Prevalence of Chronic Obstructive Pulmonary Disease and Tobacco Use in Veterans at Boise Veterans Affairs Medical Center

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BACKGROUND: Although its prevalence is still debated, chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality in the United States, and smoking cessation remains the only intervention that can significantly improve the prognosis of COPD. METHODS: To determine the prevalence of COPD in a typical population seeking care at a Veterans Affairs Medical Center; the impact of smoking, age, and sex on the prevalence of COPD in this population; and how often spirometry is done in patients at risk for COPD, we extracted data from the Veterans Integrated Service Network 20 Consumer Health Information and Performance Sets database, on patients seen at the Boise Veterans Affairs Medical Center between January 1, 1999, and May 30, 2006. RESULTS: Approximately 8.8% (2,556/28,983) of all patients and 14.1% (1,152/8,149) of smokers were reported to have COPD. The odds of COPD in smokers, after adjusting for age and sex, was 3.18 (95% confidence interval 2.88–3.50) times greater than in nonsmokers. Males were 1.48 times more likely to have COPD than females, and there was an increasing risk of COPD with age. Thirty-nine percent of all veterans and 54% of those with COPD were active smokers. 273 (60%) of the 455 symptomatic smokers without a prior diagnosis of COPD were not evaluated with spirometry. CONCLUSIONS: The prevalence of COPD in patients at the Boise Veterans Affairs Medical Center was consistent with that in other United States surveys, although the underutilization of screening spirometry in those at risk for COPD may have caused underestimation of the prevalence. Smoking, age, and male sex were identified as significant risk factors for COPD, and the prevalence of active smoking remains high in this population of veterans. *Key words: chronic obstructive pulmonary disease; COPD; veterans; smoking; pulmonary function tests; risk factors.* [Respir Care 2010;55(5):555–560. © 2010 Daedalus Enterprises]

Introduction

Chronic obstructive pulmonary disease (COPD) is a leading public health concern worldwide, and currently ranks fourth as a cause of morbidity and mortality in the United States. Early figures suggested a United States age-adjusted prevalence of 110 per 1,000 in men, and 119 per 1,000 in women.[1] A more recent meta-analysis of studies from several countries published between 1990 and 2004 suggested a COPD prevalence of 9.9% in adults age ≥ 40 y.[2] The National Health and Nutrition Examination Survey estimated a COPD prevalence of approximately 12.5% in individuals who smoke—a known risk factor for the disease.[3] By 2020 COPD is projected to rank third as a global cause of mortality and fifth as a cause of morbidity.[4,5]

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Despite the economic burden of COPD[6] it was not until the Burden of Obstructive Lung Disease (BOLD) initiative[7] that more stringent and uniform definitions and tech-

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The authors have disclosed no conflicts of interest.

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niques were used to determine the burden of COPD. The recently published BOLD results[8] suggest a higher prevalence of COPD in the general population and among smokers than did previous estimates. This includes the sample from the United States. However, the BOLD authors and others raised the question of whether the Global Initiative for Chronic Obstructive Lung Disease (GOLD) definition of COPD (ratio of forced expiratory volume in the first second to forced vital capacity [FEV_1/FVC] < 0.70)[4] substantially over-diagnoses stage-1 COPD in older subjects.[9]

Despite the uncertainty about the true prevalence of COPD, it is clear that smoking is the primary risk factor for COPD and that smoking cessation is the only intervention that clearly alters the COPD mortality rate. Recent data also confirm that early smoking cessation significantly lowers the risk of COPD, when compared to later cessation or continuous smoking.[10] To try to lower the COPD mortality rate, the GOLD authors[4] emphasized screening for COPD and smoking cessation. Given the questions of the true prevalence of COPD and of the adequacy of our smoking-cessation programs, we set out to determine the prevalence of COPD and tobacco use in a typical patient population at the Boise Veterans Affairs Medical Center. We describe and compare the prevalence of COPD in this patient population to the national and global COPD trends, evaluate known demographic risk factors for COPD, and assess the adequacy of screening for COPD in those with COPD risk factors.

Methods

Data on Boise Veterans Affairs Medical Center patient age, sex, race, smoking history, COPD diagnosis, respiratory symptoms, and spirometry testing were extracted from the Veterans Integrated Service Network 20 Consumer Health Information and Performance Sets database for the period January 1, 1999, through May 30, 2006. All patients who sought medical care at the Boise Veterans Affairs Medical Center were included in our initial search.

