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Original article

Prevalence of COPD among symptomatic patients in a primary care setting

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Abstract

Objective:
Spirometry is recognized as the gold standard assessment for the diagnosis of COPD. However, spirometry continues to be underused, perpetuating the underdiagnosis of COPD. The aim of this study was to evaluate the prevalence of COPD in a primary care setting in patients with a smoking history and self-reported chronic bronchitis symptoms.

Research design and methods:
This was a multi-center, cross-sectional study. The primary assessment was the percentage of patients with airway obstruction (post-bronchodilator FEV_1/FVC ratio ≤ 0.70) compared to those without obstruction (post-bronchodilator FEV_1/FVC ratio > 0.70).

Results:
Airflow obstruction consistent with COPD was confirmed in 26% of patients (mean age 52.9 years, FEV_1 81.4% predicted and smoking history 39.8 pack-years) that reported chronic bronchitis symptoms. Airflow obstruction increased with age and smoking history. Slight or moderate dyspnea was reported by 68% of patients and the majority had not talked to their doctor about cough and continued to smoke.

Limitations:
Patients were evaluated at a single visit. The definition of airway obstruction used may have lead to overdiagnosis in patients aged 70 and older.

Conclusion:
This study confirms that many patients with COPD remain undiagnosed in the primary care setting. Evaluation of spirometry in patients with a smoking history and chronic bronchitis symptoms can aid in the diagnosis of COPD, allowing earlier treatment thereby reducing the burden of this debilitating disease.

Clinical trial registration:
Study code ADC109043; clinicaltrials.gov #NCT00442468.

Introduction

Chronic obstructive pulmonary disease (COPD) is defined as a preventable and treatable disease characterized by airflow limitation that is not fully reversible. The airflow limitation is progressive and is associated with an abnormal inflammatory response of the lungs to noxious gases and particles and is primarily caused by cigarette-smoking[1,2].

A clinical diagnosis of COPD should be considered in any patient who has dyspnea, chronic cough or sputum production, and a history of exposure to risk factors such as cigarette smoking. The diagnosis of COPD is confirmed using

spirometry, by a post-bronchodilator forced expiratory volume in one second/forced vital capacity (FEV_1/FVC) ≤ 0.70, demonstrating airway obstruction[1,2]. COPD guidelines affirm spirometry as the gold standard for the diagnosis of COPD and consensus statements advocate the widespread use of spirometry in primary care[1,3]. However, there is evidence that spirometry is infrequently used to confirm the diagnosis of COPD[4–6]. Demonstration of airway obstruction via spirometry is a strong predictor for rapid progression of COPD and of morbidity and mortality due to COPD[3,7–9].

COPD is most prevalent among cigarette smokers, which account for 80–90% of cases diagnosed[2,10,11]. The incidence of COPD increases with age, smoking history and the presence of respiratory symptoms[12,13]. Despite the increasing incidence, nearly half of the patients with the disease remain undiagnosed[14].

The aim of this cross-sectional study was to evaluate the prevalence of COPD in a primary care setting in patients with a history of cigarette-smoking and self-reported symptoms of chronic bronchitis. We believe this is the first study to clearly evaluate the prevalence of COPD in the aforementioned setting and patient population.

Patients and methods

Patients were male or female outpatients aged > 40 years, who were either current or previous smokers of ≥10 pack-years with self reported symptoms of chronic bronchitis, defined as the presence of productive cough for at least three consecutive months in each of two successive years. Patients were excluded if they regularly used (defined as 'prescribed for use on a daily basis') ipratropium, ipratropium/albuterol combinations, tiotropium, salmeterol, formoterol, inhaled corticosteroids, inhaled corticosteroids/long acting beta-agonist combinations, theophyllines or oral beta-agonists within 6 months prior to the study visit, had previous lung surgery, had a current diagnosis of a significant lung condition (including but not limited to asthma, lung cancer, cystic fibrosis, pulmonary fibrosis, bronchiectasis, active tuberculosis, sarcoidosis, or alpha-1-antitrypsin deficiency) other than chronic bronchitis, had been evaluated by a pulmonary specialist within the past 3 years, had a COPD diagnosis confirmed by spirometry at any time or performance of spirometry testing in the past 5 years or had a medical or physical condition that would interfere with adequate performance of spirometry.

