Sexual Orientation–Related Differences in Tobacco Use and Secondhand Smoke Exposure Among US Adults Aged 20 to 59 Years: 2003–2010 National Health and Nutrition Examination Surveys

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Objectives. We investigated sexual orientation–related differences in tobacco use and secondhand smoke (SHS) exposure in a nationally representative sample of US adults.

Methods. The 2003–2010 National Health and Nutrition Examination Surveys assessed 11 744 individuals aged 20 to 59 years for sexual orientation, tobacco use, and SHS exposure (cotinine levels ≥ 0.05 ng/mL in a nonsmoker). We used multivariate methods to compare tobacco use prevalence and SHS exposure among gay or lesbian (n = 180), bisexual (n = 273), homosexually experienced (n = 388), and exclusively heterosexual (n = 10 903) individuals, with adjustment for demographic confounding.

Results. Lesbian and bisexual women evidenced higher rates of tobacco use than heterosexual women. Among nonsmokers, SHS exposure was more prevalent among lesbian and homosexually experienced women than among heterosexual women. Nonsmoking lesbians reported greater workplace exposure and bisexual women greater household exposure than heterosexual women did. Identical comparisons among men were not significant except for lower workplace exposure among nonsmoking gay men than among heterosexual men.

Conclusions. Nonsmoking sexual-minority women are more likely to be exposed to SHS than nonsmoking heterosexual women. Public health efforts to reduce SHS exposure in this vulnerable population are needed. (*Am J Public Health.* 2013;103: 1837–1844. doi:10.2105/AJPH.2013.301423)

In 2006, the US Surgeon General[1] concluded that secondhand smoke (SHS) exposure causes premature death and disease in nonsmoking persons[2,3] and that there is no risk-free level of exposure.[4] Although public health efforts to lower the rates of cigarette smoking have been generally successful over the years, cigarette smoking nevertheless remains one of the leading causes of death.[5] Among nonsmokers, minority sexual orientation (i.e., lesbian, gay, bisexual, and homosexually experienced status) may be an unrecognized risk indicator for SHS exposure. Sexual minority individuals are more likely, as a group, to smoke tobacco than heterosexual men and women are.[6–20] Indeed, estimates indicate that smoking rates may be twice as high among persons with a minority sexual orientation than among heterosexual individuals.[21] Women with minority sexual orientation, in particular, consistently show elevation in risk compared with their same-gender heterosexual counterparts.[10,13,22,23] Overall, this greater prevalence of tobacco use among friends and relationship partners of sexual minorities may inadvertently lead to higher levels of SHS exposure among nonsmoking sexual minorities.

Although there is evidence that sexual minorities share similar levels of concern as heterosexuals do about the risk of SHS exposure,[21] whether SHS exposure is nonetheless greater in this subpopulation is currently unknown, though there is reasoned suspicion that this might be so.[24] We investigated possible sexual orientation–related differences in prevalence of primary tobacco use and SHS exposure by using information available from the 2003–2010 National Health and Nutrition Examination Surveys (NHANES). During these years, the NHANES assessed both respondents' sexual orientation status and markers of tobacco use and SHS exposure. Consistent with previous studies, we hypothesized that individuals with minority sexual orientation, especially women, will show elevated tobacco use compared with their same-gender heterosexual counterparts. However, we also anticipated that, among nonsmokers, evidence of secondhand exposure to tobacco would be positively associated with minority sexual orientation.

METHODS

The study drew upon publicly available data from 8 years of NHANES (2003–2010). The NHANES continuously selects a nationally representative sample of the US civilian, noninstitutionalized population by using a multistage, complex sampling design. Initially, respondents are interviewed in their homes. This is followed soon after by an extensive health assessment in special NHANES mobile examination centers (MECs). Here individuals receive detailed physical examinations, provide biological specimens, and are interviewed again with audio computer-assisted self-interview methods.[25]

Between 2003 and 2010, the NHANES directly assessed both sexual orientation identity and lifetime histories of the genders of respondents' sexual partners. In the years 2003 through 2006, all participants aged 14 to 59 years, who were interviewed in either English or Spanish, were eligible for this assessment, with a small exception. In 2003 to 2004, sexual orientation identity was measured in those aged 18 years or older. Since

2007, the upper age range has been extended for some sexual orientation measures to 69 years. Restrictions on publicly released data have varied by survey years, but consistently include complete information on individuals aged 20 to 59 years at the time of interview. For that reason, we restricted our current study sample to respondents within this age range.

