International Journal of COPD

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ORIGINAL RESEARCH

Smoking duration, respiratory symptoms, and COPD in adults aged ≥45 years with a smoking history

This article was published in the following Dove Press journal:
International Journal of COPD
21 July 2015
Number of times this article has been viewed

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Background: The purpose of this study was to assess the relationship of smoking duration with respiratory symptoms and history of chronic obstructive pulmonary disease (COPD) in the South Carolina Behavioral Risk Factor Surveillance System survey in 2012.

Methods: Data from 4,135 adults aged ≥45 years with a smoking history were analyzed using multivariable logistic regression that accounted for sex, age, race/ethnicity, education, and current smoking status, as well as the complex sampling design.

Results: The distribution of smoking duration ranged from 19.2% (1–9 years) to 36.2% (≥30 years). Among 1,454 respondents who had smoked for ≥30 years, 58.3% were current smokers, 25.0% had frequent productive cough, 11.2% had frequent shortness of breath, 16.7% strongly agreed that shortness of breath affected physical activity, and 25.6% had been diagnosed with COPD. Prevalence of COPD and each respiratory symptom was lower among former smokers who quit ≥10 years earlier compared with current smokers. Smoking duration had a linear relationship with COPD ($P<0.001$) and all three respiratory symptoms ($P<0.001$) after adjusting for smoking status and other covariates. While COPD prevalence increased with prolonged smoking duration in both men and women, women had a higher age-adjusted prevalence of COPD in the 1–9 years, 20–29 years, and ≥30 years duration periods.

Conclusion: These state population data confirm that prolonged tobacco use is associated with respiratory symptoms and COPD after controlling for current smoking behavior.

Keywords: tobacco use, chronic obstructive pulmonary disease, respiratory symptoms, population-based study

Introduction

Chronic obstructive pulmonary disease (COPD), which includes both chronic bronchitis and emphysema, is characterized by airflow obstruction, and may be accompanied by airway hyperreactivity, chronic cough, sputum production, shortness of breath (SOB), wheezing, exercise intolerance, and poor quality of life.[1,2] For 50 years, the biologic plausibility for a link between cigarette smoking and adverse respiratory system outcomes has been supported by epidemiologic and clinical evidence.[3,4] Risks of lung cancer, COPD, and other respiratory conditions such as asthma are increased in smokers, particularly among those with extensive exposure histories.[4] Sex also appears to affect the risk of adverse respiratory effects from smoking. Most studies show that smoking has greater adverse effects on respiratory function among women than among men.[5–11] However, other studies have not been consistent with that finding.[12–15] The sex difference in many previous studies of international populations or small study populations was observed when using self-reported

pack-years (product of intensity and duration) of smoking as a measure of tobacco exposure.[6–8,11–13,15]

There has been little information about the relationship between respiratory symptoms and number of years (duration) of tobacco use, particularly in a population representative of a US state. This is also true with regard to the relationship between duration of tobacco use, respiratory symptoms, and sex. Pack-year history requires the use of two survey questions, whereas years of tobacco use can be estimated by a single question. South Carolina is a US state with a high prevalence of current smoking (21.0% in 2010) and COPD (7.7% in 2011), and a high mortality rate from COPD (68.6 per 100,000 in 2010).[16,17] The South Carolina Behavioral Risk Factor Surveillance System (BRFSS), an annual health survey, included state-added questions regarding years of tobacco use and respiratory symptoms in 2012 and provided an opportunity to assess the association of prolonged tobacco use with respiratory symptoms and COPD in a contemporary state population of adult respondents with a smoking history.

Materials and methods

The BRFSS is an annual random-digital-dialed telephone survey conducted by state health departments in collaboration with the Centers for Disease Control and Prevention (CDC) in all 50 states, the District of Columbia, and US territories. The state-based BRFSS has collected data from households with landline and cellular telephones, and has incorporated a new sample weighting method since 2011 (http://www.cdc.gov/brfss/annual_data/annual_2011.htm). The BRFSS includes core questions about sociodemographic characteristics, risk behaviors, and chronic diseases including COPD; optional modules (standardized questions provided by the CDC and chosen by a state based on the state's priorities and budget); and questions added by the state. Questions addressing respiratory symptoms and years of tobacco use were added to the 2012 South Carolina BRFSS and were analyzed in this study. The 2012 South Carolina BRFSS combined response rate (the number of respondents who completed the survey as a proportion of all eligible and likely eligible persons using standards set by the American Association of Public Opinion Research Response Rate Formula #4 [http://www.aapor.org/Standard_Definitions2.htm]) was 48.6% (http://www.cdc.gov/brfss/annual_data/2012/pdf/SummaryDataQualityReport2012_20130712.pdf). This study is a secondary data analysis, which is exempt from the need for approval of an institutional review board.

