smokers (72%) and non-smokers (69%). The probability of having asthma was marginally higher for heterosexual persons who were daily cigarette smokers (68%) than for heterosexual persons who were former smokers (65%) and non-smokers (66%).

The differences in current asthma between and within obesity status and sexual identity are presented in Figure 2. Those who self-identified as bisexuals and were obese (73%) had marginally the highest probability of having current asthma compared to lesbian/gay (72%) and heterosexual (69%) persons who were also obese. Lesbian/gay persons who were overweight (81%) had the highest probability of having asthma compared to bisexual (72%) and heterosexual (65%) persons who were also overweight. Lesbian/gay persons who were underweight (79%) had the highest probability of having current asthma compared to heterosexual (57%) and bisexual (51%) persons who were also underweight. Within lesbian/gay

persons, those who were overweight (81%) had marginally the highest probability of having current asthma compared to those who were underweight (79%), normal weight (78%), and obese (72%). Bisexual persons who were obese (73%) had fairly the highest probability of having current asthma compared to bisexual persons who were overweight (72%), had normal weight (70%), and underweight (51%). For heterosexual persons, those who were obese (69%) had the highest probability of having current asthma compared to those who were overweight (65%), had normal weight (62%), and underweight (57%).

DISCUSSION

Although the association between cigarette smoking and asthma[6,8–10] and obesity and asthma[14,15] has been established, there is a paucity of studies on the extent of these associations in population subgroups, particularly in sexual and gender minority (SGM) groups. Furthermore, the results from these prior studies are mixed or unclear.[16] As such, the use of nationally representative data in this study will contribute to research to close such gaps in the literature. This current study assessed the prevalence of current asthma among sexual identity subgroups (i.e., lesbian/gay, bisexual, and heterosexual persons), cigarette smoking status (i.e., never smoker, former smoker, and daily smoker), and obesity categories (i.e., normal weight, underweight, overweight, and obese). The findings of this study revealed that about two-thirds of the study participants currently have asthma where approximately one in ten and two in five people with asthma were daily cigarette smokers and obese, respectively. These results suggest the continuous need for public health interventions and research on asthma, with a focus on behavioral/lifestyle modifications.

In the overall population, the results of the multiple variable analyses showed that being a daily smoker was significantly associated with higher odds of current asthma by 1.17 times. This supports previous studies that have strongly linked smoking to higher odds of asthma diagnosis,[6,17] reinforcing the evidence that cigarette smoking has severe public health implications. Similarly, being obese is significantly associated with higher odds for asthma by 1.34 times. Evidence of the link between obesity status and asthma diagnosis has also been documented by several studies among adults in the U.S.[17,36] Consequently, obesity has been shown to increase the severity of asthma, leading to poorer control of the disease and quality of life, possibly owing to chronic systemic inflammation.[37–40]

In the analyses involving SGM individuals, considerable differences have been found in current asthma risks concerning cigarette smoking status, obesity status, and sexual identity groups. There are elevated asthma odds among lesbian/gay and bisexual persons irrespective of their smoking status. However, the greatest current asthma likelihoods are found among lesbian/gay and bisexual daily smokers, which highlights the severe implications of daily smoking and sexual minority status for asthma diagnosis. Studies have shown that sexual minorities are significantly more likely to smoke and be diagnosed with asthma than heterosexuals.[31,41–43] Similarly, we found that lesbian/gay and bisexual persons are linked to increased asthma likelihoods across obesity status except for underweight status. In effect, overweight lesbian/gay persons show the greatest likelihoods for current asthma diagnosis relative to their normal weight, underweight, and obese persons. In this regard, previous research has also pointed to the evidence that sexual minority women are likely to be overweight[44] while same-sex relationship status is significantly linked to asthma diagnosis.[41] Myriads of studies have indicated that these notable health disparities can be attributable to limited access to

healthcare services among sexual minorities, possibly owing to poor quality of care, unfair treatment, and discrimination against these persons when receiving medical care,[45–48] which have severe implications for the promotion of health equity. In this respect, achieving the *Healthy People 2030* goal to eliminate health disparities in the U.S.[49] will require more research into smoking and obesity in population subgroups, including SGMs.