Study design

This was a multi-center, cross-sectional study conducted from March 2007 to October 2007 in 50 primary care sites in the US. For each site, an institutional review board or ethics committee approved the study and all patients provided written informed consent prior to the conduct of study procedures. Eligible patients completed a single study visit encompassing all required study assessments.

The primary assessment was the percentage of patients with a post-bronchodilator FEV_1/FVC ratio ≤ 0.70 compared to those with a FEV_1/FVC ratio > 0.70. Secondary assessments included pre-bronchodilator FEV_1 and FEV_1/FVC ratio, post-bronchodilator FEV_1, post-bronchodilator FEV_1 reversibility, demographic information (sex, ethnic origin, age, height, and weight), smoking history, current medications, and subject completed questionnaires. Post-bronchodilator spirometry was conducted after patients self-administered four puffs (360 mcg) of albuterol via a metered dose inhaler (MDI) at the study site under the supervision of trained study coordinators. Spirometry was performed using standardized spirometry equipment provided by Biomedical Systems Corporation, St. Louis, Missouri, US, which exceeded the minimum performance recommendations of the American Thoracic Society (ATS)[15].

A composite questionnaire was used in this study. The questionnaire consisted of three individually validated questionnaires: the medical research council (MRC) dyspnea scale, the 12-item Short Form Health Survey (SF-12, version 2), a modified ATS respiratory questionnaire and additional questions about respiratory disease history, smoking history, and work and non-work activities missed due to breathing problems. The MRC dyspnea scale uses a 5-point scale to evaluate the degree of dyspnea (none, slight, moderate, severe and very severe) by the assessment of the amount of routine daily physical activity that precipitates dyspnea, the level of physical activity (including strenuous exercise to walking and to dressing and undressing)[16]. The SF-12 includes 12 questions from the SF-36 Health Survey[17]. These questions address physical functioning; role limitations because of physical health problems; bodily pain; general health perceptions; vitality; social functioning; role limitations because of emotional problems; and general mental health. The modified ATS questionnaire evaluated cough and phlegm symptoms, wheezing and chest colds/chest illness symptoms, past illnesses, occupational history and socioeconomic status, tobacco smoking, and medical history[18]. The questionnaire was completed by each study patient prior to spirometry.

Statistical analysis

Sample size considerations were based on providing an adequate number of subjects within subgroups of interest within the study population. Power analyses were not performed.

The analysis population included all patients enrolled in the study. Subgroups of interest were determined a

priori as post-bronchodilator FEV_1/FVC (≤0.70, >0.70); age group (≥50–<60, ≥60–<70, ≥70 years); smoking history (≥10–<20, ≥20–<30, ≥30–<40, ≥40 pack-years) and MRC dyspnea score (none–slight, moderate, severe–very severe).

Descriptive summaries were generated to characterize the study population and estimate the prevalence of airflow obstruction and other disease characteristics consistent with COPD. However, no formal statistical testing was done to evaluate differences between certain subgroups of patients.

Using stepwise multivariable logistic regression, the best model for predicting airway obstruction (post-bronchodilator FEV1/FVC ≤ 70%) was selected. Factors in the regression model included age, sex, race, BMI, investigative region, MRC score, smoking status, and pack-years. Model selection was based on a significance level of 0.05.

Results

Patients

A total of 1283 patients were enrolled, with 1100 (86%) completing all study procedures. Demographic data are summarized in Table 1. Patients had a mean age of 52.9 years, were predominately white (80%), current smokers (87%) with mild airway obstruction demonstrated by a mean post-bronchodilator FEV_1% predicted 81.4%.

