Differences in Smoking Prevalence and Eligibility for Low-Dose Computed Tomography (LDCT) Lung Cancer Screening among Older U.S. Adults: Role of Sexual Orientation

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Abstract

The purpose of this study was to determine the past-year prevalence estimates of cigarette smoking and eligibility for low-dose computed tomography (LDCT) lung cancer screening among older U.S. adults and examine potential variations in these estimates by sexual orientation. Data were from the 2012–2013 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC-III) and included in-person interviews with a nationally representative sample of non-institutionalized adults aged 18 and older. Eligibility for LDCT was based on U.S. Centers for Medicare and Medicaid Services (CMS) guidelines. Analyses included participants aged 55 to 77 (N = 9635). Overall, 17.5% of older adult respondents reported past year smoking. Overall rates of past-year cigarette smoking were influenced by sex and sexual orientation with males reporting higher rates compared to females. Among both males and females, smoking was most prevalent among bisexual individuals. Eligibility for LDCT was also higher among males compared to females and among bisexually-identified adults relative to homosexual and heterosexual-identified adults. Overall, 11.2% of older U.S. adults met eligibility for LDCT lung cancer screening. Eligibility for LDCT lung screening is associated with sexual orientation ; the highest rates of eligibility are among bisexual women and men (26.9% and 24.5%, respectively). The current study found variations in cigarette smoking and eligibility for LDCT lung cancer screening (a proxy for chronic high-risk smoking) among older U.S. adults based on sexual orientation. Efforts to increase screening should take into account these differences.

Keywords

LDCT lung cancer screening; cigarette smoking; sexual orientation; cancer disparities; cancer screening

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Introduction

Lung cancer is the second most common cancer and the leading cause of cancer death among U.S. adults.[1] Cigarette smoking is the leading preventable cause of lung cancer, contributing to 87% of all lung cancer deaths.[2] The overall five-year survival rate for lung cancer is poor at 17.4% but substantially improves with early detection.[3] The National Lung Screening Trial (NLST), the first, large-scale, randomly controlled trial of lung cancer early-detection screening in the U.S., demonstrated that low-dose computed tomography (LDCT) lung cancer screening in older smokers reduced lung cancer-specific mortality by 15–20% due to the detection of treatable lesions.[4] Based on trial results, the U.S. Preventive Services Task Force (USPSTF) gave a B recommendation for LDCT screening.[5] This is the same strength of recommendation associated with mammography screening. The USPSTF recommends annual screening for lung cancer with LDCT in adults aged 55 to 80 years who have a 30 pack-year smoking history and currently smoke or have quit within the past 15 years.[6] Currently, most private insurers and Medicare provide coverage for annual LDCT screening among eligible individuals.

Chronic, high frequency smoking remains the primary risk factor for lung cancer.[3] Smoking prevalence among adults in the U.S. is at a 50-year low, with approximately 15.1% of adults currently smoking.[2] Yet, disparities in smoking continue to exist (e.g., by socioeconomic status, mental health status, gender, and race/ethnicity)[7], show few signs of improving[8], and are not addressed by many tobacco control interventions.[9] There is strong evidence of approximately 50% higher smoking prevalence for lesbian, gay, and bisexual (LGB) adults than their heterosexual counterparts.[7] While data are limited, at least one study has also documented smoking disparities among LGB older adults residing in Washington state.[10] This higher prevalence of smoking exposes LGB populations to elevated risk for lung cancer. Yet, with the exception of research among HIV-positive individuals,[11] research on lung cancer risk among LGB individuals is scant.[12]

Objectives

To date, there have been no studies of the prevalence of LDCT lung cancer screening eligibility among older LGB adults. With the observed differences in smoking based on sexual orientation, it is important to determine whether sexual orientation is associated with increased lung cancer risk in order to increase outreach and lung cancer screening within those groups. As such, this study aimed to examine rates of smoking and eligibility for LDCT lung cancer screening based on sexual orientation in a nationally representative sample of adults aged 55–77. We hypothesize that LGB older adults will have higher smoking rates and have an increased likelihood of meeting eligibility for LDCT lung cancer screening compared to heterosexual older adults.

