



## COPD in Non-smokers-Prevalence and Risk Factors

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### Authors' contributions

This work was carried out in collaboration between all authors. Author MS designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author MAA managed the literature searches, analyses of the study, performed the spirometry analysis, author ZA managed the experimental process and author AE did statistical analysis. All authors read and approved the final manuscript.

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## ABSTRACT

Studies on COPD have largely focused on the smoking rather than the non-smoking population. Hence we conducted the study to identify the non-smoking causes of COPD. The study was conducted in the Department of Tuberculosis and Respiratory Diseases, Jawaharlal Nehru Medical College, AMU, Aligarh during 2011-2013 on 450 COPD patients. The aim of the study was to find out proportion of non smokers among all COPD patients, identify risk factors for COPD among non smokers and classify non-smoking COPD patients according to severity. Maximum patients (35.41%) among non smoker COPD group had more than one risk factor for COPD. Most of the patients among non smoker COPD were found to be having severe to very severe disease (63.5%). 34.4% patients had moderate COPD and very few patients had mild COPD (3%). On comparing disease severity among non-smoker and smoker COPD patients, we found that proportion of patients with very severe disease was more in smoker group (39.2% in smoker vs. 29.2% in non smoker), while proportion of patients with mild to moderate disease were more in non smoker group (35.5% in non smoker vs. 24% in smoker). Patients with severe disease in both groups were found to be of equal proportion (33.3% in non smoker vs. 36.7% in smoker).

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## 1. INTRODUCTION

Among the major causes of COPD, the role of tobacco smoking is well recognized [1]. However, in the past decade a number of studies have suggested other important factors to be strongly associated with COPD. These factors include exposure to indoor and outdoor air pollutants, workplace exposure to dust and fumes, history of repeated lower respiratory-tract infections during childhood, history of pulmonary tuberculosis, chronic asthma, intrauterine growth retardation, poor nourishment, and poor socioeconomic status. Till date our focus has mainly been on smoking as a causative factor for COPD. With the emergence of other factors which can cause COPD, there is need for evaluation of these factors. With this background, we undertook this study to identify different non smoking risk factors of COPD which will help in diagnosis, treatment and prevention of such COPD cases.

## 2. MATERIALS AND METHODS

The present study was conducted in The Department of Tuberculosis and Respiratory Diseases, J.N Medical College and Hospital, A.M.U Aligarh on both OPD and IPD patients.

Diagnosis of COPD was made by history, clinical examination, spirometric criteria and other investigations as per GOLD guidelines (Ref). Risk factors of COPD among non smoker COPD patients were identified by intensive questioning through preformed questionnaires and by visiting the home and work place (if required).

### 2.1 Inclusion Criteria

- All COPD patients who were diagnosed by history, clinical examination, and spirometric criteria.

### 2.2 Exclusion Criteria

- History of Recent MI and other co-morbid conditions.
- Chronic Asthma.
- Patients of bronchiectasis; ILD and other chronic respiratory diseases etc.

## 3. STUDY DESIGN AND STUDY POPULATION

In this study all the patients attending Outpatient and Inpatient clinic of the Department of Tuberculosis and Respiratory Diseases JN Medical college; AMU Aligarh during the period of 2011-2013 were included. A Cross-Sectional Observational Study was designed to conduct this study.

Other Investigations included- CT CHEST to rule out suspected cases of ILD, Bronchiectasis etc.

### 3.1 Echocardiography

Was done in those patients in whom cardiac comorbidities were suspected.

### 3.2 $\alpha$ -1 Anti-Trypsin

Wherever required.

## 4. OBSERVATION AND RESULTS

Of the total 450 diagnosed patients of COPD included in this study, the mean age was 56.39 yrs (Age range was from 25 years to 90 years). Age distribution according to smoking status in both sexes is shown in Table 5.1.

In the study, all the patients (n=450) were divided into two groups namely Smoker (present or past) and non smoker COPD group. Among 96 non smoker COPD patients 35 (36.5%) were males and 61 (63.5%) were females and in Smoker COPD group 324 (91.5%) were males and 30 (8.5%) were females (Table 5.1).