Airflow obstruction

For the primary assessment of post-bronchodilator FEV_1/FVC ratio, 308 (26%) patients had a post-bronchodilator FEV_1/FVC ratio ≤ 0.70 as compared to 893 (74%) with a post-bronchodilator FEV_1/FVC ratio > 0.70. Thirty-four percent of patients had a pre-bronchodilator FEV_1/FVC ratio ≤ 0.70.

The incidence of airflow obstruction increased with increasing age. This was true when looking at each increment of age (i.e. >50 years) and pack-year smoking history (i.e. >10 pack-year history) as well as ranges (i.e. ≥50–<60 years and ≥10–<20 pack-year smoking history (Table 2). While a quarter (26%) of patients >40 years of age demonstrated airflow obstruction, over a third (35%) of patients >50 years of age and nearly half (47%) of patients >60 years of age were obstructed. In patients >40 years of age with a ≥40 pack-year history of smoking, nearly 40% of patients had airway obstruction consistent with COPD. However, the percent of patients with airway obstruction consistent with COPD across MRC dyspnea scale subgroups were similar.

Patients with a post-bronchodilator FEV_1/FVC ratio ≤0.70 were older (57 versus 51 years), included a higher percentage of males (52% versus 41%), had a greater mean pack-year smoking history (48 versus 37 pack-years), had lower post-bronchodilator percent of predicted FEV_1 (68% versus 86% of predicted) compared to patients with a post-bronchodilator FEV_1/FVC ratio of >0.70. Using stepwise multivariable logistic regression, age,

Table 1. Demography and patient characteristics.

Characteristic	Total ($N = 1283$)
Age, yrs	52.9 ± 9.1
Male, %	45
Race, %	
White	80
Black	17
Other	3
Body mass index, kg/m^2	28.7 ± 6.5
Current smoker, %	87
Smoking history, pack-yrs	39.8 ± 21.7
Concomitant medication use by >5% of patients, %	
Any medication	75
Acetylsalicylic acid	16
Vitamins	10
Lisinopril	8
Atorvastatin calcium	7
Ibuprofen	7
Hydrochlorothiazide	6
Simvastatin	6
Completed high school	39%
Completed post-secondary/further education	29%
Completed university graduate or post-graduate degree	16%
Worked full time job for ≥6 months	95%
Worked in a dusty job for ≥1 year	51%
Ever been exposed to fumes in work	35%

All values are presented as absolute numbers or means ± SD.

Table 2. Frequency (number) of Patients with Post-bronchodilator FEV_1/FVC ≤ 70%.

Pack-years	Age > 40 yrs	Age > 50 yrs	Age > 60 yrs	Age > 70 yrs
>10	26% (298/1126)	35% (218/630)	47% (112/237)	58% (32/55)
≥10–<20	17% (24/144)	20% (13/64)	28% (5/18)	14% (1/7)
>20	28% (264/955)	36% (196/545)	49% (106/217)	61% (31/51)
≥20–<30	14% (32/221)	18% (17/92)	14% (4/28)	0% (0/3)
>30	32% (224/693)	40% (178/443)	54% (99/185)	65% (31/48)
≥30–<40	23% (69/294)	29% (39/135)	47% (14/30)	43% (3/7)
>40	35% (159/452)	43% (138/319)	55% (84/153)	72% (28/39)
≥40	36% (175/492)	43% (150/348)	54% (89/164)	68% (28/41)

Table 3. Predictors of airway obstruction (post-bronchodilator FEV_1/FVC ratio ≤ 0.70).

Variable	Adjusted odds ratio (95% CI)	*P*-value
Age (10 year increase)	2.0 (1.7, 2.4)	<0.001
Body mass index (5 unit decrease)	1.3 (1.2, 1.5)	<0.001
Pack-years (20 year increase)	1.2 (1.1, 1.4)	0.002
Smoking status (current versus former)	1.9 (1.2, 3.1)	0.005
Sex (male versus female)	1.5 (1.1, 1.9)	0.007

Table 4. Pre- and post-bronchodilator spirometry measures.