Methods

Sample

We analyzed 2012–2013 data from the publically available National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III), which collected data on nicotine and

tobacco use among the general U.S. civilian noninstitutionalized population of individuals 18 years of age and older. In the NESEARC-III study, in-person interviews were conducted, and the household, person, and overall response rates were 72%, 84%, and 60%, respectively. The NESARC-III sample design and weighting procedures have been described in more detail elsewhere.[13] (see Table 1 for descriptive estimates for the analytic sample). All procedures received institutional review board approval and all relevant ethical safeguards have been met by the NESARC and our research teams in relation to human subject protection.

Measures

Background characteristics included age (55–77 years old), sex (male, female), race/ethnicity (i.e., White, Black, Hispanic, and Other Race), education (i.e., High school degree or less, some college, and college degree or higher), personal income (i.e., $0 to $100,000 or more, seventeen income categories), employment status (i.e., employed full time versus not employed full time), relationship status (i.e., married versus not married), health insurance status (i.e., insured versus uninsured during the past 12 months), metropolitan statistical area (urban and rural), and geographical region (Northeast, South, North Central and West).

Sexual orientation was assessed by asking "Which of the categories on the card best describes you? (1) heterosexual (straight), (2) gay or lesbian, (3) bisexual, or (4) not sure?"

Cigarette smoking was assessed by asking respondents whether they had smoked at least 100 cigarettes in their lifetime. Among lifetime smokers, respondents were asked about cigarette smoking in the past 12 months. Separate questions also assessed age of onset of cigarette smoking, most recent time smoked, daily cigarette smoking, frequency of cigarette smoking quantity of cigarette smoking, and quit attempts and behaviors.

Eligibility for LDCT lung cancer screening was based on the Centers for Medicare and Medicaid Services (CMS) guidelines[14]: 1) aged 55 to 77 years, 2) are current smokers or former smokers who have quit smoking within the past 15 years, (3) have tobacco smoking history of at least 30 pack-years (e.g., one pack-year = smoking one pack per day for one year; 1 pack = 20 cigarettes); and (4) have no diagnosis or symptoms of lung cancer.

Data analysis

Prevalence rates and adjusted odds ratios (AOR) were estimated for both past year cigarette use and eligibility for LDCT lung cancer screening. Separate analyses were conducted for respondents who self-identified as heterosexual, gay/lesbian, bisexual, or 'not sure'. Analyses were alsostratified by sex. Consistent with CMS lung cancer screening guidelines, analyses were restricted to adults ages 55 to 77. Heterosexual was used as the reference group in logistic regression analyses.[15] We used STATA 14.0 to estimate prevalence rates, AORs, and 95% confidence intervals (Version 14.0; Stata Corp LP, College Station, Texas). We controlled for race, educational level, personal income, employment status, relationship status, health insurance status, geographic location, and metropolitan statistical area. We did not convert AORs to prevalence ratios for comparability to past literature on smoking and given the limitations in the estimation of prevalence ratio confidence intervals.[16] Additionally, the NESARC-III design included stratification and clustering of the target

population. All analytic techniques in the current study were design-based, using sampling weights to calculate estimates of population parameters and specialized variance estimation techniques to accommodate the complex design features of the sample when estimating standard errors. Pairwise deletion was used for respondents with missing data (at most, 118 respondents [1.2%] were dropped due to missing data among the analyses presented).

RESULTS

Study Participants

The NESARC-III includes 36,309 respondents ages 18 and older. An estimated 26.5% of the sample was between the ages of 55 and 77 (n = 9635). Among male respondents aged 55 and 77, 97.4% identified as heterosexual (n = 4040), 1.5% identified as gay (n = 67), 0.6% identified as bisexual (n = 33), and 0.5% identified as 'unsure' (n = 25); among female respondents aged 55 and 77, 98.4% identified as heterosexual (n = 5283), 0.8% identified as lesbian (n = 43), 0.4% identified as bisexual (n = 29), and 0.4% identified as 'unsure' (n = 24) .

