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Lung Cancer Screening Utilization & Implications of Varying Eligibility Criteria by Race and Ethnicity: 2019 Behavioral Risk Factor Surveillance System Data

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Precis: Compared to prior data, lung cancer screening rates increased in 2019 and the 2021 expanded criteria will result in a greater number of eligible individuals. Risk-based screening that utilizes additional risk factors may be more inclusive across racial subgroups.

Lay Summary: In 2013, lung cancer screening (LCS) was recommended for high risk individuals. The annual rate of LCS has risen slowly, particularly among Black individuals. In part, this racial disparity resulted in expanded 2021 criteria. We used survey data to: 1) describe the number of people screened in 2019, 2) compare the percent eligible for LCS using the 2013 vs. 2021 guidelines, and 3) determine the percent eligible using more detailed criteria. Screening rates increased in 2019 and the 2021 criteria will result in more individuals eligible for screening. Using additional criteria may identify more individuals eligible for lung screening.

Abstract

Background: In 2021, the United States Preventive Services Task Force (USPSTF) expanded the eligibility criteria for low-dose computed tomographic lung cancer screening (LCS) to reduce racial disparities that resulted from the 2013 USPSTF criteria. The annual LCS rate has risen slowly since the 2013 USPSTF screening recommendations. Using the 2019 Behavioral Risk Factor Surveillance System (BRFSS), we: 1) describe LCS utilization in 2019, 2) compare the percent eligible for LCS using the 2013 vs. 2021 USPSTF criteria, and 3) determine the percent eligible using the more detailed PLCOm2012 risk-prediction model.

Methods: The analysis included 41,544 with a smoking history from states participating in the BRFSS LCS module who were ≥50 years old.

Results: Using the USPSTF 2013 criteria, 20.7% (95% CI=19.0, 22.4) of eligible individuals underwent LCS in 2019. We compared the 2013 to the 2021 criteria and the overall proportion eligible increased from 21.0% (95% CI=20.2, 21.8) to 34.7% (95% CI=33.8, 35.6). Applying the 2021 criteria, the proportion eligible by race were: 35.8% (95% CI=34.8, 36.7) among Whites,

28.5% (95% CI=25.2, 31.9) among Blacks, and 18.0% (95% CI=12.4, 23.7) among Hispanics. Using the 1.0% 6-year threshold which is comparable to the 2021 USPSTF criteria, the PLCOm2012 model selected more individuals overall and by race.

Conclusions: Using data from 20 states and employing multiple imputation, we report higher LCS rates compared to prior BRFSS data. The 2021 expanded criteria will result in a greater number of screen-eligible individuals. However, risk-based screening that utilizes additional risk factors may be more inclusive overall and across subgroups.

Keywords: Lung cancer screening, low dose computed tomography, PLCOm2012 risk prediction model, Race disparities, United States Preventive Services Task Force, Behavioral Risk Factor Surveillance System

Introduction

Lung cancer is a major public health problem in the United States (U.S.) with disparities in the burden of disease as well as in the utilization of low-dose computed tomographic lung cancer screening (LCS).[1–3] The National Lung Screening Trial (NLST), which found that annual LCS resulted in a 20% lung cancer-specific mortality reduction compared to chest x-ray, informed the 2013 United States Preventive Services Task Force (USPSTF) screening recommendations.[4,5] These guidelines recommended annual LCS for adults 55-80 years old with a 30+ pack-year smoking history, who currently smoked or who had quit within the past 15 years. Since the release of the guidelines, several studies have examined the utilization of LCS in the United States. Initial reports indicated as low as 3.9% uptake of screening using National Health Interview Survey (NHIS) 2010 and 2015 data.[3] More recently, 12% to 19% of eligible individuals have reported LCS in the past year according to data from the Behavioral Risk Factor Surveillance System (BRFSS).[2,6–9]

In addition to reviewing uptake of screening in the U.S. population, studies began evaluating the appropriateness of the 2013 screening criteria for diverse populations, given the lack of diversity among participants in the NLST trial,[10–13] as well as the known differences in smoking patterns by race.[14] These studies suggested the 2013 USPSTF criteria might exacerbate lung cancer disparities because certain sub-groups, including African American/Black

individuals, were less likely to meet the screening eligibility criteria due to lower levels of cigarette smoking, despite being more susceptible to lung cancer.[10,15,16] These studies highlighted the importance of considering race-specific pack-year eligibility, as well as risk-based screening to make LCS guidelines more equitable.