	Total ($N = 1283$)
Subjects completing pre-bronchodilator spirometry, *n* (%)	1273 (99)
Pre-bronchodilator FEV_1, L	2.46 ± 0.72
Pre-bronchodilator FEV_1, % predicted	78.9 ± 17.2
Pre-bronchodilator FVC, L	3.41 ± 0.92
Pre-bronchodilator FEV_1/FVC, %	72.2 ± 8.8
Subjects completing post-bronchodilator spirometry, *n* (%)	1201 (94)
Post-bronchodilator FEV_1, L	2.53 ± 0.73
Post-bronchodilator FEV_1, % predicted	81.4 ± 17.1
Post-bronchodilator FVC, L	3.42 ± 0.91
Post-bronchodilator FEV_1/FVC, %	74.0 ± 9.1
Post-bronchodilator FEV_1 reversibility, %	4.0 ± 9.6

All values are presented as absolute numbers or means ± SD.

body mass index, pack-year smoking history, smoking status, and sex were predictors of airway obstruction (post-bronchodilator FEV_1/FVC ratio of ≤ 0.70) (Table 3).

Patients with a ≥40 pack-year history of smoking were older (57 versus 49–51 years) and had a lower post-bronchodilator FEV_1 percent of predicted (77% versus 83–86% of predicted) compared to patients with a ≥10–<20, ≥20–<30 and ≥30–<40 pack-year history of smoking. The percent of patients with a FEV_1/FVC ratio ≤0.70 was similar among patients with ≥10–<20 (22%) and ≥20–<30 (23%) pack-year history; however, in patients with a ≥30–<40 (33%) and ≥40 (44%) pack-year history of smoking a higher percentage of patients had a FEV_1/FVC ratio ≤0.70.

Post-bronchodilator FEV_1 percent of predicted FEV_1 decreased with increasing MRC dyspnea scores. For age subgroups, pack-year history of smoking (≥50–<60, 41-pack-years; ≥60–<70, 50 pack-years and ≥70, 57 pack-years) and the percentage of patients with a FEV_1/FVC ratio ≤0.70 (≥50–<60, 23%; ≥60–<70, 46% and ≥70, 52%) increased with increasing age. Pack-year history of smoking (0–1, 38 pack-years; 2, 43 pack-years and 3–4, 50 pack-years) increased with worsening MRC dyspnea scores and post-bronchodilator FEV_1 percent of predicted (0–1, 82%; 2, 80% and 3–4, 76%) decreased with worsening MRC dyspnea scores. The percent of patients with a FEV_1/FVC ratio ≤0.70 was similar among patients with a MRC dyspnea score of 0–1 (26%), 2 (22%) and 3–4 (30%).

Pre- and post-bronchodilator spirometry assessments are summarized in Table 4. The mean pre- and post-bronchodilator FEV_1 were 2.46 L (79% of predicted) and 2.53 L (81% of predicted), respectively. The majority of patients, 1088 patients (91%) were not reversible (defined as an increase in FEV_1 of 200 mL and ≥12% post-bronchodilator).

MRC dyspnea scale

The most frequent response for the MRC dyspnea scale (572 patients, 47%) was a score of slight dyspnea. A total of 26% of patients had a score of none and a moderate score was reported for 21% of patients, with severe to very severe scores only reported by 6% of patients. The mean MRC dyspnea scores were similar in patients with airway obstruction consistent with COPD (post-bronchodilator FEV_1/FVC ratio ≤0.70) and those without airway obstruction (post-bronchodilator FEV_1/FVC ratio >0.70).

Modified ATS respiratory questionnaire

A summary of cough and phlegm symptoms and wheezing and chest colds/chest illness symptoms from the modified ATS respiratory questionnaire are presented in Table 5.

