# Early Detection of Chronic Obstructive Pulmonary Disease in Asymptomatic High Risk Male Smoker

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## Abstract

**B**ackground: COPD is responsible for permanent morbidity, premature mortality, and great burden to the healthcare system. The most commonly encountered risk factor is tobacco smoking. Without screening, patients usually overlook early symptoms of cough and wheezes but commonly seek medical advice when they become dyspnic on mild to moderate exertion. By that time, half of their ventilatory reserves are lost. Spirometry remains the gold standard for diagnosing COPD and monitoring its progression.

**Aim of study**: since COPD is preventable condition, we tried to screen high risk individuals with the aim of early detection and prevention

**Patients and methods**: consecutive asymptomatic male smokers (n=170) were selected by high risk population screening. Participants were eligible if they were $\geq 30$ years of age, regular smokers, had smoking history of >10 pack years with no significant respiratory symptoms except for occasional cough and willing to undergo spirometry.

**Results**: a total of 170 asymptomatic male smokers were screened by spirometry according to the American thoracic society and European respiratory society. Overall, airway obstruction was seen in 30 (17.6%) subjects. Mild obstruction was seen in 19 (63.3%) and moderate obstruction in 11 (36.7%) subjects.

**Discussion**: Airway obstruction was linked with duration of smoking (P value <0.001) and number of pack years (P value <0.001).

**Conclusions** and **Recommendations**: early detection of COPD by spirometry especially in smokers of more than 20 pack years is likely to reduce the overall burden of disease.

**Key words**: spirometer, COPD, GOLD classification

## Introduction

Chronic obstructive pulmonary disease (COPD) is a slowly progressive respiratory disease that is characterized by longstanding airflow obstruction caused in part by emphysema or chronic bronchitis [1]. Chronic obstructive pulmonary disease is commonly underdiagnosed in clinical practice; several studies show that 25–50% or more of patients found to have COPD on screening spirometry have no prior or current diagnosis of COPD. Another barrier to appropriate treatment due to lack of screening programs is that COPD is frequently diagnosed late in its natural course, when lung function is poor and therapeutic options are mostly palliative.

Chronic obstructive pulmonary disease typically presents with symptoms of chronic cough, exertional dyspnea, expectoration of sputum and wheeze in conjunction with airway hyper-responsiveness. It affects nearly 10% of the general population, is responsible for chronic morbidity, early mortality, and substantial burden to the healthcare system. Present estimates suggest that 80 million people worldwide suffer from moderate to severe disease. In 2005, COPD contributed to more than 3 million deaths (5% of deaths globally) and by 2020, it seems to represent the third most important cause of death worldwide [2, 3].

Tobacco smoking is worldwide the most commonly encountered risk factor for COPD, although other known risk factors has been identified e.g. airway hyperresponsiveness, genetic abnormalities such as alpha-1-antitrypsin deficiency, air

pollution (resulting from the burning of wood and other biomass fuels), biomass smoke exposure, occupational dusts and chemicals, respiratory infections especially during childhood, and poor nutrition [4].

Chronic obstructive pulmonary disease is manifested by chronic cough with or without sputum production and wheezing and in more advanced stages by dyspnea, poor exercise tolerance, and signs/symptoms of respiratory failure and right-sided heart failure. The early symptoms of cough and slight wheezing are usually overlooked by the patients and their physicians and no appropriate interventions are made. Individuals commonly seek medical advice when they become dyspnic on mild to moderate exertion and at that time, half of the ventilatory reserves are irreversibly lost [5]. Therefore, it will be logical to diagnose COPD earlier and before development of advanced symptoms. The aim of this study is to detect COPD at an early stage where smoking cessation is found to reduce rapid decline of lung function [6, 7] and because early diagnosis in asymptomatic smokers may motivate smoking cessation which is known to slow down the loss of lung function associated with COPD [8].

Spirometry remains the gold standard for diagnosing COPD and monitoring its natural progression [9]. A diagnosis is confirmed when an individual is found to have airflow obstruction which is generally defined as a postbronchodilator $FEV_1/FVC$ ratio less than 0.70 [10] in the absence of an alternative explanation. Alternative conditions that should be excluded are symptoms of left ventricular failure, deconditioning due to poor exercise capability, or symptoms of asthma. Age-associated decrease in $FEV_1/FVC$ ratio should also be taken in account especially in those individuals elder than 65 years. The current study is undertaken in at risk population screening by using spirometry.

## Aim of study

Since COPD is prevalent condition and its detection at an early stage may prevent further lung function loss, we try to screen asymptomatic high risk smokers with the aim of preventing respiratory reserve loss.

