

# Comparison of demographic, clinical, spirometry, and radiological parameters between smoking and non-smoking COPD patients in rural Gujarat, India

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## ABSTRACT

**Context:** A total of 20% of Chronic Obstructive Pulmonary Disease (COPD) patients are non-smokers due to preventable causes, such as biomass fuel exposure, post tuberculous sequelae, occupational exposure, air pollution, persistent chronic asthma, and genetic predisposition. **Aims:** To compare smokers and non-smokers with COPD. **Settings and Design:** An observational study was conducted at a tertiary care hospital on 60 patients diagnosed with COPD, (GOLD criteria), who were divided into smoker and non-smoker groups. **Subjects and Methods:** Demographic data, clinical profile, smoking history, and radiological data were collected and compared. Exclusion criteria were individuals having active pulmonary tuberculosis and reversible air flow limitations. **Statistical Analysis Used:** Using STATA 14.2, quantitative and qualitative data were presented using descriptive statistics. **Results:** A total of 100% of smokers were male, whereas 70% of non-smokers were female. Compared to non-smokers (16.67%), smokers (26.6%) presented with higher grade of dyspnea. A statistically significant difference was seen with more smokers diagnosed as severe (40%) and very severe (30%) COPD compared to non-smokers with mild (16.67%) and moderate (46.67%) COPD ( $P < 0.012$ ), Post bronchodilator FEV<sub>1</sub> among smokers (42.63) compared to non-smokers (56.63) ( $P < 0.01$ ) and decrease in FEV<sub>1</sub> as the grade of dyspnea increased ( $P < 0.002$ ). Compared to 36.67% in non-smokers, 70% smokers showed emphysematous x-rays. **Conclusions:** In our study we found majority of non-smokers to be female, and smokers had a higher grade of dyspnea, more severe COPD, lower post bronchodilator FEV<sub>1</sub>, and more emphysematous changes on x-rays.

**Keywords:** COPD, emphysema, FEV<sub>1</sub>, smoking

## Key Messages

Non-smoking COPD patients had a higher post bronchodilator FEV<sub>1</sub>, fewer symptoms, and fewer emphysematous changes on X-rays.

## Introduction

Recently other causes of COPD apart from smoking, such as biomass fuel consumption, occupational exposure, air pollution,

post tuberculous sequelae, persistent chronic asthma, genetic predisposition like alpha 1 antitrypsin deficiency<sup>[1,2]</sup> have come to light. In developing countries especially in rural areas and people with low socioeconomic status, these other preventable factors seem to contribute to development of COPD which need to be addressed. The study of non-smoking COPD patients will help develop successful preventive strategies and assist us in formulating risk reduction strategies for better management of COPD.

## Subjects and Methods

A cross-sectional observational study was conducted over the course of 1.5 years at Shree Krishna Hospital, Karamsad (A

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tertiary care hospital) among 60 patients who attended the Department of Respiratory Medicine. Patients diagnosed with COPD (according to GOLD criteria) were selected and included in the study after taking their written consent in vernacular language. Patients were divided into two groups of smokers and non-smokers and a questionnaire was used to document demographic profile, clinical profile, and smoking history. Demographic data including age, sex, and occupation were recorded and compared. The clinical profile including cough, sputum, and grade of dyspnea according to modified British Medical Research Council (mMRC) scale was recorded and it was compared within the two groups. Spirometry parameters including pre- and post- bronchodilator FEV<sub>1</sub>, FEV<sub>1</sub>/FVC were compared between the two groups. Radiological features in the form of chest X ray were studied and compared. Associated factors of COPD like smoking, biomass fuel consumption, occupation, uncontrolled, and chronic persistent asthma were recorded and compared. The results and comparative data were analyzed systematically using STATA (14.2). Descriptive statistics were used to describe the qualitative and quantitative data. Ethical and institutional permission were duly taken for this study.