Based upon the accumulating evidence,[10,17] the USPSTF released new guidelines in March 2021 that lowered the initial age to start screening from 55 to 50 years and the smoking history from 30 to 20 pack-years (USPSTF 2021). These expanded criteria increase the estimated number of U.S. adults who are eligible for LCS from 8 million to 14.5 million.[18] Additionally, these revised criteria will increase the number of minorities who are eligible to be screened.[18,19]

However, it remains uncertain if the revised guidelines will eliminate screening eligibility disparities, because the criteria rely on age and pack-year smoking history alone. The current guidelines do not take into account other risk factors that contribute to higher lung cancer incidence and diagnosis at younger ages seen in Black individuals compared with Whites.[20,21] The validated PLCOm2012 risk prediction model was developed using data from the control arm of the Prostate, Lung, Colorectal, and Ovarian Cancer Screening randomized controlled trial. It includes 11 risk factors (including education, race and/or ethnicity, and personal history of cancer), has been validated in the US and other countries, and has shown improved sensitivity for Black individuals.[22–26] Additionally, the PLCOm2012 model has been implemented in public health lung cancer screening programs in Ontario, Canada and the United Kingdom.[27,28]

Using the BRFSS 2019 survey data, the goals of this analysis were to: 1) describe LCS utilization in the past year, 2) examine the impact of varying the pack-years and age criteria by race and ethnicity on the proportion of individuals eligible, and 3) applying a risk-prediction model to determine the percent eligible for LCS among individuals with a smoking history, stratified by race.

Materials and Methods

Study Population

The Centers for Disease Control and Prevention (CDC) BRFSS is a health-related telephone survey that collects data from more than 400,000 adults (≥ 18 years old) annually in 50 states, the District of Columbia, and 3 U.S. territories. The survey is conducted using random

digit dialing techniques on landline and cellular phones and is administered using in-house interviewers, telephone call centers, or academic institutions. Data are weighted using an iterative proportional fitting (or raking) methodology to account for age, gender, ethnicity, geographic regions within states, marital status, education level, home ownership, and type of phone ownership (landline/cellular telephone).

For the present study, we used the publicly available data from the core components and optional lung cancer screening module from the 2019 survey. We limited the dataset to include individuals 50+ years old who currently smoked or formerly smoked cigarettes. The BRFSS data are publicly available, are de-identified, and exempt from institutional review board approval.

Measures

We included items from the BRFSS core component that all participating states must ask, including demographic characteristics, health status, and behaviors (e.g., cancer screening, tobacco use, physical activity). The 4-item lung cancer screening module was an optional component of the 2019 survey and was administered by 20 states (Arizona, Idaho, Kansas, Kentucky, Maine, Maryland, Minnesota, Missouri, Montana, Nebraska, North Carolina, North Dakota, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Utah, Vermont, West Virginia, and Wisconsin).

Demographic Characteristics. We utilized race and ethnicity, age, gender, marital status, health insurance status, and education to characterize the sample. The BRFSS dataset collapsed respondents 81+ with respondents age 80 and so the present analysis includes individuals 50+ years old.

Cigarette Smoking. Ever vs. never smoking status was determined by the question, 'Have you smoked at least 100 cigarettes in your entire life?' The item, 'Do you now smoke cigarettes every day, some days, or not at all?' gauged whether an individual currently or formerly smoked cigarettes. Current smoking was defined as those who responded 'every day' or 'some days'. Former smoking included those who responded 'not at all'. To calculate pack-years, we used the age that respondents indicated they last smoked cigarettes regularly minus the age when they first started to smoke regularly, as well as the reported average number of cigarettes smoked each day ('On average, how many cigarettes do you smoke each day?'). The reported average number

of cigarettes smoked each day was divided by 20 and then multiplied by the total number of years smoked to obtain pack-years.