Among these two groups, the number of patients in the age group less than 40 years were found to be more in non-smoker COPD as compared to smoker COPD while in rest of the other age groups the number of patients were more in smoker COPD group (Table 5.5). Age distribution according to smoking status among different genders is shown in Table 5.6. In non smoker COPD group out of 96; 56 (58.3%) were from rural background and 40 (41.7%) were urban patients and in smoker COPD group; 232 (64.8%) were rural while 122 (35.2%) were urban background patients (Table 5.2).

**Table 5.1. Age distribution according to smoking status in both sex groups**

Age	Non smokers		Smokers		Total
	Male	Female	Male	Female	
< 40	4 4.2%	3 3.1%	5 1.4%	0	12 2.7%
40-59	24 25%	30 31.3%	172 48.6%	16 4.5%	242 53.8%
60-79	7 7.3%	25 26%	137 38.7%	14 4%	183 40.7%
≥80	0	3 3.1%	10 2.8%	0	13 2.8%
Total	35 36.5%	61 63.5%	324 91.5%	30 8.5%	450 100%

**Table 5.2. Geographical distribution of patients according to smoking status**

Geographical distribution	Non smoker	Smoker	Total
Rural	56 58.3%	332 64.8%	388 64
Urban	40 41.7%	122 35.2%	162 36
Total	96 100%	354 100%	450 100%

#### 4.1 Data Analysis

Data was analyzed using SPSS-17 and Microsoft Office Excel 2007 software. Chi Square test was applied to evaluate association of non-smoking risk factors with COPD. Out of 450 COPD patients 96 (21.3%) patients were non-smokers (Table 5.3). Risk factors for COPD in non smoker group are shown in Table 5.4. Additional risk factors besides smoking in smoker patients are shown in Table 5.5. Risk factors for COPD in non smoker COPD group among both sexes is shown in Table 5.6.

**Table 5.3. Proportion of non smoker COPD among All COPD Patients**

Smoking Status	Number of patients	Percent
Non smoker	96	21.3
Smoker	354	78.7
Total	450	100.0

Among 96 non smoker COPD patients, 34 patients (35.41%) had more than one non-smoking risk factor for COPD; 21 patients (21.9%) had history of exposure to biomass only, 15 patients (15.6%) developed COPD due to occupational exposure. In 11 patients (11.46%) the only known non-smoking risk factor was a

treated pulmonary tuberculosis. Environmental as a COPD risk factor was found in 9 patients (9.4%). Genetic risk factor, i.e., alpha-1 antitrypsin deficiency as non-smoking risk factor was found in 1 patient. Out of 96 patients 2 patients had recurrent respiratory infection in childhood. Passive smoking was the only non-smoking risk factor for COPD among 3 patients (Table 5.4).

As shown in Table 5.6, among the non smoker COPD group, a history of exposure to biomass was present in 2 males and 47 females. Occupational exposures were present in 21 males and 2 females. Environmental risk factors were equally present in both sexes (9 males vs. 10 females). History of past tuberculosis was present in 7 males as compared to 14 females. Passive smoking was more commonly observed among females (19 females vs. 2 males).

#### 4.2 Distribution of Risk Factors among All Patients

##### 4.2.1 Smoking

Smoking is a major risk factor for COPD. Among 450 patients 354 patients (79.7%) were smokers as shown in Table 5.7.