## Results

Demographic, symptomatic, clinical comparisons, and spirometry between smoking and non-smoking COPD patients has been presented in Table 1. In both smoker and non-smoker groups, over 70% had no occupational exposure, although a total of 12 smokers had other addictions; four were tobacco chewers, four were alcoholics, and four were chikni snuffers. None of the non-smokers had any other addictions. No significant association was seen between smoking and tuberculosis in our study.

Of note, it was observed that majority of smokers had a higher grade of dyspnea compared to non-smokers. Taking into account the severity of COPD, trends were seen with pack years though not of statistical significance [Table 2]. A statistically significant difference however was seen between the smoker and the non-smoker group, with 12 (40%) smokers having severe and 9 (30%) having very severe COPD, whereas more non-smokers had mild [6 (16.67%)] and moderate [14 (46.67%)] COPD as seen in Table 1. Among the smokers, 16 (56.3%) were current smokers and 14 (46.7%) were ex-smokers. Correlating with the mMRC grading across both groups, almost nine (26.67%)

**Table 1: Comparison of parameters between smoking and non-smoking COPD patients**

Parameters	Smokers	Non-smokers	P
Mean age	65.17 (SD=7.96)	64.7 (SD=7.81)	
Sex			
Male	30 (100%)	9 (30%)	
Female	0	21 (70%)	
BMI (kg/m <sup>2</sup> )	18.93 (SD=2.38)	18.91 (SD=2.26)	P=0.973
Cough	30 (100%)	30 (100%)	
Productive cough	17 (56.6%)	16 (53.3%)	
Type of sputum			
Mucoid	15 (88.23%)	16 (100%)	
Purulent	2 (11.76%)	0	
Chest pain	5 (16.67%)	0	
Dyspnea	30 (100%)	30 (100%)	
mMRC grades			
I	0	0	
II	7 (23.3%)	13 (43.3%)	
III	15 (50%)	12 (40%)	
IV	8 (26.6%)	5 (16.67%)	
Pack years	24.93 (SD=17.06)		
Severity of COPD (Gold staging)			
Mild	1 (3.33%)	5 (16.67%)	P=0.012
Moderate	8 (26.67%)	14 (46.67%)	(between groups)
Severe	12 (40%)	10 (33.33%)	
Very severe	9 (30%)	1 (3.33%)	
X-ray changes			
Normal	3 (10%)	6 (20%)	P=0.075
Emphysematous	21 (70%)	11 (36.67%)	(between groups)
Fibrotic	3 (10%)	8 (26.67%)	
Emphysematous + fibrotic	3 (10%)	5 (16.67%)	
Post bronchodilator FEV <sub>1</sub> (% predicted)			
Mild	88%	82%(SD=6.67%)	P=0.363
Moderate	56.25%(SD=6.64%)	58.4%(SD=6.44%)	P=0.465
Severe	41.25%(SD=6.82%)	43.67%(SD=5.70%)	P=0.401
Very severe	27%(SD=3.08%)	26%	P=0.703
Average	42.63 (SD=15.05%)	56.63%(SD=15.46%)	P=0.001

**Table 2: Severity of COPD and pack years**

Severity of COPD (gold staging)	Pack years	P
Mild	15	P=0.087 (between groups)
Moderate	18.13 (SD=9.44)	
Severe	23.5 (SD=10.01)	
Very severe	35.11 (SD=24.98)	

subjects with emphysematous changes in x-rays had grade III dyspnea.

The average post-bronchodilator FEV<sub>1</sub> (% predicted) in mild COPD non-smokers was 82% compared to 88% in smokers. This is misleading as there was only one patient in the smoker group with mild COPD. The average post-bronchodilator FEV<sub>1</sub> in moderate COPD non-smokers was 58.5% compared to 56.25% in smokers. The average post-bronchodilator FEV<sub>1</sub> in severe COPD non-smokers was 43.67% compared to 41.25% in smokers. The average post-bronchodilator FEV<sub>1</sub> in very severe COPD non-smokers was 26% compared to 27% in smokers. The average post-bronchodilator FEV<sub>1</sub> in smokers was significantly lower (42.63%) compared to non-smokers (56.63%). There were greater number of smokers with moderate 8 (33.33%), severe 12 (30%), and very severe 9 (30%) COPD as compared to non-smokers who had 14 (46.67%), 10 (33.33%), and 1 (3.33%), respectively [Table 1].