Respiratory outcomes

A history of COPD was defined by the subject's affirmative responses to the question "Has a doctor, nurse, or other health professional ever told you that you have chronic obstructive pulmonary disease or COPD, emphysema or chronic bronchitis?" The small number of persons who reported "don't know/not sure" were defined as not having been diagnosed with COPD. Overall, 76.4% of respondents with self-reported COPD also reported having had a breathing test such as spirometry.

Respiratory symptoms were measured by three variables. In response to the question "How often do you cough up mucus or phlegm?", we defined the presence of a frequent phlegm-producing cough as a response of "everyday", or "most days a week" to compare with respondents with "a few days a month", "only with occasional colds or chest infections", or "never". In response to "During the past 30 days, how often did you feel short of breath?", we defined frequent SOB as a response of "all the time" or "most of the time" to compare with respondents with a response of "some of the time", "a little of the time", or "none of the time". For the third question "Thinking about your physical activity during the last 12 months, do you agree slightly or strongly, or disagree slightly or strongly with the following statement: I do less now than I used to because of my breathing problems", we compared those who said "strongly agree" with respondents who gave the other response options. These three respiratory symptom questions were selected from a validated study with a positive predictive value of 56.8% and a negative predictive value of 86.4%, which is considered to be a highly reliable questionnaire when compared with spirometry measures.[18]

Smoking behaviors

For the analyses presented in this report, we identified respondents with a history of cigarette smoking by an affirmative response to the tobacco use question, "Have you smoked at least 100 cigarettes in your entire life?" Years (duration) of tobacco use were further determined from the question "Over your lifetime, how many years have you smoked tobacco products?" and were divided into four duration groups (1–9 years, 10–19 years, 20–29 years, and ≥30 years). Persons who responded "not at all" to the third tobacco use question, "Do you now smoke cigarettes, every day, some days, or not at all?" were defined as former smokers and the remainder were defined as current smokers. Former smokers were also asked to identify how long it had been since they last smoked a cigarette, even one or two puffs. Former

smokers were then defined either by having quit smoking for ≥10 years (72.7%) or by all other responses (26.8% reported quit durations <10 years and 0.5% failed to provide information on quit duration).

We restricted this study to adults aged ≥45 years because there was a low prevalence of COPD (3.7%) and smoking ≥30 years (1.9%) among respondents aged 18–44 years, resulting in unstable sample sizes in that age group. In the survey population of 9,386 respondents aged ≥45 years, 46.2% had never smoked, 33.8% were former smokers, and 18.3% were current smokers. Leffondre et al has observed that inclusion of respondents who have never smoked may produce overestimations of the effects of smoking duration when that group is assigned a value of zero smoking years and is set as the referent group in an analysis;[19] therefore, we restricted this study to former and current smokers (4,553 respondents) aged ≥45 years. Data from 4,135 (90.8%) respondents who provided information on smoking duration, respiratory symptoms, and history of COPD were analyzed in this study after those who had missing information were excluded.

Statistical analysis

We examined the distributions of selected characteristics among study respondents by smoking duration. We estimated 95% confidence intervals (CIs) for the percentages and used two-sided *t*-tests to compare characteristics between groups defined by smoking duration and to assess linear trends in characteristics by smoking duration. The distribution of smoking duration by current smoking status (current smokers, former smokers who had quit for ≥10 years, and other former smokers) was also examined. The age-adjusted prevalence and 95% CI of respiratory symptoms and COPD by smoking duration and current smoking status were obtained from separate logistic regression models that included age (45–59 years, 60–69 years, and ≥70 years) as the covariate. Finally, we assessed the adjusted prevalence ratios and 95% CIs for the likelihood of having respiratory symptoms and COPD associated with smoking duration using separate multivariable logistic regression models that included sex, age, race/ethnicity (non-Hispanic white, non-Hispanic black, or other/multiracial), education (less than a high school diploma, a high school graduate or equivalent, or at least some college), and current smoking status (current vs former) as covariates. Prior research suggesting that women might be more susceptible than men to the effects of smoking prompted testing for an interaction between sex and smoking duration in separate age-adjusted logistic regression models for each of the four dependent variables. The only sex interaction was observed for COPD (P=0.085). We also assessed whether the relationships between smoking duration and the dependent variables differed by current smoking status, but failed to find a significant interaction for COPD (P=0.79) or for any of the three respiratory symptoms (P>0.42). There were also no significant interactions between age and sleep duration for any outcome (P>0.30). All analyses were conducted using Statistical Analysis System (SAS)-callable SUDAAN (Release 10.0.1, Research Triangle Institute, NC, USA) to account for the complex sampling design.