## Patients and Methods

In this study, consecutive asymptomatic male smokers (n=170) were recruited and studied by spirometry between February 2012 to February 2014. Participants were eligible if they were $\geq$ 30 years of age, regular male smokers, had a smoking history of > 10 years with no significant respiratory symptoms except for occasional cough and willing to undergo spirometry. Participants were excluded if they have any of the following:

1. Subjects with smoking cessation for one year or more before enrolment.
2. Subjects known to have COPD, asthma, or other chronic respiratory illness
3. Subjects on bronchodilators, inhaled corticosteroids, Monelukast, or theophylline.
4. Subjects reporting active pulmonary symptoms (an indication for diagnostic spirometry).

All participants gave us informed consent, and the study was approved by internal medicine department/Kufa and Karbala colleges of medicine.

**Spirometric Study**

Prior to spirometry, participants underwent weight and height measurements. Using a commercially available spirometer (Figure 1-1), the minimal standards established by the American Thoracic Society (ATS) and European Respiratory Society were fulfilled by an experienced respiratory physician (11). FVC, $FEV_1$ and FEV1% were measured after administration of 400 µg of salbutamol as per the guidelines given by GOLD (9).

Figure 1.1 Spiro lab III manufactured by MIR of Italy.

Before testing for FVC, participant was instructed to make several breaths at rest. When ready, he inspired slowly as much air as possible (opening the arms helps)

and then expired all of the air as fast as possible. The cycles are repeated several times, without removing the mouthpiece, in which case spirometer will automatically select and show the best test and measured parameters.

$FEV_1$ is the volume of air that can be expelled in 1 second starting from a maximal inspiration and should be 70-80% of the forced vital capacity ($FEV_1$/FVC is 70-80%).

FEV1/FVC ratio of <0.70 was used for diagnosing COPD (9). Based on spirometry, subjects with obstructive spirometric pattern were classified as per GOLD guidelines (9) in the following ways:

| Stage | Severity | $FEV_1$/FVC | $FEV_1$ of predicted normal value |
|-------|----------|-------------|-----------------------------------|
| I | Mild | <0.7 | $\geq 80\%$ |
| II | Moderate | <0.7 | < 80% - 50% |
| III | Severe | <0.7 | <50% - 30% |

**Test Quality Control**

Through a mathematical analysis (quality control) which is applied to certain calculated indices and parameters, the spirometer automatically produces a series of comments, helpful for understanding the reliability of the test made. This control quality check assigns a letter for the current session as described below:

| | |
|---|---|
| A | At least two acceptable maneuvers, with the highest two $FEV_1$ values matching to 100 ml |
| B | At least two acceptable maneuvers, with $FEV_1$ values matching to within 101 to 150 ml |
| C | At least two acceptable maneuvers, with $FEV_1$ values matching to within 151 to 200 mL |
| D | Only one acceptable maneuver, or more than one, but $FEV_1$ values not matching to within 200 mL (with no interpretation) |
| F | No acceptable maneuvers |

**Statistical analysis**

Statistical analysis was carried out using SPSS version 17. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as (Means ± SD). Pearson's chi square ($X2$) test and Fisher exact test were used to find the association between the categorical variables. Independent sample t-test was used to compare means between two groups. A p-value of $\leq 0.05$ was considered as significant.

## Results

Between February 2012 and February 2014, 248 asymptomatic male smokers eligible for the study were included in the database. Of these, we excluded 32 (13%) individuals due to poor spirometry technique, 14 (5.6%) individuals due to missing spirometry results, and 32 (13%) individuals who were < 30 years of age, leaving a cohort of 170 study participants

each contributing a single spirometry assessment.