Cigarette Smoking by Sexual Orientation

Overall, 17.5% of older adult respondents between the ages of 55 and 77 reported past year smoking; 33.0% indicated being former smokers and 20.9% indicated being current smokers. As shown in Table 2, sexual orientation was associated with smoking with both bisexual males (51.0%) and bisexual females (38.9%) having the highest prevalence of past-year cigarette smoking when compared to their sexual minority (i.e., gay/lesbian/not sure) and heterosexual peers. This pattern was the same after adjustment for covariates (it should be noted that no statistically significant differences were found between bisexuals and respondents 'not sure' of their sexual identity). However, analyses that aggregate bisexual identification with lesbian or gay identification (as is often done in research) attenuates these differences substantially (data not shown).

LDCT Lung Cancer Screening Eligibility by Sexual Orientation

We found that 11.2% of older adult smokers met eligibility for LDCT lung cancer screening based on age and pack year history (Table 3). The highest rates of eligibility for LDCT lung cancer screening was among bisexual women and men (26.9% and 24.5%, respectively). These differences in eligibility for LDCT lung screening between bisexual females and their female heterosexual peers were significantly different both before (OR = 4.51, 95% CI = 1.66, 12.1) and after (AOR = 4.86, 95% CI = 1.26, 18.6) controlling for sociodemographic factors using multiple logistic regression. No other differences were found between heterosexual women and women who identified as lesbian or 'not sure/unknown'. Differences in eligibility for LDCT lung screening for bisexual males were statistically significant between gay males and males who were not sure of their sexual identity (this was only found in the model adjusting for sociodemographic factors), however, differences between bisexual and heterosexual males did not reach statistical significance. Results examining differences in the eligibility for LDCT screening between heterosexual and sexual minority males as a homogenous group (i.e., aggregating bisexual, gay, and not sure identifications) find no statistically significant differences while sexual minority females had

higher odds of eligibility for LDCT lung screening (AOR = 2.31, 95% CI = 1.17–4.55, p < 0.05) than heterosexual females (data not shown).

DISCUSSION

This study represents one of the first attempts to evaluate differences in lung cancer risk among older U.S. adults based on sexual orientation. Nearly one-fourth of older adults reported past year smoking. Consistent with the extant literature among adult smokers,[7] sexual orientation was associated with smoking behaviors in this sample of *older adults* with the highest prevalence of past year smoking reported by bisexual females and males. These results are in line with prior research using NESARC-III data that reported differences in smoking behaviors based on sexual orientation among adults aged 18 and older.[17] In terms of chronic smoking, overall, 11.2% of older U.S. adults met eligibility for LDCT lung cancer screening. Sexual orientation was a significant predictor of screening eligibility for females with the highest rates of eligibility among bisexual females and males. These differences are not insubstantial: Approximately one in every four bisexual women and men met eligibility criteria for LDCT lung cancer screening as compared to less than one in every ten of their lesbian and gay counterparts.

Implications of Study Findings

Our findings have implications for future research, intervention development and clinical practice. LDCT lung cancer screening detects tumors at earlier more treatable stages.[4] However, public awareness remains low and strategies for increasing awareness of eligibility and participation in screening are limited.[18] Sexual orientation appears to influence screening eligibility, especially among bisexually identified men and women. However, future studies are needed to replicate our findings in larger samples. As has been documented in the literature, our study reaffirms the importance of examining bisexual men and women separately from gay men and lesbian women. Gender identity was not measured in the NESARC-III study which prohibited investigation of LDCT eligibility based on gender identity. Given disparities in smoking for transgender adults,[19] additional research is clearly warranted among transgender individuals. Finally, studies are needed that identify correlates of chronic smoking and examines smoking-related health outcomes.

Early detection lung cancer screening may serve as a teachable moment for smoking cessation and/or continued abstinence in this high risk group. Efforts to address smoking disparities among sexual minorities are limited,[20] which further underscores the need to engage LGB smokers in evidence-based smoking cessation interventions and explore strategies to engage sexual minorities in lung cancer screening. Health care interventions that do not attend to disparities (e.g., with targeted outreach) can exacerbate disparities.[9] As such, it is critical to assess if the effectiveness of population-level interventions (e.g., promotion of LDCT screening) and healthcare interventions are moderated by sexual orientation.[20] Such moderation might happen due to differences in resources between population groups, for example job selection and discrimination,[21] and would indicate the necessity of targeted intervention approaches.