Results

Table 1 shows the distribution of selected characteristics by smoking duration among 4,135 adults aged ≥45 years with a history of smoking. The distributions of age and race/ethnicity did not differ significantly by smoking duration. Respondents who had smoked for ≥30 years were more likely to be male (P<0.05), have less than a high school education (P<0.05), and less likely to have some college education (P<0.05) than persons who had smoked for 1–9 years or 10–19 years. The proportion of the study population who were current smokers increased with increasing smoking duration (linear trend, P<0.05) such that 58.3% of those who had smoked for ≥30 years continued to be current smokers compared with 7.5% of those who had smoked for 1–9 years. The proportion of the study population comprising former smokers with quit durations of ≥10 years declined as smoking duration increased (linear trend, P<0.05).

The distribution of smoking duration was 19.2% for 1–9 years, 21.6% for 10–19 years, 23.0% for 20–29 years, and 36.2% for ≥30 years. The increase in the proportions for each smoking duration was observed in men and women, all age groups, non-Hispanic whites, non-Hispanic blacks, and all education groups (data not shown). Figure 1 shows an inverse linear trend for smoking duration category in former smokers with quit durations of ≥10 years, while current smokers and other former smokers had a linear increase such that 60.0% of all current smokers and 43.6% of other former smokers had smoked for ≥30 years in contrast with 15.6% of former smokers who had quit for ≥10 years.

We assessed the age-adjusted prevalence of COPD and the three respiratory symptoms by current smoking status (Figure 2). Former smokers with quit durations ≥10 years reported a significantly lower age-adjusted percentage of frequent productive cough (10.6% vs 24.2%, respectively, P<0.001), frequent SOB (5.7% vs 9.9%, P=0.001), agreement that SOB affects physical activity (8.8% vs 13.8%,

Table 1 Distribution of selected characteristics among 4,135 adults aged ≥45 years with a smoking history by smoking duration in South Carolina, 2012 (Behavioral Risk Factor Surveillance System)

Characteristic	n[a]	Smoking duration (years)			
		1–9 (n=799) % (95% CI)[b]	10–19 (n=952) % (95% CI)[b]	20–29 (n=930) % (95% CI)[b]	≥30 (n=1,454) % (95% CI)[b]
Sex					
Men	1,971	46.4 (41.3–51.6)	49.4 (44.8–54.0)	59.3 (54.9–63.5)	59.2 (55.7–62.7)
Women	2,164	53.6 (48.4–58.7)	50.6 (46.0–55.2)	40.7 (36.5–45.1)	40.8 (37.3–44.3)
Age (years)					
45–59	1,555	49.6 (44.5–54.7)	51.3 (46.7–55.8)	52.1 (47.6–56.7)	47.2 (43.5–50.9)
60–69	1,371	33.4 (28.8–38.4)	26.1 (22.5–30.1)	25.9 (22.3–29.8)	30.7 (27.4–34.1)
≥70	1,209	17.0 (13.9–20.5)	22.6 (19.3–26.3)	22.0 (18.7–25.7)	22.1 (19.6–24.9)
Race/ethnicity					
Non-Hispanic white	3,092	73.5 (68.5–78.0)	73.7 (69.3–77.7)	76.0 (71.6–79.9)	79.5 (76.2–82.5)
Non-Hispanic black	862	22.3 (18.3–27.0)	21.7 (18.0–25.8)	19.1 (15.7–23.1)	15.4 (12.8–18.3)
Other/multiracial	181	–[c]	–[c]	–[c]	5.1 (3.5– 7.4)
Education					
Less than high school diploma	580	14.9 (11.1–19.8)	14.1 (10.9–18.0)	20.6 (16.7–25.2)	26.6 (23.1–30.3)
High school graduate or equivalent	1,297	26.4 (22.1–31.2)	32.6 (28.4–37.0)	36.3 (32.0–40.8)	32.1 (28.9–35.5)
At least some college	2,258	58.7 (53.4–63.8)	53.4 (48.7–57.9)	43.1 (38.8–47.6)	41.3 (37.9–44.9)
Smoking status					
Current smokers	1,253	7.5 (5.1–10.8)	20.6 (16.9–25.0)	35.3 (30.8–40.0)	58.3 (54.7–61.8)
Former smokers (quit ≥10 years)	2,157	79.8 (75.4–83.6)	65.0 (60.3–69.4)	45.5 (41.0–50.0)	20.4 (17.8–23.3)
Other former smokers[d]	722	12.7 (9.8–16.4)	14.4 (11.3–18.1)	19.2 (15.8–23.1)	21.3 (18.5–24.5)