All of the participants underwent spirometric screening with a mean age of 42.4 (± 7.46) years and an age range of 30–59 years. The mean duration of smoking was 15.42 (± 2.72 SD) years and a range of 10-23 years. A large proportion (44.1%) of studied individuals had an average smoking history of 20-40 cigarettes per day (Figure 1-2).
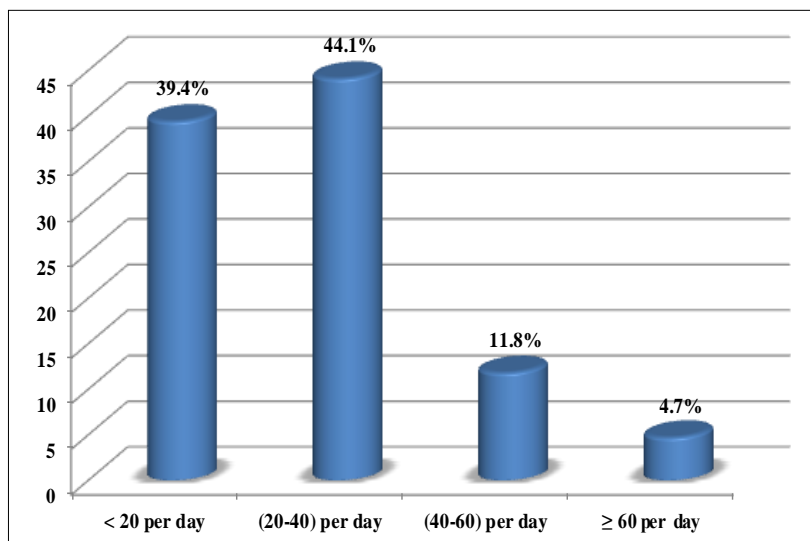


Figure 1-2 Distribution of male smokers according to the number of cigarettes smoked per day.

This was translated to 41.8 of participants had 10-20 pack year (Figure 1-3).
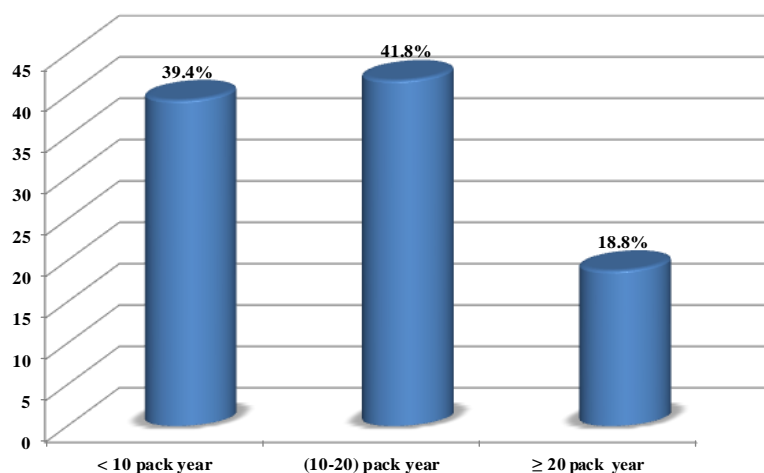


Figure 1-3 Distribution of male smokers according to the number of pack smoked per day (pack year).

The entire studied males had undergone spirometric test which showed that the majority (82.4%) of them had normal spirometric pattern and the remaining (17.6%) had obstructive pattern. Among the latter group, the majority (63.3%) had mild obstructive pattern and the significant minority (36.7%) had moderate obstructive pattern (Figure 1-4). The entire participants had been classified into two groups according to the spirometric pattern. The first group which comprised 140 participants had normal spirometric pattern and the second group (30 participants) had obstructive pattern.
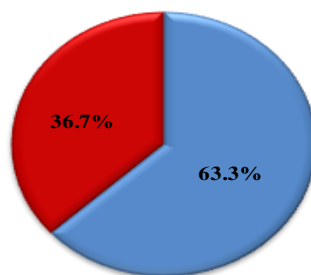
Figure 1-4. Distribution of asymptomatic COPD male smokers according to the obstructive spirometric pattern

Studying the correlation between the spirometric diagnosis and the mean differences of age between the two groups had shown no significant difference (Table 1-1). On the other hand, there was a good correlation between the spirometric diagnosis and the mean duration of smoking.

Studying the association between spirometric diagnosis and number of cigarettes smoked per day had shown significant association (Table 1-2).

Likewise, there was a good and significant association between the spirometric diagnosis and number of pack year (Table 1-3).

## Discussion

Chronic obstructive pulmonary disease is a prevalent disease that leads to considerable morbidity, premature mortality, and high healthcare expenditure. It is frequently unrecognized or only diagnosed at a late stage, when medical interventions are limited to arrest the progressive nature of COPD.