Other Risk Factors. To assess lung cancer risk, we utilized the PLCOm2012 risk prediction model, which includes sociodemographic variables: 1) age; 2) highest level of education ('What is the highest grade or year of school you completed?'); 3) race collapsed into four levels: White/Non-Hispanic, Black/ Non-Hispanic, Hispanic, and Other which included Asian, American Indian/Alaska Native, and those who identified as having 'other'. Predictors related to medical history and smoking exposure included self-reported: 4) a diagnosis of chronic obstructive pulmonary disease, emphysema, or chronic bronchitis; 5) personal history of cancer as measured by the single item, '(Ever told) you had any other types of cancer?' without consideration of skin cancer; 6) body mass index (BMI) in which we used weight in kilograms and height in centimeters (the formula used to calculate BMI is a person's weight in kilograms/their height in meters squared); 7) smoking status (current or former); 8) average number of cigarettes smoked per day; 9) duration smoked in years; and 10) number of years since quitting smoking among those who formerly smoked. As the BRFSS survey did not assess family history of lung cancer, this one variable was excluded from the model.

Lung Cancer Screening history. The single item from the lung cancer screening module assessed utilization: 'In the last 12 months, did you have a CT or CAT scan?' Response options: Yes, to check for lung cancer, No (did not have a CT scan), Had a CT scan, but for some other reason.

Statistical Methods

We used sample weights to account for the complex survey sampling design. The analyses followed the BRFSS guidelines (https://www.cdc.gov/brfss/index.html). Weighted frequency distributions are presented for all variables of interest. We describe the findings based on the absolute proportions without hypothesis testing. We present the sociodemographics, smoking history variables, and screening utilization stratified by race and ethnicity (Table 1). In Tables 2a and 2b, we show the proportion of individuals eligible using the 2013 and 2021 USPSTF screening criteria, and applying the PLCOm2012 model stratified by race.

In the analyses in which we applied the PLCOm2012 model to determine the percent eligible for LCS (Table 2a), we stratified across three groups: Non-Hispanic White, Non-

Hispanic Black, and Other (which includes Hispanic, Asian, AI/AN, Other race) as well as by four groups: Non-Hispanic White, Non-Hispanic Black, Hispanics, and Other (which includes Asian, AI/AN, Other race). Based on community-level evidence[29], the lung cancer risk effect estimated by the original PLCOm2012 underestimates the independent risk associated with being Hispanic. Due to this underestimation, Hispanics have been pooled with Whites and Other races in the updated version of the PLCOm2012. This version of the PLCOm2012 model has been well validated and has led to less under-selection of Hispanics for LCS than occurs applying the original PLCOm2012.[29] Pooling (Table 2a) helps, to an extent, overcome the deficiency and allows for comparison between the data (Tables 2a and 2b). We used a re-parameterized PLCOm2012 that excluded family history of lung cancer based on the equations provided by the developer of the model (MT). Family history of lung cancer was the only variable excluded from the risk prediction model and this re-parameterized model has been used previously.[24] Eligibility according to the PLCOm2012 lung cancer incidence risk prediction model with a 1.0% and 1.5% threshold is also presented by race. The 1.5% risk threshold was used for the analysis due to the LCS mortality reduction benefit vs. chest x-ray.[30] The 1.0% cutpoint was used, because it has been shown to be comparable to 2021 USPSTF guidelines.[29–31]