**Table 5.4. Risk factors for COPD in non smoker group**

<b>Risk factors among non smoker COPD</b>	<b>No. of patient</b>	<b>Percent</b>
More than one Risk Factor	34	35.41%
Exposure To Biomass Smoke	21	21.90%
Occupational Exposure	15	15.60%
Healed Pulmonary TB	11	11.46%
Environmental Risk Factor	9	9.40%
Genetic Risk Factor	1	1%
Recurrent Resp. Infection	2	2.08%
Passive Smoking	3	3.15%
Total	96	100%

**Table 5.5. Additional risk factors for COPD in smokers**

<b>Non smoking risk factor among smoker COPD</b>	<b>No. of patients</b>	<b>Percent</b>
Exposure To Biomass Smoke	38	10.7%
Occupational Exposure	36	10.17%
Healed Pulmonary TB	27	7.6%
Environmental Risk Factor	29	8.2%
Recurrent Resp. Infection	6	1.7%
Passive smoking	23	6.5%
Total	159	44.87%

**Table 5.6. Risk factors of COPD in non smoker group different sexes**

<b>Risk factors among non-smoker COPD</b>	<b>Male</b>	<b>Female</b>	<b>Total</b>
Exposure to biomass smoke	2	47	49
	4%	96%	100%
Occupational exposure	21	2	23
	91.3%	8.7%	100%
Post tubercular (Healed Pulmonary TB)	7	14	21
	33.3%	66.7%	100%
Environmental risk factor	9	10	19
	47.4%	52.6%	100%
Genetic risk factor	0	1	1
		100%	100%
Recurrent respiratory infection	2	0	2
	100%		100%
Passive smoking	2	19	21
	9.5%	90.5%	100%

**4.2.2 Biomass fuel**

History of exposure to biomass fuel was found in 87 patients (19.3%) out of 450 patients. Exposure to biomass fuel was found to be a major risk factor for COPD apart from smoking as shown in Table 5.8.

**Table 5.7. % of Smokers and non-smokers**

<b>Smoker</b>	<b>Number of patients</b>	<b>Percent</b>
No	96	21.3
Yes	354	79.7
Total	450	100

**Table 5.8. No. of patients exposed to Bio Mass fuel**

<b>Exposure to biomass fuel</b>	<b>Number of patients</b>	<b>Percent</b>
No	363	80.7
Yes	87	19.3
Total	450	100

**4.2.3 Post tubercular (healed pulmonary tuberculosis)**

History of pulmonary tuberculosis in the past was found in 48 patients out of 450 patients (10.7%) as shown in Table 5.9.

**Table 5.9. Number of patients with history of tuberculosis**

Healed pulmonary TB	Number of patients	Percent
No	402	89.3
Yes	48	10.7
Total	450	100

**4.2.4 Occupational risk factors**

History of Occupational exposure to dust, fume, gas, smoke etc., was found in 59 patients (13.1%) as shown in Table 5.10.

**Table 5.10. Number of patients with history of occupational exposure**

Occupational risk factor	Number of patients	Percent
No	391	86.9
Yes	59	13.1
Total	450	100

**4.2.5 Environmental risk factors**

Environmental risk factors, found in 48 patients out of 450 patients (10.7%) are shown in Table 5.11.

**Table 5.11. Number of patient with history of environmental exposure**

Environmental factors	Number of patients	Percent
No	402	89.3
Yes	48	10.7
Total	450	100

**4.2.6 Recurrent respiratory tract infection**

History of recurrent respiratory infection in childhood was found in only 8 patients out of 450 patients (1.8%) as shown in Table 5.12.

**Table 5.12. Number of patients with history of recurrent RTI**

Recurrent RTI	Number of patients	Percent
No	442	98.2
Yes	8	1.8
Total	450	100

**4.2.7 Passive smoking**

History of passive smoking was found in 44 patients among all 450 patients (9.8%) as shown in Table 5.13.

**Table 5.13. Number of patients with history of passive smoking**

Passive smoker	Number of patients	Percent
No	406	9.8
Yes	44	90.2
Total	450	100

**4.3 Risk Factors Associated With COPD in Non-smoker Group Patients**

Number of patients in different age group of both smoker and non smoker COPD are shown in Table 5.14. On analysis of the observed data, chi square value was 11.565 and p value was <0.05

which is clinically significant. This shows that COPD occurred significantly earlier in non smoker group.

In non smoker COPD group 36.5% were males and 63.5% were females as compared to smoker COPD group in which 91.5% were males and 8.5% were females (Table 5.14). This observation was analysed by using chi square test and it was found that chi square value was 141.950 and p value was <0.05. This shows that non smoker COPD is significantly higher among female patients.