Over the 8-year period of interest, 14 475 individuals aged 20 to 59 years participated in the NHANES survey. Of these, 12 308 were administered the sexual behavior assessment module during their MEC examination and nearly all (n = 12 262) gave codeable information for sexual orientation classification. Approximately 96% of these respondents also provided a blood sample necessary for the biological assessment of tobacco exposure. Biological specimen availability varied minimally by sexual orientation. Specifically, persons reporting any same-gender sexual partners but not a lesbian, gay, or bisexual identity were somewhat more likely to have available biological assessments (98.9%; 95% confidence interval [CI] = 98.2%, 99.7%) than heterosexual (96.3%; 95% CI = 95.9%, 96.8%) individuals but there were no other group differences by sexual orientation. The final sample size consisted of 11 744 respondents, all of whom provided codeable sexual orientation responses and had available biologic data.

Measures

Sexual orientation. The NHANES measured respondents' current sexual orientation identity and self-reported genders of sexual partners, both lifetime and in the 12 months before the interview. Following the suggestion of the National Center for Health Statistics,[26] we logically recoded all individuals who were administered the sexual behavior questionnaire but did not affirmatively acknowledge being sexually experienced (n = 752) as having a positive lifetime history of different-gender sexual partners if they reported a current marital status consistent with heterosexual sexual experience (i.e., married, widowed, divorced, separated; n = 397), or absent that, for women, a history of being pregnant, either by self-report or by a positive urine pregnancy test during their MEC examination (n = 10). Except for assessment of sexual orientation identity, these 752 individuals were skipped out of further sexual history questions during their MEC examination.

From the available information, we then classified participants into 1 of 4 categories: (1) affirmative lesbian or gay identity, regardless of sexual history (n = 180); (2) affirmative bisexual identity, regardless of sexual history (n = 273); (3) homosexually experienced (n = 388), including all who reported a positive history of same-gender sexual partners in the absence of a lesbian, gay, or bisexual identity (92%, in fact, explicitly identified as being heterosexual); or (4) exclusively heterosexual (n = 10 903), including those who reported a heterosexual identity (n = 10 656) or, in the absence of a declared sexual orientation identity, reported a positive lifetime history of exclusively different-gender sexual partners (n = 233) or a marital or pregnancy history consistent with heterosexuality (n = 14). A fuller description of the demography of sexual orientation in the NHANES is described elsewhere.[27,28]

Demographic and household characteristics. The NHANES measured a number of demographic characteristics known to be associated with both tobacco use[29] and sexual orientation.[30,31] These included gender, age, race/ethnicity, educational attainment, a ratio of family income to the federal poverty threshold, household composition, and current employment status. We coded age into 4 categories: 20 to 29 years, 30 to 39 years, 40 to 49 years, and 50 to 59 years. We grouped race/ethnicity into 4 classes: Hispanic, non-Hispanic White, non-Hispanic Black, and non-Hispanic other. We collapsed educational attainment into 2 categories (high-school education or less vs more), family income into 2 (below the federal poverty level vs federal poverty level or higher), household composition into 2 (lives alone vs lives in a multiperson household), and employment status into 2 groups (reports working or employed in the past week vs not).

Tobacco use. Self-reported tobacco use was measured twice in the NHANES. During the household interview, respondents were asked if they had smoked 100 or more cigarettes in their lifetime and whether they currently smoked cigarettes. Additional questions assessed whether any person in the household smoked tobacco products inside the abode. Later during the MEC examination, participants were asked if they had used any nicotine-containing products (including cigarettes, pipes, cigars, chewing tobacco, nicotine patches, or nicotine gum) in the previous 5 days. Twenty-three individuals reported sole use of nicotine patches or gum but not any tobacco product.