Multiple Imputation. Missing variables were imputed for all patients aged 50 or more. After the imputation process, we selected patients meeting the USPSTF 2013 or USPSTF 2021 criteria. We utilized a two-stage multiple imputation procedure to address the missing values of variables of interest, including: screened in the past year (34% missing), pack-years (20% missing), total years of smoking (17% missing), years since quitting smoking (16% missing), and number of cigarettes smoked per day (16% missing). The two-stage imputation procedure was required due to skip patterns. For stage 1, we imputed all variables except the number of cigarettes smoked per day and the age that respondents indicated when they last smoked cigarettes regularly. For stage 2, we imputed the number of cigarettes smoked per day and the age that respondents indicated when they last smoked cigarettes regularly only for the subsets of records of current or former smokers generated from Stage 1. We created ten multiple imputed datasets and analyzed them by taking into account the complex survey sampling design. We combined the results of the analyses of the 10 multiple imputed datasets using the rule of Rubin and provided estimated means with standard errors for the continuous variables and estimated

percentages with 95% CIs for the categorical variables.[32] All analyses were performed using SAS, version 9.4 (SAS Institute, Cary, NC).

Results

Participants (Table 1)

Of the 41,544 individuals included in the present analysis, 88.5% (36,787) were Non-Hispanic White, 5% (2,066) were Non-Hispanic Black/African American, 2% (786) were Hispanic, and 4.5% (1,905) reported being of a Non-Hispanic Other race (Asian, American Indian/Alaska Native, Other). The mean age of respondents was 64.7 (SE=0.1) with White respondents being older on average (M=65.1, SE=0.1) compared to Blacks (M=63.6, SE=0.3), Hispanics (M=61.1, SE=0.5), and Others (M=62.6, SE=0.4). White individuals were least likely to be currently smoking (28.3%, 95% CI=27.4, 29.2). Hispanic individuals had the fewest pack-years (M=15.2, SE=1.2) followed by Blacks (M=19.5, SE=0.6). Black individuals reported the longest duration of total years smoked (M=31.3, SE=0.5).

LCS Utilization (Table 1)

Among those eligible according to the 2013 USPSTF screening criteria (55 years + and with 30+ pack-years), 20.7% (95% CI=19.0, 22.4) were screened in the past 12 months. When stratified by race, the rates were comparable with 20.8% (95% CI=19.0, 22.5) of Whites and 20.2% (95% CI=10.8, 29.6) of Black individuals. The highest rates of screening were among Hispanics at 23.8% (95% CI=4.4, 43.3) and the lowest at 19.1% (95% CI=12.0, 26.2) of others having reported a CT scan to check for lung cancer within the last year.

Comparing 2013 & 2021 USPSTF Screening Eligibility Criteria (Tables 2a & 2b)

Overall, the proportion of individuals who would be eligible for LCS increased from 21.0% (95% CI=20.2, 21.8) using the 2013 USPSTF criteria to 34.7% (95% CI=33.8, 35.6) using the 2021 USPSTF criteria. There were similar increases in the proportion eligible for screening between the 2013 and 2021 criteria across racial subgroups (14% absolute increase for Whites, 13% increase for Blacks, and 13% increase for others). Applying the 2021 USPSTF criteria, the proportion of individuals who would be eligible for LCS by race were: 35.8% (95% CI=34.8, 36.7) among Whites, 28.5% (95% CI=25.2, 31.9) among Blacks, and 29.9% (95%

CI=26.4, 33.5) among others. Table 2b shows the proportion eligible for screening using the 2021 USPSTF criteria compared to the 2013 screening criteria among Hispanic individuals.

Using the PLCOm2012 Model for Screening Eligibility Criteria (Table 2a)

Using the 1.5% 6-year lung cancer risk threshold, 35.3% (95% CI=34.4, 36.2) of the sample would be eligible for lung screening. To compare 2021 USPSTF criteria to the PLCOm2012 model using the 1.0% 6-year risk threshold, the risk prediction model selected a larger proportion of individuals 45.0% (95% CI=44.1, 45.9) vs. 34.7% (95% CI=33.8, 35.6) of the sample being eligible for LCS. The proportion of individuals eligible by race using the PLCOm20212 model (1.0% cutpoint) were: 46.3% (95% CI=45.3, 47.2) among Whites, 39.3% (95% CI=35.8, 42.7) among Blacks, and 37.8% (95% CI=33.5, 42.1) among others.