This study is not without a few limitations. This study is a cross-sectional study; therefore, we were unable to examine the biological or longitudinal mechanisms of the associations between sexual orientation and asthma. Also, we were unable to assess temporal sequence or causal relationships to determine the triggers to initiate the inflammatory process to cause secretion and bronchospasm. As such, we did not make causal inferences in this study; instead, we reported associations. This current study provides formative information for longitudinal and experimental studies to explore these mechanisms. The data were based on self-reported information such as current asthma status (yes/no), which may be prone to bias including recall and social desirability biases. This may result in underreporting, which could lead to the underestimation of results. However, the NSDUH questions used to assess the self-reported responses such as asthma status have been widely adopted and sensitive to apply.[25,26] Additionally, our study did not include other factors (e.g., neighborhood characteristics, family history of asthma) that may explain differences in asthma between and within subgroups (e.g., sexual identity groups). Nevertheless, this study makes an invaluable contribution to the literature by providing between and within-group analysis of asthma diagnosis among SGM and subgroups by their status of cigarette smoking and obesity in the U.S. Further, the study utilized a large nationally representative sample to enhance accurate statistical estimations and generalizability of our findings to the general U.S. population.

CONCLUSIONS

Asthma is a major cause of morbidity and mortality in the U.S., and this study confirms findings in the extant literature that cigarette smoking and obesity are important risk factors for asthma diagnosis across the general population. Additionally, this study suggests that there is evidence of considerable disparities by sexual identity group with SGM individuals being disproportionately burdened with asthma relative to heterosexual adults across cigarette smoking and obesity. As such, identifying between and within-group differences in asthma-related risk factors by this study can help to determine the number of public health resources needed for specific population subgroups. These findings also provide formative information for future longitudinal and experimental studies to explore the mechanisms of these asthma risks, especially among sexual and gender minorities.

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QUICK LOOK

Current knowledge

Asthma prevalence rates are associated with cigarette smoking and obesity in the general U.S. population. Cigarette smoking increases the risk of developing more severe pulmonary disease symptoms, including symptoms of asthma attacks and asthma-related mortality. Obesity increases inflammatory cytokines or substances which impair lung functioning and airway changes that lead to asthma. However, between and within-group differences in asthma prevalence among sexual and gender identity subgroups who smoke and are obese are sparse.

What this paper contributes to our knowledge

Although sexual minority individuals had higher odds of having asthma than heterosexual individuals, there were significant differences in odds between and within sexual identity subgroups. Cigarette smoking or obesity was associated with increased odds of having asthma, with daily smoking or being obese associated with a higher likelihood of having asthma between and within lesbian/gay, bisexual, and heterosexual individuals. Lesbian/gay and bisexual individuals had higher odds of asthma than heterosexual individuals.

Table 1: Current asthma status across participants' sociodemographic characteristics, cigarette smoking status, and obesity status: A weighted sample of U.S. adults (N= 26,641,428), NSDUSH 2017–2019

	Overall **N (%)**	No Current Asthma **n (%)**	Current Asthma **n (%)**	***p*-value**
	26,641,428 (100%)	8,957,326 (33.62)	17,684,102 (66.38)	
Age:				< .001
18-25	4,235,216 (18.02)	1,748,216 (22.27)	2,487,001 (15.89)	
26-34	4,349,601 (18.51)	1,723,613 (21.95)	2,625,987 (16.78)	
35-49	5,600,030 (23.83)	1,825,736 (23.25)	3,774,294 (24.11)	
50-64	5,197,496 (22.11)	1,433,256 (18.25)	3,764,240 (24.05)	
65 or Older	4,121,631 (17.54)	1,121,143 (14.28)	3,000,488 (19.17)	
Sex:				< .001
Male	10,987,928 (41.24)	4,980,278 (55.60)	6,007,651 (33.97)	
Female	15,653,500 (58.76)	3,977,048 (44.40)	11,676,452 (66.03)	
Race/Ethnicity:				< .001
Non-Hispanic White	17,354,453 (65.14)	5,711,709 (63.77)	11,642,744 (65.84)	
Non-Hispanic Black/African American	3,292,701 (12.36)	929,290 (10.38)	2,363,411 (13.37)	
Hispanic	3,933,760 (14.77)	1,512,218 (16.88)	2,421,542 (13.69)	
Other race	2,060,514 (7.73)	804,109 (8.98)	1,256,405 (7.10)	
Sexual identity				.003
Heterosexual	21,271,859 (91.42)	7,248,024 (93.01)	14,023,836 (90.62)	
Lesbian or Gay	654,965 (2.81)	165,766 (2.13)	489,199 (3.16)	