Table 1-1 The mean differences of age and duration of smoking by spirometric diagnosis

| Variable | Spirometric diagnosis | No. | Mean ± S.D | t-test | P value |
|---|---|---|---|---|---|
| Age (years) | Normal spirometry | 140 | 42.29 ± 7.65 | -0.426 | 0.671 |
| | Obstructive pattern | 30 | 42.93 ± 6.56 | | |
| Duration of smoking (years) | Normal spirometry | 140 | 14.85 ± 2.36 | -6.646 | <0.001 |
| | Obstructive pattern | 30 | 18.1 ± 2.72 | | |

Table 1-2 The association between spirometric diagnosis and number of cigarettes smoked per day

| Characteristics | Spirometric diagnosis | | P-value |
|---|---|---|---|
| | Normal spirometry (%) | Obstructive pattern (%) | |
| Number of cigarettes per day | | | |
| < 20 per day | 67 (47.9) | 0 (0.0) | <0.001 [a] |
| (20-40) per day | 72 (51.4) | 3 (10.0) | |
| (40-60) per day | 1 (0.7) | 19 (63.3) | |
| ≥ 60 per day | 0 (0.0) | 8 (26.7) | |
| [a] Fisher-exact test | | | |

Table 1-3  The association between spirometric diagnosis and number of pack year

| Characteristics | Spirometric diagnosis | | χ2 | P-value |
|---|---|---|---|---|
| | Normal spirometry (%) | Obstructive pattern (%) | | |
| Number of pack year | | | 157.09 | <0.001 |
| < 10 pack years | 67 (47.9) | 0 (0.0) | | |
| (10-20)  pack years | 71 (50.7) | 0 (0.0) | | |
| ≥ 20  pack years | 2 (1.4) | 30 (100.0) | | |

Therefore, screening for early diagnosis is important to provide support for smoking cessation initiatives and to reduce the deleterious nature of the disease [1, 3, 6, 7].

In this study, we evaluated the results of spirometry screening of 170 asymptomatic male smokers. The age of participants selected was 30 years and above since the deterioration of lung function progresses with increasing age and COPD is more prevalent in elderly population although most of the smokers start smoking at much early stage [12]. Most of the population based studies have taken subjects above 30-40 years of age for screening early COPD. In DIDASCO study (Differential Diagnosis between Asthma and COPD), a population based study, subjects aged 35 to 70 years were subjected to spirometry for early detection of airflow limitation [13]. We found in our study that the prevalence of undiagnosed airway obstruction was 17.6% and that was significantly linked to the duration of smoking (18.1 ± 2.72 years) and logically with the number of pack years. This finding suggested the easy feasibility in screening and identifying asymptomatic smokers with undiagnosed airway obstruction. In 2003, a reduction in smoking prevalence were recorded in Finland after a national prevention and treatment program for COPD that was launched in 1998 in which early diagnosis of COPD was made possible with spirometry followed by management in smoking cessation clinics. This provides an evidence of the effect of early diagnosis on natural history and burden of COPD [14]. Similarly, Gorecka et al [8] had shown that diagnosis of airway obstruction combined with smoking cessation advice increases smoking cessation rate.

The higher prevalence of airflow obstruction in our study was because the selection criteria that included high risk male smokers. Previous studies had variable prevalence depending on the characteristics of the population under study and on the spirometry criteria used for diagnosis. Buffels J. et al in his prospective study had found evidence of obstructive airway disease in 18% of participants with respiratory complaints compared with only 4% among those without symptoms [13]. Zielinski J. et al in his epidemiologic study of early detection of COPD in a high-risk population using spirometric screening found that airway obstruction is prevalent in 23% of the participants screened for COPD [15]. Bednarek and colleagues performed a case-finding study in 1960 primary care patients over 40 years of age using a questionnaire, physical examination, and spirometry [16]. The study revealed that 9% of these patients had airway obstruction.

Analysis of sub-groups in the study showed that mild obstruction seen in 63.3% of smokers with smoking history of 20 and above pack years and moderate obstruction in 36.7 of smokers with a smoking history of 20 and above pack years. Neither severe obstruction pattern nor obstructive pattern in less than 20 pack years had been noticed. Zielinski et al of "Know the age of your lung study group" evaluated the efficacy of mass spirometry in detection of airflow obstruction in high risk population above 39 years of age [15]. 11027 subjects were screened with mean age of 51.8 ± 12.5 years and mean smoking history of 26.1 ± 16.8 pack-years.

Mild obstruction was seen in 9.5%, moderate in 9.6% and severe in 5.2% subjects. The difference from our study is explained by the high mean age and the differences in inclusion criteria.

## Conclusions and Recommendations

The present study shows that early detection of COPD via spirometric screening increases with increasing smoking duration and quantum of smoking.

Routine spirometry is an easy way for screening and identifying asymptomatic smokers with undiagnosed airway obstruction since the early diagnosis of airway obstruction provides an excellent chance to implement various smoking cessation measures and because the earlier the smoker quits the larger the benefits for lung function. However, additional data about the actual benefit of early interventions and the cost-effectiveness of screening are needed before spirometry can be routinely adopted in clinical practice.

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