We conducted a sensitivity analysis using the non-imputed dataset to compare it to the imputed dataset (see Supplemental Tables). When using the non-imputed data, we found the percent eligible for screening was higher among Whites and those in the Other race category, but lower among Blacks. The overall proportion eligible was higher using the raw data for the 2013 and 2021 USPSTF criteria.

Discussion

Based on 2019 BRFSS survey data from 20 U.S. states, 20.7% of those meeting the 2013 USPSTF LCS guidelines underwent a low-dose CT exam for lung cancer. This represents an increase from the prior BRFSS surveys conducted in 2017-2019 with screening rates ranging from 12 to 19%.[2,6–9] It should be noted the states included in 2017-2019 were not identical to the 20 states included in the present analysis. Possible reasons for differences in the rates presented from prior publications include: 1) different states administering the optional lung cancer screening module over the years, 2) the current analysis includes individuals 80 years and older, and 3) imputation of missing values rather than doing a complete case analysis. Although, based on the differences in the rates between the non-imputed and imputed datasets, we believe that the imputation resulted in more accurate estimates. Importantly, White (20.8%) and Black (20.2%) respondents had similar rates of LCS in 2019, which is a change to 2017, in which it was reported that 14.8% of Whites vs. 12.6% of Blacks reported undergoing LCS in the past year.[2] Hispanics reported the highest rate of LCS at 23.8% which also represents an increase from the

2017 BRFSS report.[2] Compared to the other three groups, individuals in the other race group reported the lowest proportion of being screened for lung cancer in the last 12 months.

This study also compared the percentage of individuals who would be eligible for LCS according to the 2013 and 2021 USPSTF criteria. Supporting prior research,[18] our findings suggest the 2021 USPSTF criteria will increase the proportion of individuals eligible for LCS across racial and ethnic groups compared to the 2013 guidelines. However, racial differences remained in the percent eligible according to the 2021 USPSTF criteria, such that Whites still have the highest percentage eligible when compared to Blacks and Hispanics according to the new guidelines. These findings align with data evaluating the 2021 guidelines among racial/ethnic populations using 2017 and 2018 BRFSS data. Reese and colleagues (2021) found Black and Hispanic individuals were less likely to be eligible for LCS compared with White respondents.[33]

To examine a risk-based model for determining screening eligibility, the PLCOm2012 model using both the 1.0% and 1.5% 6-year risk threshold identified the largest proportion of individuals overall and within racial subgroups. The 1.0% threshold that is comparable to the 2021 guidelines selected the largest proportion of individuals overall and within racial subgroups. This supports a previous finding that showed greater sensitivity of the PLCOm2012 in identifying more racially diverse groups at risk for lung cancer.[22] Consideration of other factors beyond age and pack-years may be important in further reducing screening eligibility disparities.

In this sample, Black and Hispanic individuals had fewer pack-years. These results support previous studies reporting different smoking patterns among Black individuals and younger ages of individuals who smoke among Hispanics.[14,20,34,35] The differences in smoking behavior between subgroups continue to have important implications for the revised screening criteria and lung cancer risk. Whether duration smoked or amount smoked is a larger contributor to lung cancer is an important question and may be related to other factors like greater exposure to carcinogens through inhalation and/or metabolism.[20,21,36] These differences should continue to be considered when determining the optimal way to screen eligible individuals to address disparities in lung cancer incidence and mortality rates.