The NHANES used serum obtained from MEC blood draws to measure serum cotinine level in biological samples by using an isotope dilution–high performance liquid chromatography–atmospheric pressure chemical ionization tandem mass spectrometry method. Serum cotinine is the major metabolite of nicotine and is widely used as a biomarker of first- and secondhand tobacco smoke exposure.[32] Levels of serum cotinine greater than 10 nanograms per milliliter are consistent with active nicotine use.[29] To capture current tobacco-use status, we coded information from the 3 sets of variables as follows: (1) current smoker by self-report in the household interview (at least 100 lifetime cigarettes smoked and currently smokes), (2) use of any tobacco product excluding sole use of nicotine gum or patch in the 5 days before the MEC examination, and (3) serum cotinine levels greater than 10 nanograms per milliliter in an individual who did not report only nicotine gum or patch use. We then classified individuals as nonsmokers if they were negative for all 3 tobacco-use indices. Nonsmokers were treated as exposed to SHS if their serum cotinine level was at or above the detectable limit of 0.05 nanograms per milliliter.[29] We omitted the 23 persons who reported only use of nicotine gum or patch in the 5 days before the interview from analyses of nonsmoker's SHS exposure because of our inability to distinguish their source of elevated serum cotinine levels.

The NHANES also assessed self-reports of exposure to secondhand smoke in 2 domains: the household and the workplace. Using available information about household composition, we coded possible household exposure into 3 categories: (1) lives alone; (2) lives with others, no smoking in the home reported; (3) lives with others, smoking occurs in household. Workplace exposure was assessed in the NHANES by positive reports of smelling tobacco smoke from other persons' cigarettes, cigars, or pipes in the worksite. We used additional information from current employment status to code for 3 categories: (1) not currently working; (2) working, no

tobacco smoke reported; (3) working, tobacco smoke reported.

Data Analysis

We analyzed data with SUDAAN version 10 (Research Triangle Institute, Research Triangle Park, NC) by using both design information and weights as suggested by National Center for Health Statistics for the analysis of NHANES data.[25] Initially, we examined possible sexual orientation differences in demographic characteristics with a single multinomial logistic regression model entering all characteristics and survey year simultaneously. Next we investigated sexual orientation–related differences in tobacco use. To start, we first evaluated evidence for the presence of interactions between sexual orientation and each of the possible demographic confounders including gender, age, race/ethnicity, educational attainment, family income, and living and employment status.[29] After observing significant interactions between sexual orientation and gender across all smoking outcomes, but not with any other measured demographic confounder, we utilized a specified levels approach[33] for all subsequent analyses. This approach captures the effect modification by gender of sexual orientation effects via decomposing the 2 (gender) multiplied by 4 (sexual orientation) cells into a comprehensive set of interpretive contrasts (e.g., gay men vs heterosexual men). We then entered these contrasts simultaneously into our regression models, while also adjusting for possible confounding attributable to age, race/ethnicity, educational attainment, family income, work and living status, and survey year.

In a second set of analyses, we investigated sexual orientation differences in SHS exposure among nonsmokers via logistic or multinomial regression methods, as appropriate, while adjusting for confounding of the demographic factors and survey year. Finally, for some analyses of SHS exposure in the home or workplace, we restricted the sample to either nonsmokers living in multiperson households or employed persons, respectively, to focus on those individuals at risk for SHS exposure in those respective domains. In these analyses, we adjusted for possible confounding attributable to age, race/ethnicity, educational attainment, family income, and survey year. We report weighted prevalences and standard errors, Wald F test results evaluating overall tests of effects, and odds ratios and confidence intervals (CIs) adjusted for confounding. We based all significance tests on the criterion of $P<.05$; all CIs were estimated with 95% certainty.

RESULTS

Across 8 years of the NHANES, approximately 7.2% (95% CI = 6.5%, 8.0%) of the weighted sample reported a minority sexual orientation including self-identifying as lesbian or gay (1.8%; 95% CI = 1.4%, 2.2%), bisexual (2.2%; 95% CI = 1.8%, 2.6%), or homosexually experienced (3.3%; 95% CI = 2.8%, 3.9%; Table 1). Sexual orientation was associated with multiple demographic factors that might confound associations between sexual orientation and smoking status including gender ($F[3] = 25.22$; $P<.001$), age ($F[9] = 4.65$; $P<.001$), educational attainment ($F[3] = 9.08$; $P<.001$), current employment status ($F[3] = 4.68$; $P<.01$), family income ($F[3] = 3.47$; $P=.02$), and living in a multiperson household ($F[3] = 17.80$; $P<.001$).