To maintain patient confidentiality, no personal identifiers were collected. All patients older than 84 y and younger than 21 y were grouped together as older than 84 y and younger than 21 y, respectively, to reduce the likelihood of identifying individuals. Race was combined into white, other, and unknown, to maintain anonymity. This project was approved by the University of Washington institutional review board.

To determine the prevalence of COPD we used the International Classification of Diseases 9 (ICD-9) diagnostic codes for COPD and related diseases: bronchitis (490), chronic bronchitis (491), emphysema and emphysematous bleb (492), and chronic airway obstruction (496). All fields containing ICD-9 codes were searched. The total number of cases was divided by the total number of patients who visited the center during the study period. We assumed that patients who did not have a diagnosis of COPD did not have COPD.

To determine the prevalence of smokers, we used 2 methods to extract information on smoking status. Health-factor-code groups had been previously determined by the hospital administration as a means of better targeting patient populations who would most benefit from tobacco counseling. They grouped patients into smokers, previous smokers (within the last 7 y), and non-smokers (never smoked or quit > 7 y ago). Data from all patients with health-factor codes (obtained with a questionnaire administered by nursing staff at every primary care visit) were retrieved and analyzed. There were 2,522 patients who had conflicting health-factor codes (eg, never smoked and current smoker) due to a change in status over the study period. Those patients were classified as smokers or previous smokers. The numbers of smokers, previous smokers within the last 7 y, and non-smokers were divided by the total number of individuals with smoking information to determine the proportion in each category.

In an attempt to capture patients who might not have undergone screening with health-factor codes, we tallied patients with ICD codes indicating tobacco use (305.1), a history of tobacco use (V15.82), or tobacco use intervention (799.9), from the same Veterans Integrated Service Network 20 Consumer Health Information and Performance Sets database. The data collected by physicians identified only 13.8% of patients (4,011/28,983) as smokers, compared to 38.9% identified as smokers with the health-factor codes. Of the 4,011 individuals identified as smokers by physicians, 414 were misclassified as non-smokers with the health-factor codes, which suggests a 10.3% error rate. We corrected the classification of those 414 patients to reflect their smoking status. In addition, 456 patients who did not have health-factor information but were identified by physicians as smokers were added to the data set.

We used a logistic regression model to determine whether age at diagnosis, sex, or smoking status were statistically associated with COPD or one of the related COPD conditions. To simplify the model, and since there was no significant difference between previous smokers and smokers, these 2 groups were aggregated. We also categorized the age at diagnosis into 3 groups (under 50 y, 50–65 y, and ≥ 65 y) to improve the fit of the logistic regression analysis. We tested all first-order interaction terms for significance, and performed a Hosmer-Lemeshow goodness-of-fit test to determine whether the model fit the data. We report the prevalence of COPD for all significant risk factors, controlling for all others. We considered a factor significant if its P was $< .05$.

Table 1. Demographics of Patients at the Boise Veterans Affairs Medical Center, January 1, 1999, to May 30, 2006

	Total Population	Patients With Smoking-Status Data				Patients With COPD
		Total	Smoker	Previous Smoker	Nonsmoker*	
Total (*n*)	28,983	20,906	8,149	279	12,478	2,556
Male (*n*, %)	26,993 (93.1)	19,722 (94.3)	7,730 (94.8)	268 (96.1)	11,724 (94.0)	2,504 (98)
Race† (%)						
White	75.3	ND	ND	ND	ND	ND
Unknown	21.9	ND	ND	ND	ND	ND
Other	2.8	ND	ND	ND	ND	ND
Age‡ (mean ± SD)	ND	61.1 ± 15.0	56.1 ± 13.6	63.8 ± 13.6	64.3 ± 15.0	67.8 ± 10.4
Prevalence of COPD (%)	8.8	10.2	14.1	16.1	7.5	100

*Nonsmokers include those who previously smoked but quit > 7 y ago.
†Race data available for 14,357 patients.
‡Age at time of first visit.
COPD = chronic obstructive pulmonary disease
ND = no data available

To determine the population of patients with respiratory symptoms, we extracted ICD-9 codes data on respiratory symptoms, including, dyspnea, shortness of breath, cough, wheezing, tachypnea, hemoptysis, and painful respiration.