Study limitations are similar to other studies conducted with BRFSS data.[2,7,33] These include the potential for limited generalizability as only 20 states administered the optional lung cancer screening module. In the current sample, 5% were Black in comparison to 13.4% Black or African American in the total US population.[37] The US population is18.5% Hispanic or Latino, whereas in the current sample only 2% were of Hispanic origin. The present study was unable to provide eligibility estimates for the other racial/ethnic groups separately due to data limitations and future research should examine each of these subgroups. Due to self-report, responses may be subject to recall bias. To our knowledge, the current BRFSS lung cancer screening question has not been validated. Without medical record validation and with the reliance on self-report, it is possible that some participants might be unaware of the exact test they received or if their doctor ordered it for LCS. However, in comparing our estimates to past BRFSS data, we report an increase in screening utilization. The BRFSS survey collapses age for those 80 and older and there was no way to tease apart these individuals in the present analysis, although we expect this number to be small. Finally, there was substantial missingness on several key variables which is a limitation. Other related studies[2,7,8,33] have not used statistical methods to deal with missing data, and have performed their statistical analyses only on complete data. Therefore, a substantial strength of this study is that we employed a two-stage multiple imputation procedure, which accounted for the uncertainty of the imputed values and therefore had potential to improve the validity of the estimations.

Collected prior to the COVID-19 pandemic, our study reports the highest rates of LCS using the 2013 USPSTF criteria compared to lung screening utilization reported using past BRFSS data.[2,6,7,9] Importantly, we observed gains among Blacks and Hispanics evening out differences between racial/ethnic groups. It should be noted that estimates from other sources have suggested lower uptake of LCS.[38,39] It is possible the current BRFSS lung cancer screening question wording measures something different from low dose CT scans reported to the American College of Radiology Lung Cancer Screening Registry, because the BRFSS lung cancer screening rates appears higher than what is reported by radiology facilities to the American College of Radiology. A recent review article has suggested that it may be helpful to revise the wording of the BRFSS lung cancer screening question or add additional items to improve the accuracy of surveillance of lung cancer screening.[40] Future validation studies on the BRFSS lung screening module items as well as additional questions to improve the accuracy of

surveillance of lung cancer screening are needed. With the recently expanded screening criteria, it will be imperative to ensure those newly eligible individuals are informed of their option to get screened, particularly once insurance coverage becomes available.[41] The lowering of both the age and pack-year criteria has substantially increased the number of people eligible, especially those groups, like Black and Hispanic individuals, with a long-term smoking history, who were excluded under the 2013 criteria, but yet are still at high risk for developing lung cancer. Inclusion of other risk factors may still be needed to close the gap between the proportion eligible by race.

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Table 1. Sociodemographic and smoking history among 50+ years old by race/ethnicity