Exacerbations

Thirty-eight percent of patients had a chest illness that kept them at home within the last 3 years and with 80% reporting a chest illness that produced phlegm. Bronchitis attacks were reported by 50% of patients with 81% of patients having the condition confirmed by a doctor. Pneumonia was reported by 34% of patients and 19% of patients received antibiotics for a chest illness in the 12 months prior to the study. Thirty percent required treatment for wheezing attacks and 43% had wheezing with shortness of breath.

Tobacco smoking/medical history

As of 1 month prior to the study visit 86% of patients were smoking. The mean age when patients first started smoking was 17.2 years. Patients smoked an average of 21 cigarettes/day at the time of the visit. A total of 76% and 60% of patients reported that their father and mother, respectively, were cigarette smokers with 79% of patients having someone who smoked regularly in their childhood home. Sixty-two percent of patients were exposed to tobacco smoke from others within 24 hours prior to the study visit with 46% of patients having someone else in their home who smoked regularly.

Table 5. Key findings from modified ATS respiratory questionnaire.

	Yes	No	Don't Know
Usually have cough	79%	18%	3%
Usually bring up phlegm from chest	73%	24%	2%
Chest sound wheezy or whistling	75%	21%	3%
Ever had wheezing attack with SOB	43%	50%	6%
Required treatment for wheezing attacks	30%	65%	5%
Ever had asthma	8%	87%	5%
	Never	Some-times	Most Days
Chest wheezy with exercise or exertion	21%	58%	21%
Chest wheezy with exposure to pollen	35%	47%	18%
Chest wheezy after taking aspirin	88%	11%	<1%
Chest wheezy with dust exposure	31%	53%	15%
	Mean	Min	Max
How many years had cough	9.0	0	58
How many years had trouble with phlegm	8.6	0	80
How long cough/phlegm epi-sode per year	7.8	0	50
How many years had wheezing/whistling	7.8	0	58
Age first wheezing attack with SOB	41	0	88
No. of chest illnesses with increased phlegm in last 3 years	3.6	0	98

Of the medical conditions included in the questionnaire, hypertension (518 patients, 41%) was the most frequently reported condition. Other conditions reported by ≥25% of patients were gastrointestinal reflux disease (36%), depression requiring treatment (29%), and anxiety/panic attacks (26%). Conditions such as heart trouble, heart attack, stroke, and heart failure were reported more frequently in patients with airway obstruction consistent with COPD.

SF-12 health survey

The majority of patients (53%) reported that they were in good health with 21% of patients reporting fair or poor health. The majority of subjects had little or no limitation with moderate activities or climbing stairs and reported that they felt downhearted or depressed at little of the time or none of the time. The highest mean scores were observed for role-emotional and social functioning, with the lowest score observed for vitality. The scores for the mental component summary and the physical component summary were 47.9 and 42.9, respectively.

Discussion

The results from this study suggest that approximately 1 in 4 smokers 40 years of age and older with self reported symptoms of chronic bronchitis in primary care settings have airway obstruction consistent with a diagnosis of COPD.

Underdiagnosis of COPD in primary care is a recognized problem[19,20]. Several factors are thought to contribute to the underdiagnosis of COPD such as patients not reporting symptoms until they have severe disease or significant impairment, patients adapting their lifestyle to the subtle onset of symptoms, lack of access to spirometry in primary care and lack of primary care physician awareness of the treatability of COPD[21–24].

Often in clinical practice only pre-bronchodilator spirometry is utilized in the diagnosis of COPD[25]. Guidelines recommend that post-bronchodilator spirometry be performed to confirm the diagnosis of COPD[1,2]. A recent study indicated that when spirometry was utilized in the diagnosis of COPD in primary care, post-bronchodilator spirometry was done less than half of the time[26]. Compared to post-bronchodilator spirometry, the use of pre-bronchodilator spirometry may result in a higher rate of COPD diagnosis[25]. The current study supports these findings. When pre-bronchodilator FEV_1/FVC ratio ≤70 was used to indicate obstruction consistent with COPD, 34% of patients would have been identified as compared to the 26% identified when a post-bronchodilator FEV_1/FVC ratio ≤70 was utilized.