Prevalence of Tobacco Use

Overall, more than a quarter of respondents reported that they were current cigarette smokers (26.6%; 95% CI = 25.1%, 28.2%),

TABLE 1—Demographic Characteristics of US Adults Aged 20 to 59 Years by Sexual Orientation: National Health and Nutrition Examination Survey, 2003–2010

Characteristics	Gay or Lesbian (n = 180), % (SE)	Bisexual (n = 273), % (SE)	Homosexually Experienced (n = 388), % (SE)	Exclusively Heterosexual (n = 10 903), % (SE)
Female gender**	36.2 (5.8)	71.8 (3.2)	69.4 (2.7)	49.0 (0.4)
Age,** y				
20–29	19.5 (3.0)	38.4 (4.0)	23.6 (2.4)	24.1 (0.6)
30–39	30.5 (4.0)	28.3 (3.8)	26.8 (2.6)	24.0 (0.6)
40–49	30.7 (5.0)	18.4 (2.8)	27.1 (3.0)	27.7 (0.6)
50–59	19.3 (4.9)	14.9 (2.4)	22.5 (3.0)	24.2 (0.7)
Race/ethnicity				
Hispanic	10.4 (2.1)	10.8 (1.9)	10.6 (1.4)	14.2 (1.2)
Non-Hispanic Black	9.3 (1.9)	15.2 (2.2)	11.3 (1.6)	11.1 (0.8)
Non-Hispanic White	73.4 (4.0)	70.5 (3.1)	72.0 (2.8)	69.1 (1.7)
Other	7.0 (2.4)	3.5 (1.2)	6.1 (1.4)	5.7 (0.4)
High-school education or less**	17.5 (3.2)	41.0 (4.1)	28.2 (3.0)	40.1 (1.0)
Family income below poverty level*	11.4 (2.2)	25.9 (3.2)	14.5 (1.6)	14.0 (0.6)
Lives in multiperson household**	71.2 (4.6)	82.5 (3.0)	84.7 (2.2)	90.8 (0.4)
Currently employed*	77.2 (4.4)	67.1 (4.1)	68.8 (3.0)	78.2 (0.7)

Note. Weighted percentages and standard errors shown. Sexual orientation–related differences in demographic characteristics were evaluated by a single multinomial logistic regression model in which all characteristics and survey cycle were entered simultaneously.
*$P < .05$; **$P < .001$.

with about a third (32.0%; 95% CI = 30.3%, 33.8%) reporting use of tobacco products in the 5 days before their MEC examination and 32.4% (95% CI = 30.6%, 34.2%) evidencing serum cotinine levels consistent with being a current tobacco user. As anticipated, sexual orientation was significantly associated with tobacco use status, but this was true only among women (Table 2). This included higher prevalences of self-reported current cigarette smoking ($F[3] = 20.30$; $P < .001$), recent tobacco use ($F[3] = 27.64$; $P < .001$), and high serum cotinine levels consistent with current tobacco use (i.e., serum cotinine > 10 ng/mL; $F[3] = 21.98$; $P < .001$). Individual contrasts between lesbian, bisexual, and homosexually experienced women, respectively, and exclusively heterosexual women, with adjustment for confounding, revealed that all 3 groups of sexual-minority women evidenced higher rates of tobacco use across all 3 measures. We classified about two thirds of respondents regardless of gender (65.8%; 95% CI = 64.0%, 67.4%) as nonsmokers on the basis of on self-reported tobacco use or serum cotinine levels at or below 10 nanograms per milliliter. Although sexual orientation appeared unrelated to nonsmoking status among men ($F[3] = 0.20$; $P = .89$), among women, sexual orientation was strongly associated with nonsmoker status ($F[3] = 25.25$; $P < .001$). Specifically, lesbians, bisexual women, and homosexually experienced women were all less likely to be nonsmokers than exclusively heterosexual women.

Prevalence and Patterns of Exposure to Secondhand Smoke

Approximately 37% (95% CI = 34.2%, 39.5%) of nonsmokers evidenced serum cotinine levels consistent with exposure to SHS (Table 3). Although we observed no significant sexual orientation–related differences in SHS exposure among nonsmoking men ($F[3] = 0.28$; $P = .84$), differences were observed among nonsmoking women ($F[3] = 7.42$; $P < .001$; Table 4). In particular, both lesbians and homosexually experienced women, compared with exclusively heterosexual women, were more likely to have elevated serum cotinine levels consistent with SHS exposure. Bisexual women also showed some elevation in risk compared with exclusively heterosexual women, but this did not achieve statistical significance.