Variables	White – Non-Hispanic N=36,787	Black – Non-Hispanic N=2,066	Hispanic N=786	Other – Non-Hispanic[a] N=1,905	Total N=41,544
Age, Mean (SE)	65.1 (0.1)	63.6 (0.3)	61.1 (0.5)	62.6 (0.4)	64.7 (0.1)
Gender, (%)					
Male	51.9 (51.0, 52.8)	50.7 (47.4, 54.1)	55.6 (49.2, 62.0)	59.8 (55.5, 64.1)	52.2 (51.3, 53.1)
Female	48.1 (47.2, 49.0)	49.3 (45.9, 52.6)	44.4 (38.0, 50.8)	40.2 (35.9, 44.7)	47.8 (46.9, 48.7)
Marital Status, (%)					
Married	58.0 (57.1, 58.9)	34.8 (31.6, 38.1)	55.9 (49.5, 62.3)	50.4 (45.8, 55.1)	55.5 (54.6, 56.4)
Not married	42.0 (41.1, 42.9)	65.2 (61.9, 68.4)	44.1 (37.7, 50.5)	49.6 (44.9, 54.2)	44.5 (43.6, 45.4)
Missing (N)	231	11	4	11	257
Health Insurance, (%)					
Yes	94.3 (93.9, 94.8)	91.3 (89.0, 93.5)	82.6 (77.0, 88.2)	92.5 (90.0, 94.9)	93.6 (93.1, 94.1)
No	5.7 (5.2, 6.1)	8.7 (6.5, 11.0)	17.4 (11.8, 23.0)	7.5 (5.1, 10.0)	6.4 (5.9, 6.9)
Missing (N)	89	10	4	4	107
Education, (%)					
Less than high school graduate	12.6 (11.9, 13.4)	19.9 (17.0, 22.8)	43.6 (37.1, 50.0)	18.8 (14.6, 23.0)	14.5 (13.8, 15.3)
High school graduate	34.8 (33.9, 35.7)	35.3 (32.0, 38.5)	21.3 (16.3, 26.4)	30.0 (25.3, 33.8)	34.2 (33.3, 35.0)
Some college	32.6 (31.7, 33.4)	31.0 (27.9, 34.0)	23.0 (18.0, 27.9)	32.3 (28.1, 36.6)	32.1 (31.3, 32.9)
College graduate	20.0 (19.4, 20.7)	13.9 (12.0, 15.8)	12.1 (8.6, 15.6)	19.3 (15.7, 22.9)	19.2 (18.6, 19.8)
Missing (N)	108	6	3	4	121
History of Lung Diseases, COPD (%)					
Yes	19.4 (18.7, 20.2)	16.8 (14.2, 19.4)	8.7 (5.6, 11.9)	24.9 (20.5, 29.2)	19.1 (18.4, 19.8)
No	80.6 (79.8, 81.3)	83.2 (80.6, 85.8)	91.3 (88.1, 94.4)	75.1 (70.8, 79.5)	80.9 (80.2, 81.6)
Missing (N)	283	15	4	27	329
Cancer History, (%)					
Yes	15.2 (14.6, 15.9)	12.8 (10.6, 15.1)	9.8 (6.0, 13.6)	13.8 (11.0, 16.6)	14.8 (14.2, 15.4)
No	84.8 (84.1, 85.4)	87.2 (84.9, 89.4)	90.2 (86.4, 94.0)	86.2 (83.4, 89.0)	85.2 (84.6, 85.8)
Missing (N)	108	4	5	15	132
Body Mass Index, Mean (SE)	28.6 (0.1)	29.8 (0.2)	29.1 (0.4)	28.3 (0.3)	28.7 (0.1)

Missing (N)	1,778	97	50	86	2,011
Smoking Status, (%) Current smoker Former smoker	 28.3 (27.4, 29.2) 71.7 (70.8, 72.6)	 38.6 (35.3, 41.9) 61.4 (58.1, 64.7)	 33.2 (26.9, 39.6) 66.8 (60.4, 73.1)	 40.7 (36.0, 45.4) 59.3 (54.6, 64.0)	 29.9 (29.0, 30.7) 70.1 (69.3, 71.0)
Cigarettes per day, Mean (SE) Missing (N)	18.5 (0.1) 5,666	12.3 (0.3) 478	12.3 (0.6) 160	17.1 (0.6) 342	17.6 (0.1) 6,646
Pack-Years, Mean (SE) Missing (N)	27.4 (0.3) 7,069	19.5 (0.6) 591	15.2 (1.2) 209	27.3 (1.3) 440	26.3 (0.2) 8,309
Duration of Smoking: Total Number of Years, Mean (SE) Missing (N)	29.1 (0.2) 6,114	31.3 (0.5) 516	24.3 (1.1) 184	30.4 (0.8) 363	29.2 (0.1) 7,177
Screened in past year (among 50-80 years with any pack-years), (%)[b] Missing (N)	13.1 (12.4, 13.8) 7,827	14.6 (12.0, 17.2) 495	9.5 (4.3, 14.7) 157	14.9 (10.8, 18.9) 471	13.2 (12.6, 13.8) 8,950
Screened in past year (among those eligible according to the USPSTF 2013 screening criteria 55-80 years old with 30+ pack-years), (%)[c] Missing (N)	20.8 (19.0, 22.5) 1,800	20.2 (10.8, 29.6) 78	23.8 (4.4, 43.3) 24	19.1 (12.0, 26.2) 100	20.7 (19.0, 22.4) 2,002

Note: Percentages are weighted.

[a]Other – Non-Hispanic Asian N=101, American Indian/Alaska Native N=845, Other race N=959.

[b]N= 33,235 individuals 50-80 years old with any pack-years.