In non smoker COPD group 58.3% were rural and 41.7% were urban as compared to smoker COPD group in which 65.5% were rural and 34.5% were urban (Table 5.15). Geographical distribution of the patients of non smoker COPD group was not found to be statistically significant (P value >0.05). Thus, COPD was equally present in both the rural and urban background patients.

Out of 96 non smoker COPD patients 49 (51%) were exposed to biomass smoke as compared to 10.7% in the smoker COPD group (Table 5.16). Exposure to biomass smoke was found to be statistically significant (P value <0.05) risk factor for COPD.

About 21.9% patients among non smoker COPD group had history of pulmonary tuberculosis in the past as compared to 7.6% in smoker COPD group (Table 5.17). In this study pulmonary tuberculosis was found to be a statistically significant (P value <0.05) risk factor for COPD.

About 20% (19.8%) patients in non smoker COPD group as compared to 8.2% patients in smoker COPD group having history of exposure

to environmental factors (Table 5.19). In our study exposure to environmental factors was found to be statistically significant (P value <0.05) risk factor for COPD.

Only 2.1% patients among non smoker and 1.7% patients among smoker COPD group had history of recurrent respiratory infection in childhood. This was not found to be statistically significant risk factor for COPD (P value >0.05) (Table 5.20).

Passive smoking was found in 21.9% patients among non smoker group and 6.5% patients among smoker COPD group (Table 5.21). Passive smoking was found to be statistically significant risk factor for COPD (p value <0.05).

#### 4.4 Risk Factor Associated With COPD in Smoker Group Patients

All non smoker COPD patients were classified according to severity and it was found that 3.1% patients were in grade 1 (mild COPD), 34.4% patients were in grade 2 (moderate COPD), 33.3% patients were in grade 3 (severe COPD) and 29.9% patients were in grade 4 (very severe COPD) (Table 5.22). Smoker COPD Patients were also classified according to severity and it was found that 1.4% patients were in grade 1 (mild COPD), 22.6% patients were in grade 2 (moderate COPD), 36.7% patients were in grade 3 (severe COPD) and 39.3% patients were in grade 4 (very severe COPD). Severity of COPD in both group were compared as shown Table 5.23.

**Table 5.14. AGE Number of patients in different age group of both smoker and non-smoker COPD**

Age group	Non-smoker	Smoker	Total
< 40	7 7.3%	5 1.4%	12 2.7%
40-59	54 56.3%	188 53.1%	242 53.8%
60-79	32 33.3%	151 42.7%	183 40.7%
≥80	3 3.1%	10 2.8%	13 2.9%
Total	96 100%	354 100%	450 100%

*Chi square = 11.565 and P value < 0.05 (significant)*

**Table 5.15. Geographical distribution**

Geographical area	Non-smoker	Smoker	Total
Rural	56 58.3%	232 65.5%	288 64%
Urban	40 41.7%	122 34.5%	162 36%
Total	96 100%	354 100%	450 100%

*Chi square = 1.7101 and P value > 0.05 (not significant)*

**Table 5.16. Biomass fuel**

Exposure to biomass fuel	Non-smoker	Smoker	Total
No	47 49%	316 89.3%	363 80.7%
Yes	49 51%	38 10.7%	87 19.3%
Total	96 100%	354 100%	450 100%

*Chi square = 78.673 and P value < 0.05 (significant)*

**Table 5.17. Post tubercular (healed pulmonary tuberculosis)**

Post tubercular	Non-smoker	Smoker	Total
No	75 78.1%	327 92.4%	402 89.3%
Yes	21 21.9%	27 7.6%	48 10.7%
Total	96 100%	354 100%	450 100%

*Chi square = 16.089 and P value < 0.05 (significant)*

**Table 5.18. Occupational exposure**

Occupational exposure	Non-smoker	Smoker	Total
No	73 76%	318 89.8%	391 86.9%
Yes	23 24%	36 10.2%	59 13.1%
Total	96 100%	354 100%	450 100%