Overall, about 16% (95% CI = 15.1%, 17.6%) of nonsmokers, irrespective of sexual orientation, reported SHS exposure in their home or a work environment. Household or workplace exposure was also associated with SHS exposure determined from elevated serum cotinine levels (Wald $\chi^2 = 75.01$; $P < .001$). Reports of secondhand smoke did not differ appreciably by sexual orientation among nonsmoking men ($F[3] = 1.18$; $P = .32$) but did among women ($F[3] = 3.20$; $P < .05$). Specifically, bisexual women were more likely than exclusively heterosexual women to report household or work-related SHS exposure.

Although patterns of household SHS, in particular, were associated with sexual orientation among nonsmoking men ($F[6] = 11.94$; $P < .001$) this effect appeared to reflect the fact that nonsmoking gay and bisexual men were more likely to live alone than were nonsmoking heterosexual men, greatly reducing for both gay and bisexual men as a whole the chances of household SHS exposure from living with smokers. After we restricted the sample to nonsmoking men living in multiperson households, we observed no overall sexual orientation–related difference in household SHS exposure among men ($F[3] = 0.74$; $P = .53$). In addition, group-specific comparisons of gay, bisexual, and homosexually experienced men to heterosexual men did not achieve statistical significance. Among women, there was also no overall sexual orientation–related effect among nonsmokers including those living alone or not ($F[3] = 1.84$; $P = .11$). However, when we restricted the female sample

TABLE 2—Tobacco Exposure Among US Adults Aged 20 to 59 Years by Gender and Sexual Orientation: National Health and Nutrition Examination Survey, 2003–2010

Smoking Status	Gay or Lesbian		Bisexual		Homosexually Experienced		Exclusively Heterosexual, % (SE)
	% (SE)	AOR (95% CI)[a]	% (SE)	AOR (95% CI)[a]	% (SE)	AOR (95% CI)[a]	
Men							
Current cigarette smoker	28.9 (5.3)	1.25 (0.69, 2.27)	36.6 (7.0)	1.30 (0.68, 2.46)	28.9 (4.9)	1.07 (0.64, 1.80)	29.6 (1.0)
Tobacco used in previous 5 d	28.5 (5.6)	0.76 (0.41, 1.43)	42.4 (7.0)	1.09 (0.69, 1.58)	37.2 (4.8)	1.04 (0.69, 1.58)	39.0 (1.2)
Serum cotinine level > 10 ng/mL	27.9 (5.9)	0.78 (0.40, 1.51)	47.5 (7.4)	1.37 (0.74, 2.54)	33.8 (5.2)	0.89 (0.55, 1.43)	39.2 (1.2)
Nonsmoker[b]	67.6 (5.3)	1.18 (0.66, 2.12)	54.4 (7.0)	0.90 (0.49, 1.65)	62.1 (4.9)	1.03 (0.69, 1.56)	58.6 (1.1)
Women							
Current cigarette smoker	35.8 (5.9)	2.04 (1.20, 3.48)	44.5 (3.8)	2.43 (1.69, 3.49)	41.4 (4.0)	2.77 (1.95, 3.94)	21.8 (0.9)
Tobacco used in previous 5 d	39.1 (6.1)	2.16 (1.25, 3.74)	47.8 (3.7)	2.54 (1.75, 3.67)	47.9 (3.8)	3.35 (2.35, 4.76)	23.1 (1.0)
Serum cotinine level > 10 ng/mL	42.1 (5.6)	2.41 (1.41, 4.11)	46.5 (3.5)	2.31 (1.62, 3.29)	46.8 (3.7)	3.12 (2.17, 4.47)	23.9 (1.0)
Nonsmoker[b]	56.6 (5.6)	0.43 (0.25, 0.73)	50.8 (3.8)	0.42 (0.29, 0.62)	50.9 (4.0)	0.32 (0.22, 0.45)	72.8 (0.8)

Note. AOR = adjusted odds ratio; CI = confidence interval. Point prevalence and partial results of logistic regression analyses are shown (weighted percentages and standard errors). Sample size for men: 109 gay, 85 bisexual, 125 homosexually experienced, 5390 exclusively heterosexual; for women: 71 gay or lesbian, 188 bisexual, 263 homosexually experienced, 5513 exclusively heterosexual. Differences evaluated by specified levels multivariate logistic regression models adjusting for possible confounding attributable to age, race/ethnicity, education, family income, living and work status, and survey year.