Notes: [a]Unweighted sample size; [b]weighted percentage and 95% CI; [c]unreliable estimate due to small sample size; [d]other former smokers include persons who did not provide quit durations (n=11) as well as those with quit durations <10 years.
Abbreviation: CI, confidence interval.

$P<0.0001$), and COPD (8.6% vs 22.7%, $P<0.0001$) compared with current smokers. In contrast, other former smokers with either no stated quit duration or quit durations <10 years did not differ significantly from current smokers in prevalence of frequent SOB, agreement that SOB affects physical activity, and COPD, although this former smoker group reported a significant lower age-adjusted percentage of frequent productive cough than did current smokers (11.5% vs 24.2%, $P<0.0001$).

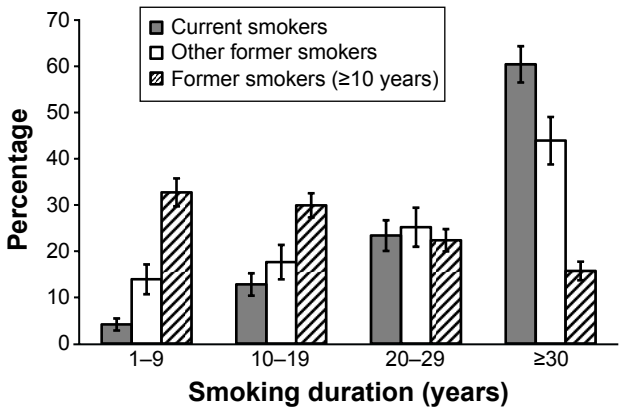

Figure 1 Distribution of years of tobacco exposure among 4,135 adults aged ≥45 years with a smoking history by current smoking status in South Carolina, 2012 (Behavioral Risk Factor Surveillance System).

Data in Table 2 demonstrate that the age-adjusted prevalence of each respiratory symptom and COPD increased with increasing smoking duration (linear trend, $P<0.001$). Among those who had smoked for ≥30 years, 25.6% reported COPD, 25.0% had frequent productive cough, 11.2% had frequent

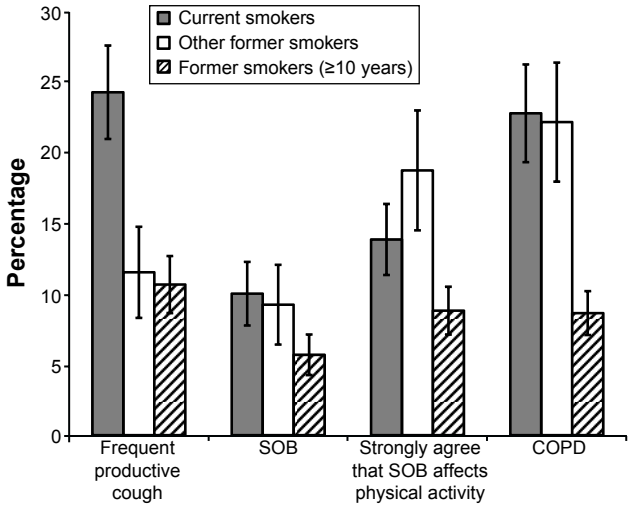

Figure 2 Age-adjusted percentage of respiratory symptoms and COPD among adults aged ≥45 years with a smoking history by current smoking status in South Carolina, 2012 (Behavioral Risk Factor Surveillance System).
Abbreviations: COPD, chronic obstructive pulmonary disease; SOB, shortness of breath.