This study found that 26% of all patients 40 years of age or older with smoking history and self reported symptoms of chronic bronchitis had airflow obstruction consistent with COPD and reiterates the importance of spirometry. These results are slightly higher, but still in line with previous studies in primary care settings that found 10–22% of patients with undiagnosed COPD[10,27–30]. The current study may have found a higher incidence of undiagnosed COPD because patients enrolled were required to have both a 10 pack-year history of smoking and self-reported symptoms of chronic bronchitis. The majority of the studies did not require that patients have respiratory symptoms to be enrolled and not all required the patients to be current or previous smokers. The study with the highest reported incidence of undiagnosed COPD included smokers and/or patients with respiratory symptoms of chronic cough and sputum[29].

When examined by age and smoking history, nearly half of patients over 60 years of age and more than 40% with a ≥40 pack-year history of smoking respectively, had evidence of airflow obstruction consistent with COPD.

These findings reaffirm the greater prevalence of COPD with increasing age and smoking history[12,13].

To further understand if any differences existed in patients with and without airflow obstruction consistent with COPD, the characteristics of both sub-groups were evaluated.

As expected the patients with a FEV_1/FVC ratio ≤ 0.70 were older, consisted of more males, had lower FEV_1, and were slightly more reversible post-bronchodilator. Interestingly, the MRC dyspnea score and SF-12 Health Survey Scores (summary scores for mental and physical components) were not different between those with and without airflow obstruction consistent with COPD, affirming the weak correlation between symptoms and airflow obstruction[31]. These findings emphasize the importance of utilizing spirometry to confirm the diagnosis of COPD as symptoms are not a good predictor of airflow limitation.

Diagnosing COPD earlier could have considerable impact on the burden of COPD. Earlier diagnosis would allow aggressive smoking cessation efforts. A study by Risser and Belcher demonstrated that when given evidence such as spirometry and pulmonary symptom results, patients were more than twice as likely to quit smoking when given smoking cessation education[32]. Smoking is a well known critical factor in altering disease progression in COPD[8]. In addition, patients could be placed on appropriate treatment to improve measures of lung obstruction and hyperinflation, symptoms, exercise endurance time, and to prevent exacerbations of COPD[2].

Some of the limitations of this paper include that patients were only evaluated at a single clinic visit and it is possible that the airflow obstruction could have returned to normal in a small number of patients following a course of inhaled corticosteroids. However, it is unlikely that many patients with asthma were included, since only 9% were categorized as reversible. By using the definition of $FEV_1/FVC \leq 0.70$ for airway obstruction consistent with COPD, it could have resulted in the overdiagnosis of COPD in patients aged 70 and older[33].

Conclusions

This study confirms that a considerable number of patients with risk factors for COPD remain undiagnosed in the primary care setting. Utilization of spirometry in patients $\geq$40 years of age with risks factors for COPD such as smoking history and symptoms of chronic bronchitis can facilitate the early diagnosis of COPD. Early diagnosis may reduce the burden of this debilitating disease by allowing aggressive smoking cessation and implementation of therapy to improve lung function and symptoms, and prevent exacerbations of COPD.

Transparency

Declaration of funding

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Declaration of financial/other relationships

B.Y. has disclosed that she has received research grants from GSK, Novartis and BI/Pfizer in the area of COPD screening, and has served on the advisory committee for COPD related studies of GSK and BI-Pfizer. D.M. has disclosed that he has received research funding from GSK, Novartis and Pfizer, and has served as a speaker or consultant for GSK, Novartis, Pfizer, Astra-Zeneca, Dey and Sepracor. T.L. disclosed that he has no conflicts of interest. G.R. has disclosed that he is on the speakers' bureau and advisory boards for GSK and Cephalon, and that his corporation has received research grant support from GSK, Cephalon, Sepacor, Novartis, Wyeth, Sanyko, Forrest, Takada, Orthomcneil and Capnia. G.C., I.R. and A.E. have disclosed that they are GSK employees, and G.C. and A.E. own stock in the company.

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