Health care providers working with LGB smokers should be educated about LDCT lung cancer screening guidelines and encouraged to recommend screening to their eligible patients. Consistent with best practices identified by CMS LDCT lung cancer screening should be paired with advice to quit and assistance in obtaining smoking cessation resources.[14] The literature suggest that lung cancer screening may serve as a "teachable moment" for promoting smoking cessation.[22] Specifically, LDCT lung screening research studies have reported smoking cessation rates of 11% to 24% in the first 2 years of screening versus a 5% to 7% annual rate among all smokers in the general population.[23]

Strengths and Limitations

This study addressed many of the limitations of prior research on smoking among older LGB individuals - regional or non-representative samples, aggregation of sexual minority subgroups, and a lack of heterosexual comparison groups. However, study limitations should be noted. First, data were cross-sectional and causality cannot be determined. As in most large-scale surveys, information was based on self-report and not confirmed by objective methods. Current smoking status was based on past year smoking and may have introduced bias into prevalence estimates. Cell sizes were too small to examine LDCT eligibility based on comparisons of former versus current smokers. The dataset did not include a measure of gender identity other than male or female and results may not generalize to transgender or non-binary older adults. Further research is warranted to replicate study results with larger samples.

Conclusions

Our results suggest that risk for lung cancer may be higher among sexual minority smokers due to elevated rates of past year and chronic smoking, particularly among bisexual men and women. As such, interventions aimed at increasing participation in LDCT screening and smoking cessation treatments are needed to reduce smoking-related health disparities among this population of older adults.

Acknowledgments

Abbreviations

LDCT	low-dose computed tomography
NESARC	National Epidemiologic Survey on Alcohol and Related Conditions

CMS	Centers for Medicare and Medicaid Services
NLST	National Lung Screening Trial
USPSFT	United States Preventive Services Task Force
LGB	lesbian, gay, and bisexual Eligibility for LDCT Lung Cancer Screening 3

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Table 1

Demographics, US adults aged 55–77, 2012–2013 (Source: NESARC-III)

Sexual Identity	Total (n = 9635) % (n)	Females (n = 5428) % (n)	Males (n = 4207) % (n)
Heterosexual/straight	97.9% (9323)	98.4% (5283)	97.4% (4040)
Gay or Lesbian	1.1% (110)	.8% (43)	1.5% (67)
Bisexual	.5% (62)	.4% (29)	.6% (33)
Not sure/unknown	.5% (49)	.4% (24)	.5% (25)
Race			
White	75.4% (6152)	75.0% (3457)	76.0% (2695)
Black	10.0% (1807)	10.6% (1040)	9.5% (767)
Hispanic	8.8% (1151)	9.0% (653)	8.4% (498)
Other race	5.8% (525)	5.4% (278)	6.1% (247)
Education			
High school degree or less	39.8% (4216)	41.5% (2431)	38.0% (1785)
Some college	29.7% (2866)	31.2% (1671)	28.0% (1195)
College degree or higher	30.1% (2553)	27.2% (1326)	34.0% (1227)
Personal Income			
$0 to $24,999	49.4% (5169)	59.7% (3323)	37.8% (1846)
$25,000 to $59,999	31.6% (2972)	28.7% (1532)	34.8% (1440)
$60,000 and higher	19.0% (1494)	11.5% (573)	27.4% (921)
Employment			
Not employed full-time	70.6% (6910)	74.8% (4015)	66.0% (2895)
Employed full-time (35+ hours)	29.4% (2725)	25.2% (1413)	34.0% (1312)
Marital Status			
Not married	36.7% (5021)	42.8% (3131)	29.9% (1890)
Married	63.3% (4614)	57.2% (2297)	70.1% (2317)
Health Insurance Status			
Insured	92.1% (8671)	92.4% (4901)	91.8% (3770)
Not insured	7.9% (954)	7.6% (523)	8.2% (431)
U.S. Region			
Northwest	18.7% (1415)	18.5% (790)	18.9% (625)
Midwest	22.0% (2121)	21.9% (1160)	22.1% (961)
South	37.2% (3838)	37.7% (2238)	36.6% (1600)
West	22.1% (2261)	21.9% (1240)	22.4% (1021)
Urbanicity			
Suburban/Urban	72.4% (7396)	72.3% (4174)	72.5% (3222)
Rural	27.6% (2239)	27.7% (1254)	27.5% (985)

Sample sizes vary due to missing data. Unweighted sample sizes are provided. Percentages incorporate survey weights provided by the NESARC-III.