[a]Referent is exclusive heterosexual.

[b]Nonsmoker defined as not reporting current cigarette smoking or recent use of tobacco products and evidencing a serum cotinine level ≤ 10 ng/mL.

TABLE 3—Prevalence of Secondhand Smoke Exposure Among Nonsmoking US Adults Aged 20 to 59 Years by Gender and Sexual Orientation: National Health and Nutrition Examination Survey, 2003–2010

Exposures	Gay or Lesbian, % (SE)	Bisexual, % (SE)	Homosexually Experienced, % (SE)	Exclusively Heterosexual, % (SE)
Men				
Serum cotinine level ≥ 0.05 ng/mL	34.6 (10.1)	46.2 (9.2)	30.5 (7.1)	40.7 (1.4)
Household tobacco exposure				
Lives alone	37.2 (6.4)	31.9 (7.6)	12.5 (4.4)	8.8 (0.7)
Lives with others: no household smoking	59.6 (6.6)	60.7 (8.3)	85.8 (4.2)	85.7 (0.9)
Lives with others: smoking in household	3.2 (2.6)	7.4 (5.2)	1.7 (1.3)	5.5 (0.5)
Workplace tobacco exposure				
Not employed	17.9 (5.4)	18.4 (6.3)	17.3 (5.5)	11.3 (0.6)
Employed: no tobacco smoke reported in workplace	79.5 (5.3)	65.1 (7.7)	66.8 (7.2)	72.5 (1.0)
Employed: tobacco smoke reported in workplace	2.6 (2.2)	16.5 (6.2)	15.9 (4.4)	16.2 (0.8)
Exposed either in household or at work or both	5.8 (3.5)	23.9 (7.4)	16.6 (4.5)	20.8 (0.9)
Women				
Serum cotinine level ≥ 0.05 ng/mL	56.2 (8.8)	45.1 (7.4)	47.7 (5.9)	33.0 (1.5)
Household tobacco exposure				
Lives alone	11.4 (5.5)	14.3 (5.1)	12.1 (3.7)	8.7 (0.7)
Lives with others: no household smoking	85.6 (5.8)	68.4 (7.7)	82.0 (4.2)	85.9 (0.9)
Lives with others: smoking in household	2.9 (2.1)	17.3 (5.9)	5.9 (2.1)	5.4 (0.6)
Workplace tobacco exposure				
Not employed	24.8 (9.2)	29.0 (7.0)	31.1 (4.8)	25.6 (1.0)
Employed: no tobacco smoke reported in workplace	54.1 (9.8)	64.0 (6.5)	62.4 (5.0)	66.4 (1.1)
Employed: tobacco smoke reported in workplace	21.1 (7.1)	6.9 (3.0)	6.5 (2.4)	7.9 (0.6)
Exposed either in household or at work or both	24.0 (7.2)	23.3 (5.7)	11.0 (2.9)	12.8 (0.8)

Note. Nonsmoker is defined as not reporting current cigarette smoking or recent use of tobacco products and evidencing a serum cotinine level ≤ 10 ng/mL. Individuals reporting nicotine patch or gum use in the absence of tobacco use were excluded. Weighted percentages sum to 100 except for rounding error. The sample sizes for men were: 70 gay, 43 bisexual, 73 homosexually experienced, 3077 exclusively heterosexual; for women: 38 gay or lesbian, 83 bisexual, 135 homosexually experienced, 4155 exclusively heterosexual.

to women living with others, sexual orientation–related differences were present ($F[3] = 3.53$; $P < .05$). Specific group comparisons revealed that bisexual women, compared with exclusively heterosexual women, were more likely to report smoking by others in the household.

Reports of workplace exposure to tobacco smoke did not vary by sexual orientation among nonsmoking men overall ($F[2] = 1.39$; $P = .24$) or when the sample was restricted to employed men only ($F[3] = 1.64$; $P = .19$). However, specific group contrasts indicated that among employed men, gay men, but not bisexual or homosexually experienced men, were less likely than exclusively heterosexual men to report smelling tobacco smoke in their workplaces. Among nonsmoking women, sexual orientation was also not strongly associated overall with reports of workplace SHS ($F[6] = 2.05$; $P = .08$) or when the sample was restricted to employed women only ($F[3] = 2.25$; $P = .09$). But in specific group comparisons, lesbians were more likely than exclusively heterosexual women to report workplace exposure. We did not observe such workplace-related differences in the specific comparisons between bisexual or homosexually experienced women and exclusively heterosexual women.