Table 2 Age-adjusted prevalence and multivariable-adjusted likelihood of COPD and selected respiratory symptoms associated with smoking duration among adults aged ≥45 years with a history of smoking in South Carolina, 2012 (Behavioral Risk Factor Surveillance System)

Characteristic	Smoking duration (years)								P-value (linear trend)
	1–9		10–19		20–29		≥30		
	%[b]	PR (95% CI)[c]	%[b]	PR (95% CI)[c]	%[b]	PR (95% CI)[c]	%[b]	PR (95% CI)[c]	
Study population (n=4,135)[a]	799		952		930		1,454		
COPD	6.8	1.00 (referent)	9.1	1.32 (0.87–2.02)	11.6	1.64 (1.08–2.48)	25.6	3.39 (2.32–4.96)	<0.001
Frequent productive cough	7.0	1.00 (referent)	9.2	1.20 (0.73–1.97)	14.7	1.67 (1.04–2.69)	25.0	2.55 (1.63–3.98)	<0.001
Frequent SOB	3.7	1.00 (referent)	5.5	1.54 (0.81–2.95)	7.7	2.04 (1.10–3.77)	11.2	2.90 (1.64–5.15)	<0.001
Strongly agree SOB affects physical activity	6.4	1.00 (referent)	9.6	1.58 (0.97–2.58)	12.3	1.94 (1.20–3.14)	16.7	2.72 (1.71–4.31)	<0.001
Adults without COPD (n=3,495)[a]	738		871		811		1,075		
Frequent productive cough	5.8	1.00 (referent)	6.5	1.01 (0.55–1.85)	12.0	1.55 (0.87–2.74)	16.5	1.85 (1.06–3.21)	0.009
Frequent SOB	2.2	1.00 (referent)	3.4	1.48 (0.60–3.64)	4.8	1.90 (0.80–4.50)	3.7	1.37 (0.59–3.17)	0.51
Strongly agree SOB affects physical activity	4.8	1.00 (referent)	6.3	1.38 (0.72–2.61)	7.9	1.57 (0.84–2.96)	6.9	1.41 (0.74–2.67)	0.57

Notes: [a]Unweighted sample size; [b]weighted age-adjusted prevalence; [c]PR and 95% (CI) for the likelihood of having each dependent variable associated with selected years compared with 1–9 years of smoking were obtained from separate multivariable logistic regression models that included sex, age, race/ethnicity, education, and current smoking status (current vs former) as covariates.

Abbreviations: CI, confidence interval; COPD, chronic obstructive pulmonary disease; SOB, shortness of breath; PR, prevalence ratio.

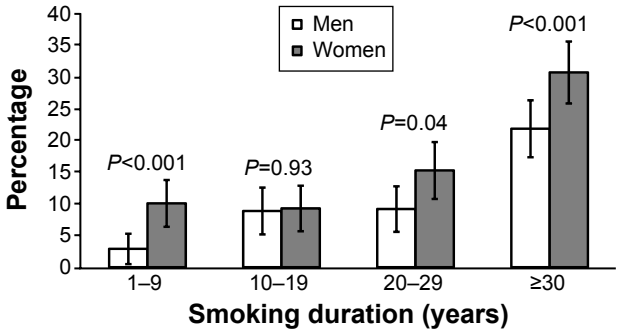

Figure 3 Age-adjusted prevalence of chronic obstructive pulmonary disease among adults aged ≥45 years with a history of smoking by sex and smoking duration in South Carolina, 2012 (Behavioral Risk Factor Surveillance System).

SOB, and 16.7% strongly agreed that SOB had affected physical activity in the previous year. After controlling for age, sex, race/ethnicity, education, and current smoking status, there remained an increased likelihood for having COPD and all three respiratory symptoms associated with increasing smoking duration (linear trend, $P<0.001$).

However, after restricting the analyses to the 3,495 respondents who responded that they had not been diagnosed with COPD, only one respiratory symptom remained significantly associated with smoking duration (Table 2, $P<0.001$). The age-adjusted percentage of respondents without COPD who reported having frequent productive cough increased with increasing smoking duration (linear trend, $P<0.001$). This relationship persisted even after adjustment for age, sex, race/ethnicity, education, and current smoking status (linear trend, $P=0.009$). However, only a modest significant association was observed among respondents without COPD and with a smoking duration ≥30 years compared with those in the 1–9 year duration (prevalence ratio 1.85; 95% confidence interval 1.06–3.21).