To determine the population of patients who had spirometry tests, we collected Current Procedural Terminology codes data on patients who were reported to have had any of 7 pulmonary-function tests (PFTs): spirometry, bronchodilator responsiveness, vital capacity, functional residual capacity or residual volume, thoracic gas volume, respiratory flow-volume loop, and multiple-breath nitrogen washout curve. We compared the list of individuals who had PFTs to those diagnosed with COPD. The numerical results of the PFT studies were not in the database and therefore could not be analyzed.

We ran a query to determine whether patients who were smokers or had a history of smoking in the last 7 y had undergone at least one PFT during the study period (January 1, 1999 to May 30, 2006). We also queried how many patients with respiratory symptoms and a history of smoking in the last 7 y had undergone a PFT.

Descriptive and statistical analyses were done with statistics software (Minitab 15.0, Minitab, State College, Pennsylvania).

Results

General Population

There were 28,983 patients with unique social security numbers who visited the Boise Veterans Affairs Medical Center between January 1, 1999, and May 30, 2006. Ninety-three percent of these patients were male, and of the 14,330 patients with information on their race, 75% were white (Table 1).

Chronic Obstructive Pulmonary Disease

Approximately 8.8% (2,556/28,983) of the patients were reported to have COPD or a related condition. Ninety-eight percent of those patients were male. The mean age of individuals with COPD was 67.8 y (range 26.4–97.8 y, see Table 1).

Smoking Status

Smoking status was available for 20,906 patients. Approximately 39.0% of these patients were smokers, 1.3% were previous smokers, and 59.7% reported never having smoked in the last 7 y (see Table 1). The average age of patients who smoked was 56.1 y, and that of the reported non-smokers was 64.3 y. The demographics of this subset of patients were similar to that of the general patient population (see Table 1).

There was information on the smoking status of 2,130 of the 2,556 patients with COPD. Approximately 54% (1,152/2,130) were smokers, 2.1% (45/2,130) were previous smokers, and 43.8% (933/2,130) were nonsmokers (ie, never smokers or quit > 7 y earlier).

Males > 65 y of age with a history of smoking had the highest prevalence of COPD (Table 2). The logistic regression analysis suggests that smoking, sex, and age are significantly associated with COPD (Table 3). After controlling for smoking status and age, males were 1.48 times more likely to have COPD than were females (odds ratio 1.48, 95% confidence interval [CI] 1.09–2.02, $P = .01$). After controlling for age and sex, smoking within the last 7 y increased the odds of COPD by 3.18 (95% CI 2.88–3.50, $P < .001$). Age was a significant risk factor for COPD. After adjusting for sex and smoking differences, individuals 50–65 y old were 5.10 times more likely to

Table 2. Prevalence of COPD

	Prevalence of COPD (%, 95% CI)	
	Smokers and Previous Smokers	Nonsmokers
Male (all ages)	14.6 (13.9–15.4)	7.8 (7.3–8.3)
Male < 50 y	3.2 (2.5–3.9)	0.9 (0.5–1.5)
Male 50–65 y	14.5 (13.3–15.7)	4.5 (3.9–5.2)
Male > 65 y	27.9 (26.1–30.0)	11.6 (10.8–12.4)
Female (all ages)	6.3 (4.2–9.0)	2.5 (1.5–3.9)
Female < 50 y	2.3 (0.9–4.6)	0.8 (0.2–2.2)
Female 50–65 y	13.3 (6.8–22.4)	4.7 (2.2–8.8)
Female > 65 y	23.1 (11.1–39.3)	4.0 (1.6–8.1)

COPD = chronic obstructive pulmonary disease
CI = confidence interval

Table 3. Logistic Regression Analysis on COPD Data From Boise Veterans Affairs Medical Center, January 1, 1999, through May 30, 2006

Predictor	Odds Ratio (95% CI)	*P*
Male*	1.48 (1.09–2.02)	.01
Smoked in the last 7 y†	3.18 (2.88–3.50)	<.001
Age 50–65 y‡	5.10 (4.12–6.30)	<.001
Age > 65 y‡	12.4 (10.07–15.28)	<.001

*Reference category = female.
†Reference category = had not smoked in the last 7 y
‡Reference category = age < 50 y
COPD = chronic obstructive pulmonary disease
CI = confidence interval

have COPD than individuals younger than 50 y (odds ratio 5.1, 95% CI 4.12–6.30, $P < .001$), and individuals older than 65 y were 12.4 times more likely to have COPD than individuals younger than 50 y (odds ratio 12.4, 95% CI 10.07–15.28, $P < .001$). The Hosmer-Lemeshow statistic suggests that the logistic regression model, which included sex, smoking status, and age, fit the data adequately ($P = .68$). No first-order interaction terms were significant (ie, sex × age, age × smoking status, or smoking status × sex, P always $> .29$).