Bisexual	1,342,006 (5.77)	378,671 (4.86)	963,334 (6.22)	
Level of education completed:				< .001
Twelfth grade or less grade	5,274,629 (19.80)	1,610,044 (17.98)	3,664,585 (20.72)	
High School diploma/GED	4,975,607 (18.68)	1,516,670 (16.93)	3,458,937 (19.56)	
Some college credit but no degree	5,942,587 (22.31)	2,072,952 (23.14)	3,869,635 (21.88)	
Associate's degree	2,374,509 (8.91)	744,137 (8.31)	1,630,372 (9.22)	
College graduate or higher	8,074,096 (30.31)	3,013,523 (33.64)	5,060,573 (28.62)	
Total family income:				< .001
Less than $20,000	4,368,316 (16.40)	1,169,453 (13.06)	3,198,863 (18.09)	
$20,000 - $49,999	7,315,884 (27.46)	2,425,253 (27.08)	4,890,631 (27.66)	
$50,000 - $74,999	4,292,031 (16.11)	1,450,888 (16.20)	2,841,142 (16.07)	
$75,000 or More	10,665,197 (40.03)	3,911,732 (43.67)	6,753,465 (38.19)	
County metro/non-metro area:				.012
Large metro	14,994,621 (56.28)	5,267,921 (58.81)	9,726,699 (55.00)	
Small metro	7,985,334 (29.97)	2,561,519 (28.60)	5,423,814 (30.67)	
Non-metro	3,661,473 (13.74)	1,127,885 (12.59)	2,533,588 (14.33)	
Obesity status:				< .001
Normal	8,014,299 (30.08)	3,046,482 (34.01)	4,967,817 (28.09)	
Underweight	804,187 (3.02)	312,462 (3.49)	491,725 (2.78)	

Overweight	7,380,117 (27.70)	2,618,619 (29.23)	4,761,498 (26.93)	
Obese	10,442,825 (39.20)	2,979,764 (33.27)	7,463,062 (42.20)	
Cigarette smoking				.001
status:				
Non-smoker	17,648,011 (66.81)	6,110,817 (68.82)	11,537,194 (65.79)	
Former smoker	6,310,481 (23.89)	2,091,069 (23.55)	4,219,412 (24.06)	
Daily smoker	2,458,539 (9.31)	677,755 (7.63)	1,780,784 (10.15)	

Data Source: National Survey on Drug Use and Health (NSDUH) 2019, 2018, and 2017.

1. *Weighted N*= 26,641,428
2. *Statistical significance at p<0.05.*
3. *All p-values are based on chi-square tests for the categorical variables.*

Table 2. Adjusted odds ratios of current asthma status associated with sociodemographic characteristics, cigarette smoking status, and obesity status (Weighted N= 26,641,428)

	AOR	95% CI
Age:		
18-25	Ref	-
26-34	1.12	(0.98, 1.28)
35-49	1.51***	(1.32, 1.73)
50-64	1.82***	(1.45, 2.28)
65 or Older	1.88***	(1.53, 2.31)
Sex:		
Female	Ref	-
Male	0.42***	(0.37, 0.47)
Race/Ethnicity:		
Non-Hispanic White	Ref	-
Non-Hispanic Black/African American	1.19*	(1.01, 1.41)
Hispanic	0.80**	(0.69, 0.93)
Other race	0.89	(0.71, 1.11)
Sexual identity		
Heterosexual	Ref	-
Lesbian or Gay	1.86***	(1.29, 2.68)
Bisexual	1.33**	(1.10, 1.62)
Level of education completed:		
College graduate or higher	Ref	-