There was a borderline significant sex interaction ($P=0.085$) of the relationship between smoking duration and prevalence of COPD (Figure 3). The age-adjusted prevalence increased with increasing smoking duration for both men and women. However, women had a significantly higher age-adjusted prevalence of COPD than men for a smoking duration of 1–9 years (10.1% vs 2.8%, $P<0.001$), 20–29 years (15.3% vs 9.2%, $P=0.04$), and ≥30 years (30.9% vs 21.9%, $P<0.001$) but there was no difference at 10–19 years (9.3% vs 8.9%, $P=0.93$).

Discussion

Our study is the first population-based health survey in many years that has assessed the relationship between duration of tobacco use and respiratory outcomes in adults

with a smoking history in the USA. This study provides a population-based perspective of the relationship between smoking duration, three respiratory symptoms, and COPD in a US state with a high prevalence of current cigarette smoking and COPD. These relationships in a contemporary population in 2012 are consistent with similar dose–response relationships observed in a Norwegian study (1995–1997) for number of pack-years of smoking and chronic bronchitis, breathlessness, persistent coughing, coughing with phlegm, and reduced lung function.[7,8] We observed that the significant relationship between smoking duration and frequent productive cough was also present in adults without a self-reported diagnosis of COPD; however, the relationship between smoking duration, frequent SOB, and the effects of SOB on physical activity were not significant in adults without COPD. Our results also showed that smoking cessation for ≥10 years in contrast with current smoking was associated with a much lower prevalence of COPD and of each of the three respiratory symptoms. Our results are consistent with the COPD prevention strategy that smoking cessation improves respiratory function and prevents excessive decline in lung function in smokers with COPD as well as in smokers without chronic symptoms.[20,21] The health benefits of smoking cessation with regard to the rate of decline in forced expiratory volume in 1 second (FEV_1) and mortality appear to be most significant for persons who quit before 40–50 years of age.[14,22]

The sex difference in the age-adjusted relationship of smoking duration with COPD demonstrated in this study is consistent with reports that women may be more susceptible to the detrimental effects of smoking at the 1–9 year duration than men. Women were similar to men in terms of the significant relationship between smoking duration and respiratory symptoms. Prior studies conducted in the late 1990s and early 2000s suggested that women smokers were particularly susceptible to the deleterious effects of smoking, with an augmented decline in FEV_1 compared with male smokers.[6,8,9,11,20] In addition, results from the Lung Health Study (1986–1994) showed that smoking cessation has a greater impact on rate of FEV_1 decline in women than in men.[23] However, Kohansal et al did not report a sex difference in the loss of lung function associated with continued or stopping smoking.[14] Suggested explanations for the female–male difference in relationship between smoking duration and respiratory function have included sex variation in the prevalence of lifetime smoking, biologic differences such as smaller lungs and larger airways in women, hormonal factors that influence epithelial cell function, sex differences in inflammatory responses, greater awareness or recall of respiratory symptoms and diagnosed disease among women, and sex differences in the clinical presentation of COPD.[8,20,24] A previous study suggested that African-American women with COPD had a greater loss of lung function due to cigarette smoking than other COPD patients.[5,25] However, the current study did not have a sample size sufficient to assess that relationship in groups defined by race, sex, and smoking duration.

As would be expected, current smokers were more likely to have a frequent productive cough. The "smoker's cough" is consistent with chronic bronchitis, and is primarily due to excessive inflammation and hypersecretion of mucus secondary to smoking tobacco products.[3,26] Analysis of the COPDGene cohort showed that slightly more than one quarter of COPD subjects reported chronic bronchitis.[27] There was also a twofold increase in risk of chronic bronchitis in current smokers in the COPDGene study. In contrast, more than one-third of our study respondents reported a frequent productive cough, perhaps reflecting causes of chronic cough other than COPD. Notably, there was less of a difference in the frequency of dyspnea between current vs former smokers; we speculate that dyspnea may be an important reason for smoking cessation in some cases.