[c]N=7,273 individuals eligible according to the USPSTF2013 screening criteria 55-80 years old and with 30+ pack-years.

Table 2a. Percent eligible for screening by race/ethnicity (3-level) using multiple imputation				
	% eligible USPSTF2013[a]	% eligible USPSTF2021[b]	% eligible for screening $PLCO_{M2012}$ at 1.5%	% eligible for screening $PLCO_{M2012}$ at 1.0%

			threshold [c]	threshold [c]
White – Non-Hispanic	21.9 (21.1, 22.7)	35.8 (34.8, 36.7)	36.2 (35.2, 37.1)	46.3 (45.3, 47.2)
Black – Non-Hispanic	16.0 (13.2, 18.8)	28.5 (25.2, 31.9)	31.1 (27.7, 34.5)	39.3 (35.8, 42.7)
Other[d]	16.7 (13.9, 19.5)	29.9 (26.4, 33.5)	30.9 (27.2, 34.6)	37.8 (33.5, 42.1)
Total	21.0 (20.2, 21.8)	34.7 (33.8, 35.6)	35.3 (34.4, 36.2)	45.0 (44.1, 45.9)

[a] Eligible according to USPSTF2013 screening criteria (55-80 years old, ≥30 pack-years, current, or former quit within 15 years).

[b] Eligible according to USPSTF2021 screening criteria (50-80 years old, ≥20 pack-years, current, or former quit within 15 years).

[c] Eligible using the $PLCO_{M2012}$ risk prediction model that predicts 6-year risk of lung cancer using multiple risk factors (age, education, body mass index, COPD/emphysema/chronic bronchitis, personal history of cancer, race/ethnicity, smoking status, cigarettes per day, duration smoked, years quit). Participants with a probability of being diagnosed with lung cancer of 1.5% and 1.0% or greater using the $PLCO_{m2012}$ criteria.

[d]Other which includes Hispanic, Asian, AI/AN, Other race due to the smaller sample size among Hispanics that resulted in lower estimates.

Table 2b. Percent eligible for screening by race/ethnicity (4-level) using multiple imputation

	% eligible USPSTF2013[a]	% eligible USPSTF2021[b]	% eligible for screening $PLCO_{M2012}$ at 1.5% threshold [c]	% eligible for screening $PLCO_{M2012}$ at 1.0% threshold [c]
White – Non-Hispanic	21.9 (21.1, 22.7)	35.8 (34.8, 36.7)	36.2 (35.2, 37.1)	46.3 (45.3, 47.2)
Black – Non-Hispanic	16.0 (13.2, 18.8)	28.5 (25.2, 31.9)	31.1 (27.7, 34.5)	39.3 (35.8, 42.7)
Hispanic	9.8 (5.3, 14.3)	18.0 (12.4, 23.7)	15.0 (9.7, 20.2)	20.3 (13.7, 26.9)
Other – Non-Hispanic[d]	22.1 (18.2, 26.0)	39.3 (34.5, 44.0)	43.4 (38.7, 48.1)	51.4 (46.6, 56.3)
Total	21.0 (20.2, 21.8)	34.7 (33.8, 35.6)	35.3 (34.4, 36.2)	45.0 (44.1, 45.9)

[a] Eligible according to USPSTF2013 screening criteria (55-80 years old, ≥30 pack-years, current, or former quit within 15 years).

[b] Eligible according to USPSTF2021 screening criteria (50-80 years old, ≥20 pack-years, current, or former quit within 15 years).

[c] Eligible using the $PLCO_{M2012}$ risk prediction model that predicts 6-year risk of lung cancer using multiple risk factors (age, education, body mass index, COPD/emphysema/chronic bronchitis, personal history of cancer, race/ethnicity, smoking status, cigarettes per day, duration smoked, years quit). Participants with a probability of being diagnosed with lung cancer of 1.5% and 1.0% or greater using the $PLCO_{m2012}$ criteria.
[d] Other which includes Non-Hispanic Asian, AI/AN, Other race.