Twelfth grade or less grade	1.86***	(1.44, 2.39)
High School diploma/GED	1.30**	(1.07, 1.57)
Some college credit but no degree	1.11	(0.95, 1.30)
Associate's degree	1.21	(0.95, 1.54)
Total family income:		
Less than $20,000	Ref	-
$20,000 - $49,999	0.78**	(0.66, 0.91)
$50,000 - $74,999	0.80*	(0.65, 0.97)
$75,000 or More	0.80*	(0.66, 0.96)
County metro/non-metro area:		
Large metro	Ref	-
Small metro	1.07	(0.92, 1.25)
Non-metro	1.01	(0.86, 1.19)
Obesity status:		
Normal	Ref	-
Underweight	0.76	(0.53, 1.09)
Overweight	1.13	(0.96, 1.34)
Obese	1.34***	(1.15, 1.56)
Cigarette smoking status:		
Non-smoker	Ref	-
Former smoker	0.96	(0.85, 1.08)
Daily smoker	1.17*	(1.01, 1.37)

Note: Weighted N= 26,641,428. *AOR= Adjusted odds ratio. 95% CI= 95% confidence interval. Ref.= Reference group.* $^{*}p \leq 0.05$, $^{**}p \leq 0.01$, $^{***}p \leq 0.001$.

Figure 1: Differences in current asthma between and within cigarette smoking status and sexual identity

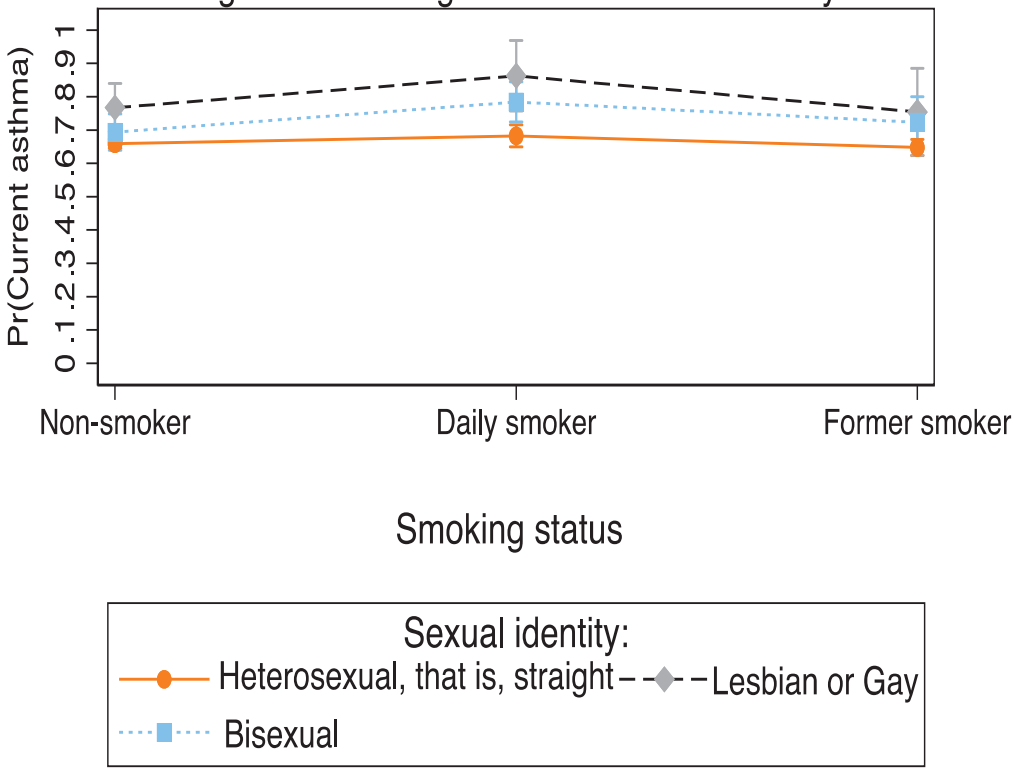

Figure 2: Differences in current asthma between and within obesity status and sexual identity