Chronic productive cough also increased with smoking duration among smokers with no evidence of COPD in the current study. A study that evaluated the relationship among respiratory symptoms, COPD, and airflow for over 30 years found that 40% of smokers developed chronic bronchitis and half of those developed COPD.[28] In the Seven Countries Study, among continuous smokers without chronic bronchitis or any other pulmonary disease, those with a smoking history of 20–40 pack-years (P=0.001) or >40 pack-years (P=0.002) had lower mean $FEV_{0.75}$ than those with a smoking history of <20 pack-years.[28] Furthermore, of smokers with no airflow obstruction in the COPDGene study, those with chronic bronchitis had a greater pack-year smoking history and were more likely to be current smokers than those without chronic bronchitis.[29] In that study, non-obstructive chronic bronchitis was defined by a history of cough and phlegm production for ≥3 consecutive months per year, and its results suggest that bronchitic symptoms such as productive cough in the absence of airflow obstruction could be an early marker of susceptibility and risk for COPD.[29–31] Unfortunately, COPD in the current study was defined by having emphysema, chronic bronchitis, and/or COPD, so that those subgroups cannot be determined.

Little information has been available in US populations to address the relationship between smoking duration, COPD, and respiratory symptoms, so this study is unique. However, our study had several limitations. First, the BRFSS is a cross-sectional study of the South Carolina population, so causal relationships between smoking duration, COPD,

and respiratory symptoms cannot be established. Second, the study response rate was less than 50% and selection bias might influence our results if participation varied by smoking duration. Third, the analyses relied on self-reported information from a telephone interview about current smoking, smoking duration, respiratory symptoms, and COPD, and cannot be validated. However, previous studies support that a self-report of provider-diagnosed COPD is highly reliable,[18,32] although undiagnosed COPD may affect our results.[33–35] Validity may also differ between self-reported emphysema and self-reported chronic bronchitis.[36]

While 76.4% of subjects with self-reported COPD also reported having had a breathing test in our study, there is no information regarding test interpretation. However, having had a breathing test did not differ by smoking status among those with COPD. This finding is comparable with that of a larger 2011 US survey of approximately 13,000 adults with self-reported COPD, in which the percentage of subjects having had a breathing test to diagnose COPD did not differ by smoking status.[37] Furthermore, use of smoking duration and current smoking status give only partial information about tobacco use. Other useful information for such a study could include intensity (number or packs smoked per day), pack-years (a product of intensity and duration), age at initiation, and time since cessation, but such information cannot be obtained during a time-limited interview.[19] However, our results are consistent with findings for pack-years of smoking that have been applied in previous studies.[5–7] In addition, using smoking duration rather than pack-years or additional smoking indicators that employ a time factor in the same analytic models may have helped to reduce multicollinearity and avoid a cohort effect.[19]

The US Preventive Services Task Force so far has found no evidence to support screening adults (including asymptomatic smokers) for COPD using spirometry.[38] However, the recommendations do suggest that current smokers should receive smoking cessation counseling and pharmacologic therapies that have been demonstrated to increase cessation rates. Smoking cessation may improve respiratory symptoms and bronchial hyperresponsiveness and prevent excessive decline in lung function among smokers with COPD as well as among smokers without chronic symptoms.[21] Smokers with respiratory symptoms, including dyspnea and productive cough, may be more susceptible to the effects of smoking on rate of decline in FEV_1 than those without symptoms, thus representing an important target group for smoking cessation interventions.[14] The United States Public Health Service guidelines recommend a simple intervention of "5 As", ie, "ask about tobacco use", "advise to quit", "assess willingness to make a cessation attempt", "assist in cessation attempt", and "arrange follow-up" to make prevention and cessation of tobacco use more successful.[39] Therefore, there are opportunities for physicians to provide tobacco cessation counseling to all patients who smoke, particularly those with respiratory symptoms and/or COPD. Such efforts will have the largest impact on decreasing COPD in men and women alike.

Conclusion

In this population-based survey of adults with a smoking history, prolonged tobacco use was associated with an increased likelihood of having COPD, frequent productive cough, frequent SOB, and agreement that SOB affected physical activity even after controlling for current smoking behavior. Former smokers who had quit smoking for ≥10 years had a lower prevalence of COPD and respiratory symptoms than current smokers. The prevalence of COPD was higher in women than in men at all levels of smoking duration. This study also demonstrates that the BRFSS is a useful surveillance tool to describe the association of potential risk factors for COPD and respiratory symptoms in an adult state population and could be expanded to other US states for public health surveillance purposes.

Acknowledgment

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Disclosure

The authors report no conflicts of interest in this work.

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