*Chi square = 12.604 and P value < 0.05 (significant)*

**Table 5.19 Environmental exposure**

Environmental exposure	Non-smoker	Smoker	Total
No	77 80.2%	325 91.8%	402 89.3%
Yes	19 19.8%	29 8.2%	48 10.7%
Total	96 100%	354 100%	450 100%

*Chi square = 10.664 and P value < 0.05 (significant)*

**Table 5.20. Recurrent respiratory infection in childhood**

Recurrent respiratory infection	Non-smoker	Smoker	Total
No	94 97.9%	348 98.3%	442 98.2%
Yes	2 2.1%	6 1.7%	8 1.8%
Total	96 100%	354 100%	450 100%

*Chi square = 0.065 and P value > 0.05 (Not significant)*

**Table 5.21. Passive smoking**

Passive smoking	Non-smoker	Smoker	Total
No	75 78.1%	331 93.5%	406 90.2%
Yes	21 21.9%	23 6.5%	44 9.8%
Total	96 100%	354 100%	450 100%

*Chi square = 20.244 and P value < 0.05 (significant)*

**Table 5.22. Severity of COPD according to smoking status in both sexes**

COPD severity	Non-smoker		Smoker		Total
	Male	Female	Male	Female	
Grade 1	2 2.08%	1 1.04%	5 1.4%	0	8
Grade 2	10 10.4%	23 24%	70 19.8%	10 2.8%	113
Grade 3	12 12.5%	20 20.8%	117 33%	13 3.7%	162
Grade 4	11 11.5%	17 17.2%	132 37.3%	7 2%	167
Total	35 36.5%	61 63.5%	324 91.5%	30 8.5%	450

**Table 5.23. COPD severity according to smoking status in different age group**

Age group	COPD severity								Total
	Grade 1		Grade 2		Grade 3		Grade 4		
	Non smoker	Smoker	Non smoker	Smoker	Non smoker	Smoker	Non smoker	Smoker	
< 40	1	1	2	2	3	0	1	2	12
40-59	2	2	18	68	17	81	16	38	242
60-79	0	2	11	11	10	46	12	91	183
>=80	0	0	1	0	2	3	0	7	13
Total	3	5	32	81	32	130	29	138	450

## 5. DISCUSSION

Findings from early studies reported that exposure to toxic gases in the workplace [1] grain dust in farms [2] and dust and fumes in factories [3] was strongly associated with COPD. Results from longitudinal studies have associated COPD with occupational exposures in coal miners, hard-rock miners, tunnel workers, and concrete manufacturers. In heavily exposed workers, the effect of dust exposure might be greater than that of smoking [4]. Construction workers exposed to fumes and mineral dust have a significantly higher risk of death due to COPD than do unexposed construction workers [5]. Persistent exposure to silica in construction, brick manufacturing, gold mining, and iron and steel foundries is strongly associated with COPD; average respirable dust concentration is 10000 µg/m<sup>3</sup> [6,7].

The contribution of outdoor air pollution to COPD was investigated in 1958 in UK postmen—the prevalence of COPD was higher in those working in more polluted areas than in those working in areas with less pollution, and the association was independent of smoking [8]. Results of a later study showed reduced lung function in postmen who worked in more polluted cities than in those who worked in less polluted areas [6]. These

findings have been reinforced by studies in the general population in the UK [8] and USA [9] and in people living close to roads with heavy motor vehicular traffic [10].

The present study has reported the proportion and potential risk factors for COPD using GOLD stages among non-smokers COPD, and distinct profiles of COPD in non-smokers versus smokers.