DISCUSSION

Elevated risk for harmful tobacco use exposure among lesbian, gay, and bisexual individuals, especially among women, has been well documented.[6–15,21,22,34] We, too, observed in the 2003–2010 NHANES sample much higher rates of current tobacco use, assessed both by self-reports and high levels of serum cotinine, and lower rates of nonsmoker status among sexual minority women in contrast with exclusively heterosexual women.

This greater risk for tobacco use was accompanied by a greater risk for SHS exposure in the current study among nonsmoking sexual minority women compared to exclusively heterosexual women, after we adjusted for demographic confounding. Although the source of this exposure cannot be precisely determined, our findings hint that it may partially result from both workplace exposure for lesbians and household exposure for bisexual women. To date, there has been a dearth of focus on tobacco control among sexual minorities.[35] However, the work that does exist has generally targeted individuals who are themselves smokers[36] or social environments, such as gay bars, where many younger adults in the visible lesbian, gay, and bisexual community congregate.[37] Our findings suggest strongly that tobacco control efforts in this vulnerable population need to be broadened to encompass other sources of SHS exposure that may be differentially linked to sexual orientation. For example, sexual orientation differences in occupational interests[38] may

TABLE 4—Results of Analyses Investigating Sexual Orientation–Related Differences in Secondhand Smoke Exposure Among Nonsmoking US Adults Aged 20 to 59 Years by Gender: National Health and Nutrition Examination Survey, 2003–2010

Exposures	Gay or Lesbian, No. or AOR (95% CI)	Bisexual, No. or AOR (95% CI)	Homosexually Experienced, No. or AOR (95% CI)	Exclusively Heterosexual, AOR
Men				
Nonsmokers				
Sample size	70	43	73	3077
Serum cotinine level ≥ 0.05 ng/mL	0.89 (0.35, 2.28)	1.29 (0.56, 2.98)	0.76 (0.36, 1.63)	1.00 (Ref)
Reports household or work SHS exposure or both	0.30 (0.08, 1.08)	1.46 (0.56, 3.81)	1.00 (0.50, 1.98)	1.00 (Ref)
Nonsmokers living with others				
Sample size	45	27	64	2817
Reports household tobacco exposure	1.14 (0.19, 6.78)	1.75 (0.29, 10.42)	0.37 (0.08, 1.69)	1.00 (Ref)
Employed nonsmokers (n = 58, 32, 60, and 2637, respectively): reports workplace tobacco exposure	0.16 (0.03, 0.91)	1.23 (0.45, 3.32)	1.30 (0.62, 2.69)	1.00 (Ref)
Women				
Nonsmokers (n = 38, 83, 135, and 4155, respectively)				
Serum cotinine level ≥ 0.05 ng/mL	2.57 (1.23, 5.39)	1.64 (0.93, 2.90)	2.04 (1.27, 3.26)	1.00 (Ref)
Reports household or work SHS exposure or both	2.04 (0.93, 4.45)	2.11 (1.12, 3.97)	0.90 (0.50, 1.62)	1.00 (Ref)
Among nonsmokers living with others (n = 33, 74, 121, and 3867, respectively): reports household tobacco exposure	0.47 (0.11, 2.06)	3.96 (1.67, 9.39)	1.24 (0.57, 2.72)	1.00 (Ref)
Among employed nonsmokers (n = 27, 56, 93, and 2857, respectively): reports workplace tobacco exposure	2.96 (1.22, 7.21)	0.86 (0.35, 2.12)	0.85 (0.38, 1.94)	1.00 (Ref)

Note. AOR = adjusted odds ratio; CI = confidence interval; SHS = secondhand smoke. Nonsmoker is defined as not reporting current cigarette smoking or recent use of tobacco products and evidencing a serum cotinine level ≤ 10 ng/mL. Individuals reporting nicotine gum or patch use in the absence of tobacco use are excluded. Unweighted sample sizes, adjusted logistic odds ratios, and 95% confidence intervals are shown. Sexual orientation–related differences evaluated by multivariate logistic regression adjusting for possible demographic confounding and survey year.

result in differential patterns of workplace SHS exposures among individuals who vary their sexual orientation.