## Discussion

Smoking is a known cause of COPD, chronic bronchitis, and emphysema, and the risk increases with pack-years.<sup>[3,4]</sup> These findings were supported by NICE guidelines 2010 which states that greater than 20 pack years' history of smoking has a high likelihood of getting COPD.<sup>[5]</sup> The mean pack years in our study were 24.93 years, with a clear trend that demonstrated that an increase in pack years was associated with increase in severity of COPD. The trend was not as clear with duration of smoking which is in contrast to studies that suggest a linear relationship between smoking duration and severity of COPD.<sup>[6]</sup> However, due to the small sample size of our study we could not establish a statistical significance for both outcomes.

The major symptoms of COPD include cough, dyspnea, sputum production of varying severities.<sup>[7]</sup> In our study, almost equal number of smokers and never smokers reported production of mucus or phlegm, which correlates with a well-known fact that smoke is a primary cause of goblet cell hyperplasia and resultant mucus hypersecretion in the pathophysiology of COPD.<sup>[8]</sup> This could explain the reason for increase mucus production reported by non-smoker COPD patients in our study as biomass fuel exposure is present in a majority of these patients.<sup>[9]</sup>

Demographically, the gender distribution between the two groups in our study is comparable to that seen in the Burden of Obstructive Lung Disease(BOLD) study. In our study 21 (70%)

never smokers were females and 9 (30%) were males, similar to distribution in the BOLD study where 67.2% of never smokers were females and 32.8% were males.<sup>[10]</sup> The average age of smokers and non-smokers was 65.17 and 64.7 respectively, which was higher than the average age seen in the BOLD study.

In spite of their comparable age and years since diagnosis, non-smokers with COPD showed less airflow limitation (higher levels of FEV<sub>1</sub>) than smokers with COPD. The chronic inflammatory process induced by tobacco smoking promotes thickening and narrowing of the small conducting airways, as well as destruction of the parenchyma and reduced alveolar-bronchiolar attachments.<sup>[8,11,12]</sup> More severe expiratory airflow obstruction in smokers could be secondary to these additional changes.

Between the two groups, the average body mass index (BMI) was comparable at 18.49 kg/m<sup>2</sup> for non-smokers and 18.91 kg/m<sup>2</sup> for smokers. This was significantly lower than that seen in the BOLD study, attributed to the possibility of poor general nutritional status in Indians. Whether low BMI is a risk factor to develop COPD, or COPD leads to low BMI is a matter of much debate.<sup>[13-15]</sup>

The full burden of disease is not reflected by lung function and symptoms of disease, although they have been the main focus for improving outcomes in COPD. The potential role of addressing physical limitations imposed by systemic alterations has been highlighted by more recent endeavors. Systemic manifestation in COPD are very common, many patients demonstrate a gradual and significant weight loss that exacerbates the course and prognosis of disease. Marked contributions to exercise limitation and impaired quality of life occur due to weight loss which is often accompanied by peripheral muscle dysfunction and weakness. Weight loss has been postulated to be the result of a high metabolic rate that is not compensated for by increased dietary intake.<sup>[16]</sup>

COPD is frequently complicated by the presence of pain, with a reported prevalence ranging from 44% to 88%.<sup>[17]</sup> In our study only five (16.67%) smokers had chest pain, whereas none of the smokers complained of chest pain.

Breathlessness and exercise intolerance are the most common symptoms in COPD and progress relentlessly as the disease advances.<sup>[17]</sup> While all 60 (100%) subjects in our study presented with dyspnea, non-smokers with COPD showed a trend toward less severe shortness of breath compared to smokers with COPD.