First, the proportion of COPD according to GOLD diagnostic Criteria among non-smokers in our study was 21.3%. As with results from other spirometry based surveys, COPD proportion in non-smokers COPD showed variation across countries and areas. Our finding is consistent with the finding of Menezes AMB et al. [11]. They found that proportion of non smoker COPD in Maxico (23.2%), in Brazil (25%), in Uruguay (25%), in Venezuela (17%) among all COPD patients. They used post bronchodilator spirometry as diagnostic tool for these studies similar to our study, but in our study in addition to spirometry clinical criteria and other investigation like chest x-ray also used for diagnosis. The similar result also found by von Hertzen et al. 2003 in Finland [12], they found that proportion of non smoker COPD was 20.2% among all COPD patients and they used similar diagnostic criteria



like respiratory symptoms, clinical examination and post bronchodilator spirometry criteria (FEV1/FVC <0.70) as used in this study. Our result of proportion of non smoker COPD is also consistent with result found by Lindberg et al. in 2005 [13] in Sweden, he found that proportion of non smoker COPD were 22% when he used BTS and ERS criteria for diagnosis, and 20% when he used GOLD criteria for diagnosis of COPD as used in this study. Cerveri et al. [14] studied multinational population of 16 countries and they found that proportion of COPD in non-smokers were 17% which is also consistent with our result, they also used similar diagnostic criteria as used in our study like post bronchodilator spirometry (FEV1/FVC <0.70) and questionnaires. Behrendt et al. [15] studied national wide population of USA, they found that proportion of non-smoker COPD were 24.9% which is consistent with our result, and they also used post bronchodilator spirometry for diagnosis as used in this study.

Proportion of non smoker COPD among all COPD patients were 14.7% in Japan and 15.5% in Korea [16] which are lower than our results (21.3%). This difference could be due to difference in methodology used or other risk factors, independent of smoking, may be contributing to COPD in these countries less immensely than in India.

Proportion of COPD in non-smokers among all COPD patients in India showed wide variation (9.4%-68.6%) in different studies. But overall proportion (national median value) of non smoker COPD in India was found to be 17.7% which is similar to the results found in our study. Wig et al. [17] found that the proportion of non smoker COPD was 33.5% in Delhi, which is higher than the result found in our study (21.3%). The discrepancy of result, might be due to difference in methodology and age of the study population. He used clinical examination and chest X-Ray for diagnosis, while apart from these two methods we also used post bronchodilator spirometry in our study. Brashier B et al. [18] found that the proportion of non smoker COPD in the slums of Pune city were 68.7%, which is much higher than the result found in our study (21.3%). This might be due to difference in the study population. The study population chosen by Brashier et al. [18] belonged to low socioeconomic status and overcrowded residential areas which are independent risk factors for COPD.

In this study we found that among non smoker COPD patients, 36.5% were males and 63.5%

were females. The higher female ratio could be due to the exposure of females to biomass smoke during cooking "which is a major risk factor for COPD other than smoking". These results agree with the results from a population-based study in Spain [19] and the recently published results from the Swiss Study on Air Pollution and Lung Disease in Adults (SAPALDIA). Studies have suggested that women are more susceptible to the effects of tobacco smoke [20] and this susceptibility may also apply to other harmful exposures. Moreover, the presence of chronic airway obstruction in non-smokers raises the question of whether there is an autoimmune component to COPD pathogenesis [21]. As most autoimmune diseases occur more frequently in women than men, the autoimmune hypothesis is worth considering as a contributor to the predominance of females among non-smokers with COPD.

In this study most of the patients were from rural background in both smoker and non smoker group (58.3% in non smoker vs. 64.8% in smoker). There is no significant difference in geographical distribution among both the groups.

More than half of the patients in both smoker and non smoker groups were 40-59 years old (56.3% in non smoker vs.53.1% in smoker). The proportion of patients in the age group less than 40 years and more than 80 years were found to be more in non smoker COPD as compared to smoker COPD. Proportion of females was found to be more in non smoker COPD and that of male was found to be more in smoker COPD among all age group except age group less than 40 years in which proportion of male were more in non smoker COPD group.