Respiratory Symptoms

Respiratory symptoms were recorded for 1,885 patients during the study period. Coughing and shortness of breath were the most commonly reported symptoms. Of the 2,556 patients with COPD (or related condition) only 418 had respiratory symptoms entered in the database, and 248 had their COPD diagnosis recorded before the symptoms were recorded.

Spirometry

A total of 3,657 patients had one or more PFTs. The average age of these patients at the time of their first PFT was 61.6 ± 14.1 y. For the smokers the average age at the time of first PFT was 59.8 ± 11.9 y. For the non-smokers and those who had quit smoking > 7 y earlier the average age at first PFT was 64.6 ± 13.9 y. Approximately 20% of the PFTs were with individuals < 50 y of age, 35% of the PFTs were with individuals 50–65 y old, and 45% were with individuals > 65 y of age. This age distribution is similar to that of the general patient population seeking care at the Boise Veterans Affairs Medical Center.

Smoking status and sex data were available for 3,055 of the 3,657 patients who had PFTs. Of those, 48.8% (1,492/3,055) were smokers, 49.1% (1,499/3,055) were nonsmokers, and 2.1% (64/3,055) were previous smokers. Approximately 18% (1,492/8,149) of individuals identified as smokers had a spirometry test at some time during the study period. A slightly higher percentage of previous smokers (64/279, 22.9%) had spirometry at some time during the study period. Only 12% (1,499/12478) of the nonsmokers and approximately 45.5% (1,164/2,556) of those with a diagnosis of COPD were reported to have had a PFT. Ninety-five percent of the PFTs were performed on males.

Of the 1,692 patients with respiratory symptoms and information on their smoking status, 642 were smokers or previous smokers and 1,050 were non-smokers. Of these 642 individuals, 187 had a diagnosis of COPD. Of the remaining 455 patients with respiratory symptoms and a history of smoking, 273 (60%) did not have spirometry within the study period.

Discussion

The overall prevalence of COPD and related conditions for patients seeking medical care at the Boise Veterans Affairs Medical Center between January 1, 1999, and May 30, 2006, was 8.8% (see Table 1), which is consistent with a recent meta-analysis of adults age ≥ 40 y throughout the world,[2] and with prior United States estimates from the National Health and Nutrition Examination Survey (1988–1994).[3]

Our logistic regression analysis suggested the odds of COPD were significantly higher for individuals who had smoked in the last 7 y, males, and individuals over age 65 y (see Tables 2 and 3).

The prevalences of COPD in male and female smokers and nonsmokers of various age groups were similar to the North American estimates of stages II through IV COPD reported in the BOLD study.[8] The similarity was somewhat unexpected, given the differences in study populations (ie, hospital-based vs general public). The low re-

sponse rate in the American study population in the BOLD study, and the fact that the BOLD authors included individuals from only one city, Lexington, Kentucky, which was reported to have high occupational exposure to air particulates and a high prevalence of smokers, may have biased their prevalence estimates. Contributing to the unexpected high prevalence of COPD in the BOLD study was the use of the GOLD definition of COPD ($FEV_1/FVC < 0.70$),[4] which may significantly over-diagnose stage-1 COPD in older subjects.[9] In contrast we, like others,[2] relied on the physician's diagnosis to identify cases of COPD, which may have under-diagnosed early stages of the condition.