Table 2

Past-year cigarette smoking by gender and sexual orientation, US adults aged 55–77, 2012–2013 (Source: NESARC-III)

	Females % Past 12-month smoking			Males % Past 12-month smoking		
	% (n)	OR (95% CI)	AOR (95% CI)	% (n)	OR (95% CI)	AOR (95% CI)
Heterosexual/straight	14.8% (5283)	Reference	Reference	20.3% (4040)	Reference	Reference
Gay or Lesbian	12.9% (43)	.858 (.310, 2.37)	.903 (.325, 2.50)	18.7% (67)	.904 (.454, 1.80)	.698 (.332, 1.46)
Bisexual	38.9% (29)	3.67** (1.62, 8.33)	3.47** (1.50, 7.97)	51.0% (33)	4.08*** (1.75, 9.52)	4.13*** (1.87, 9.14)
Not sure/unknown	14.6% (24)	.987 (.320, 3.04)	.871 (.286, 2.65)	24.0% (25)	1.23 (.290, 5.28)	.827 (.219, 3.12)
	(n = 5379)	(n = 5376)	(n = 5373)	(n = 4165)	(n = 4163)	(n = 4158)

*
p<.05,

**
p<.001.

Analyses estimating adjusted odds ratio's (AOR) control for race, educational level, personal income, employment status, relationship status, health insurance status, geographic location, and metropolitan statistical area. Sample sizes vary due to missing data. Unweighted sample sizes are provided. Percentages and estimates from the logistic regression analyses incorporate survey weights provided by the NESARC-III. We have checked our models with respect to any potential issue regarding multi-collinearity and found that the average variance inflation factors for the models with control variables estimating the adjusted odds ratios (AOR) for males and females was 1.87 and 1.68 (these values are well below the conservative threshold of 2.5, indicating that collinearity was not an issue with these models).

Table 3

LDCT lung screening eligibility (defined by 30+ smoking pack years, current smoker or quit within past 15 years, and no mention of a lung cancer or other cancer) as a function of sexual identity, US adults aged 55–77, 2012–2013 (Source: NESARC-III)

	Females % eligible for LDCT lung screening			Males % eligible for LDCT lung screening		
	% (n)	OR (95% CI)	AOR (95% CI)	% (n)	OR (95% CI)	AOR (95% CI)
Heterosexual /straight	7.6% (5278)	Reference	Reference	15.2% (4028)	Reference	Reference
Gay or Lesbian	9.4% (43)	1.25 (.382, 4.14)	1.50 (.422, 5.33)	9.1% (67)	.557 (.246, 1.26)	.426 (.177, 1.02)
Bisexual	26.9% (28)	4.51** (1.66, 12.1)	4.86* (1.26, 18.6)	24.5% (33)	1.81 (.675, 4.87)	1.69 (.741, 3.85)
Not sure/unknow	13.8% (24)	1.95 (.525, 7.24)	1.86 (.521, 6.66)	6.9% (24)	.419 (.116, 1.51)	.289 (.070, 1.18)
n	(n = 5373)	(n = 5373)	(n = 5370)	(n = 4152)	(n = 4152)	(n = 4147)

*
p<.05,

**
p<.001.

Analyses estimating adjusted odds ratio's (AOR) control for race, educational level, personal income, employment status, relationship status, health insurance status, geographic location, and metropolitan statistical area. Sample sizes vary due to missing data. Unweighted sample sizes are provided. Percentages and estimates from the logistic regression analyses incorporate survey weights provided by the NESARC-III.