In this study we found age is the statistically significant risk factor for COPD, similar results were also found by Behrendt et al. 2005 in USA [15]. In our study, sex is also found statistically significant risk factor for COPD, we found that non-smoker COPD were higher in female patients, but it might be due to factors like exposure to biomass smoke, which is itself a major non-smoking risk factor for COPD, was more common in female. Female sex as a risk factor for COPD in non-smoker group was also found by Ten et al. 2003 in 12 countries of Asia pacific [16]. Exposure to biomass smoke as a risk factor has been found to cause COPD in non-smoker group in this study and the association of this factor is statistically significant with non-smoker COPD. Similar association has also been

found by Lindstrom et al. 2001 in Finland and Sweden [22].

There is evidence that substantial proportion of COPD, up to 20% can be attributed to occupational exposure [23]. In our study we also found 15.6% patients among non-smoker COPD having history of occupational exposure as a single risk factor for COPD which is statistically significant and it was found that after biomass smoke occupational exposure is the most common single risk factor for COPD in non-smoker COPD group. Most of the patients with risk of occupational exposure in our study were males (91.3%) because exposure to occupational risk is more among males. Occupational exposure as a risk factor among non-smoker COPD were also found by Lampracht et al. 2008 in Austria [24] and Ehrlich et al. 2008 in South Africa [25].

Treated pulmonary tuberculosis was also found as a single risk factor for COPD in non-smoker COPD group, which was found to be statistically significant in our study. Similar association of treated pulmonary tuberculosis as a risk factor with non-smoker COPD was also found Ehrlich et al. 2008 in South Africa [25] because in these countries prevalence of pulmonary tuberculosis is high as in India. In our study we found that treated pulmonary tuberculosis is the third most common risk factor for COPD among non-smoker COPD group (11.46%) and most of the patients with this risk factor among non-smoker COPD were female (66.7%), it might be due to difference in smoking habit in both sexes. Smoking habit is more common in male due to which most of the male patients with history of treated pulmonary tuberculosis were excluded from non-smoker COPD group, that's why proportion of patients with risk factor of treated pulmonary tuberculosis were mostly female in this study.

Environmental risk factors were found to be in 9.4% of non smoker COPD patients as a single risk factor in this study and we found this association of environmental risk factors with non-smoker COPD were statistically significant. Proportion of male and female patients associated with this risk factors among non-smoker COPD were found to be equal in our study.

Genetic susceptibility has attracted general attention [26]. Nonetheless,  $\alpha$ 1-antitrypsin deficiency is still the only genetic factor

definitively identified to date and this only accounts for <1% of COPD. We also found only one patient with  $\alpha$ 1-antitrypsin deficiency in our study among non-smoker COPD, which also account for around 1% of non-smoker COPD.

History of recurrent respiratory infections in childhood were found in around 2% patients of non-smoker COPD in this study, which is statistically insignificant unlike other studies [27], in which the risk factor was found to be statistically significant. The difference is because our study is hospital based study and most of the patients were of age >40 years, so it is very difficult to take history of respiratory infection in childhood in the absence of patient's parents.

There is evidence that exposure to passive smoke is associated with COPD [28], and affects women more often than men [29]. We also found similar evidence in our study with statistical significance.

Maximum patients (35.41%) among non-smoker COPD group having more than one risk factor for COPD.

Most of the patients among non-smoker COPD were found to be having severe to very severe diseases (63.5%), 34.4% patients having moderate COPD and very few patients having mild COPD (3%) in our study. It is because of our study is hospital based study, where most of the patients present were of advanced diseases.

On comparison of disease severity among non-smoker and smoker COPD group, we found that proportion of patients with very severe disease were more in smoker group (39.2% in smoker vs. 29.2% in non-smoker), while proportion of patients with mild to moderate disease were more in non smoker group (35.5% in non-smoker vs. 24% in smoker). Patients with severe disease in both groups were found to be of equal proportion (33.3% in non-smoker vs. 36.7% in smoker).

## 6. CONCLUSIONS

As against the popular belief that smoking is the major cause of COPD, we have demonstrated that apart from smoking biomass fuel, environmental exposure, occupational exposure etc are other causes of COPD.

## CONSENT

Written Consent was taken from all the patients.

## ETHICAL APPROVAL

Ethical Approval was taken from Institutional Ethical Committee.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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