Limitations

Whereas we did not detect significant sexual orientation–related differences in rates of firsthand smoking among men, in contrast to multiple findings that have been reported from regional[7,14,15,21,34] but not national surveys,[10] we note that constraints in the NHANES data set did not allow adjustment for possible confounding associated with geographic location. This is especially important in this instance; cigarette smoking is far less common in regions of the country[39] that are also associated with higher density of same-sex couples.[40] Furthermore, the sexual orientation–related difference in tobacco use is generally greater among women than among men, making it perhaps easier to detect a difference in the current study despite uncontrolled regional confounding and restricted statistical power. Thus, it may be that we have underestimated sexual orientation differences among men.

In a similar way, we also failed to detect greater SHS exposure among nonsmoking sexual minority men compared with exclusively heterosexual men. Although this may reflect the effects of residual confounding or inhibited statistical power as well, sexual orientation differences in household composition and workplace exposure are likely to have contributed to the absence of detecting a differential rate of SHS exposure. In particular, among nonsmokers, gay and bisexual men were significantly more likely than heterosexual men to live alone, reducing their likelihood of being exposed to tobacco use by other persons in their place of residence. Furthermore, gay men were also significantly less likely than heterosexual men to report that they worked in settings where they could smell tobacco smoke. Again, this may reflect differential occupational patterns that are linked to both sexual orientation and the risk of SHS exposure.

Three additional study limitations warrant consideration in interpreting the findings reported here. First, we measured SHS exposure by serum cotinine levels, but the source of exposure (e.g., coworkers, friends, or romantic partners) is indeterminable. Second, although we combined multiple years of the NHANES samples to obtain a fairly large sample of sexual minorities, for some subanalyses (e.g., comparisons of employed nonsmokers or nonsmokers living with others) the sample sizes were relatively small. This issue both reduced our power to detect sexual orientation–related differences and may have generated relatively unstable estimates. Thus, we may have under- or overestimated sexual orientation–related differences. Further research is needed to evaluate the robustness of some of these findings. In addition, the age restriction on the sample (20 to 59 years) coincides with the highest smoking rates in the US population, a factor that somewhat elevated study prevalences above that observed for US adults in general during this time period.[39] Whether older sexual minorities evidence a decrease in smoking rates similar to their heterosexual counterparts is unknown. Third, although it is well

known that the presence of children in the household tends to inhibit indoor household smoking,[41,42] the public NHANES data set does not permit analyses that distinguish between persons in the household who are children or adults. It likely that household compositions vary by sexual orientation[31] and future research is needed to identify how these differences moderate household-based SHS exposure.

Conclusions

Despite these concerns, findings from the present study provide critical and much-needed information about the burden of SHS exposure among sexual-minority individuals. Whereas SHS exposure is a major public health problem among adults in general[1,3] results reported here suggest that the harmful health effects of SHS exposure may be even more common among sexual minority women than among heterosexual women. This is important especially among lesbian or bisexual women, who may possibly experience higher rates of breast cancer than heterosexual women do.[43,44] Previous research has indicated that SHS exposure is a suggestive causal factor of breast cancer among premenopausal, but not postmenopausal, women.[1]

Our results also have other important public health implications. Only 27 states in the United States have banned smoking in all public places (such as bars, nightclubs, and restaurants), despite evidence that comprehensive public smoking bans lead to reduced incidence of cardiovascular and respiratory conditions.[45] Efforts to ban smoking in public places where sexual minorities are present, including all sexual minority bars and nightclubs, should be undertaken, as well as increased efforts to develop interventions targeted directly at sexual-minority female smokers. Furthermore, these interventions can be designed to prevent SHS exposure in the homes and workplaces of sexual minorities. The effects of policies to reduce or ban smoking in public places and in the home may help prevent or reduce the progression of illness in at-risk individuals and alleviate the burden of illness attributable to tobacco use in this population, especially among sexual-minority women. ■

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Contributors

S. D. Cochran conceptualized the study, conducted analyses, and wrote an initial draft of the article. F. C. Bandiera drafted additional sections to the article. All authors conceptualized the ideas for the current article, interpreted the findings, and edited drafts of the article.

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