The only notable discrepancy between our results and those of others was with regard to the relationship between sex and COPD. We observed a higher prevalence of COPD in males than in females, after controlling for age and smoking status (see Tables 2 and 3). This was contrary to the findings of Feinlieb et al[1] and the BOLD study,[8] which suggest that United States females have a higher risk of COPD than males. It is possible that the female patients at the Veterans Affairs Medical Center are less susceptible to COPD than the populations of females observed by others. It is also possible that our coarse categorization of the smoking and age resulted in inadequate adjustment of these variables and confounding bias. There may also have been bias toward diagnosing COPD more in males than in females, which has been reported by others.[11] Further, our odds ratios were based on a sample of only 46 females with COPD, out of a population of 1,184 females, compared to 2,084 males with COPD, out of 19,722 males. It is therefore possible there was an interaction between smoking, sex, and age, but because of the low numbers of females with COPD, it was not detected in our statistical model. The high ratio of males to females in the Veterans Affairs system is a limitation of studying this population, so conclusions about the female population must be drawn with caution.

Another limitation of this data set was that we could not determine how long the individuals had smoked, which made it impossible to determine the relationship between age, smoking, and COPD. Though early smoking cessation lowers the risk of developing COPD to near the risk of never-smokers,[10] it is likely that our combining individuals who had never smoked with those who quit more than 7 y earlier slightly overestimated the prevalence of COPD in the "nonsmoking" group and underestimated the odds ratio of COPD for smokers.

The prevalence of current tobacco use in this veterans population (39%) and more specifically in those with COPD (54%) is dramatically higher than in the general United States population (19.8% in 2007)[12] or in the state of Idaho (17.9% in 2005).[13] This highlights the need to more aggressively screen veterans for COPD and to intensify the smoking-cessation programs for veterans.

The high prevalence of COPD in the older patients with a history of smoking at the Boise Veterans Affairs Medical Center suggests that COPD screening programs should target smokers in their 50s. Recently the Veterans Administration adopted the recommendations of GOLD, the American Thoracic Society, and the European Respiratory Society to conduct screening spirometry on all patients with respiratory symptoms and a history of smoking.[14,15] To assess prior compliance with this new recommendation we examined the data set to determine whether smokers with respiratory symptoms underwent spirometry. The diagnostic codes for respiratory symptoms were recorded for only 642 smokers, of whom 187 were diagnosed with COPD, 182 were screened for COPD and were negative, and 273 were not evaluated. Respiratory symptoms were probably under-reported in the database, since only 418 of the 2,556 COPD patients reported respiratory symptoms. Nonetheless, it appears that patients were not consistently screened for COPD, despite having some risk factors and symptoms.

While the diagnosis of COPD should be made only after spirometry, some[16] have questioned whether spirometry is under-utilized. We found that more than 50% of the COPD cases were diagnosed without the use of PFTs during the study period, potentially due to testing done prior to our sampling window. Other contributors to this finding include patients who refuse or cannot tolerate PFTs and who are diagnosed empirically, often based on obvious emphysema seen on imaging and/or air-flow obstruction found on physical examination. Interestingly, there did not appear to be a strong age or sex bias to the population that received PFTs. That is, the age distribution and proportion of PFTs conducted on males and females (95% and 5%, respectively) were very similar to the age distribution and proportion of males and females who sought health care at the Boise Veterans Affairs Medical Center during the study period (see Table 1).

Our findings on the use of PFTs raise the question of how we can better diagnose early stages of COPD. The Veterans Affairs Health Care System, as the largest integrated health-care system in the United States, with its dramatic advances in the use of an electronic medical record, has improved its delivery of primary care and prevention through various computerized clinical reminders to its health-care providers. Computerized clinical reminders to consider spirometry in patients with respiratory symptoms and a history of smoking would be a natural extension of the current computerized clinical reminder system.

Conclusions

We found a COPD prevalence of 8.8% at the Boise Veterans Affairs Medical Center—a figure that is compa-

rable to prior figures for the general United States population. COPD was found to be more prevalent in smokers, males, and individuals older than 65 y. Thirty-nine percent of the veterans population and 54% of those with COPD continued to smoke, which highlights the need for more intensive smoking-cessation programs. We also identified a population of symptomatic smokers without a prior diagnosis of COPD who had not undergone spirometry, which suggests the need to more aggressively screen the at-risk population for COPD and raises the possibility that underdiagnosis of COPD may have resulted in an underestimation of the prevalence of COPD in the study population.

ACKNOWLEDGMENTS

We thank Felicia Price and Mary Curtis for assistance with the Veterans Integrated Service Network 20 database and health-factors data.

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