A large proportion of patient's in both the groups had a history of tuberculosis. According to the below mentioned study, patients with a history of Tuberculosis(TB) were diagnosed with COPD 5 years earlier, hospitalized more often due to COPD exacerbations, and had a life expectancy that was 5 years shorter. Considering these findings we can conclude that post TB sequelae negatively impacts long term course of COPD.<sup>[18]</sup>

A recent prospective cohort study by Basham *et al.*<sup>[19]</sup> suggest that a twofold higher risk of airway disease was observed among immigrants diagnosed with respiratory TB, compared with non-TB controls, in a low-TB-incidence setting.

Approximately, 15% of COPD is work-related. Occupational exposure to dusts, chemicals, gases should be considered an established risk factor.<sup>[20]</sup> The PAR (population attributable risk) for COPD attributable to work was estimated at 19% overall and 31% among never smokers.<sup>[21]</sup> In our study, six (23.33%) smokers and seven (26.67%) non-smokers had occupational exposure to mainly silica, some also to wood.

Radiographically, emphysematous changes reflect the presence of lung destruction, over-inflation, and bulla formation which is a direct sign of emphysema. Focal areas of increased lucency due to the presence of lung destruction are difficult to identify, because of the limited contrast resolution of the chest radiograph. Some of the other signs of lung destruction include focal absence of pulmonary vessels and reduction in vessel caliber with tapering toward the lung periphery, which is highly suggestive of emphysema although it has low sensitivity. In the classic study by Thurlbeck and Simon<sup>[22]</sup> these findings had a sensitivity of only 40% in detecting emphysema. More common but not specific are findings related to over-inflation, particularly flattening of the diaphragm and increased retrosternal airspace.<sup>[23,24]</sup> In one investigation the combination of signs of hyperinflation and vascular alterations allowed the diagnosis of emphysema in 29 (97%) of 30 necropsy proven and symptomatic cases, but only eight (47%) of 17 necropsy proven but asymptomatic cases.<sup>[25]</sup> The combination of signs of hyperinflation and vascular alterations on the radiograph allows diagnosis of emphysema in the majority of patients with moderate to severe disease.<sup>[26,27]</sup> Limitations of chest radiography in the diagnosis of emphysema include low specificity, low sensitivity in the diagnosis of mild emphysema,<sup>[28]</sup> considerable interobserver disagreement in the interpretation of findings,<sup>[23,24,26]</sup> and inability to quantify the severity of emphysema. In our study, the emphysematous changes in x-ray were present much more in the smoker group-21 (70%) as compared to the non-smoker group-11 (37%) ( $P=0.075$ ). We also observed that severity of COPD did not dictate the pattern of x-ray changes seen in the patient. In non-smokers, normal x-ray findings were seen in mild, moderate, and severe COPD patients, whereas emphysematous changes were also present across the board among mild, moderate, severe, and very severe COPD patients. Likewise, in smokers, emphysematous changes were present across moderate, severe, and very severe COPD patients.

Our results confirm that tobacco smoking increases the rate of lung function decline in males and females.<sup>[27-33]</sup> There is also significant variability in the rate of decline of lung function in continuous smokers and, in particular, the rate of FEV<sub>1</sub> decline was slightly but significantly higher in continuous smoking males than females. This is consistent with data from the Tucson respiratory study more than 20 years ago.<sup>[34]</sup> The greater decline in those with respiratory disease or reduced lung function is

consistent with some smokers having a more rapid rate of FEV<sub>1</sub> decline.<sup>[35]</sup>

In summary in our study it was observed that non-smoking COPD patients were more likely to be women with milder symptoms, lesser degree of deterioration in spirometry and radiology less suggestive of emphysematous changes. Tuberculosis is an endemic problem in our country and biomass fuel exposure is still quite prominent especially in females in rural areas. With these etiological factors contributing significantly to non-smoking COPD cases it is pertinent to be able to identify these patients early and provide timely treatment which would improve their quality of life. As primary care physicians are point of first contact for majority of patients in India, awareness among them about the various demographic, clinical, spirometry, and radiological differences between non-smoking and smoking cases COPD will help them identify these patients earlier and improve overall diagnosis and treatment and quality of life for these patients.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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