Original Article

A comparative study of lung functions in non-smoker COPD patients from various localities with healthy subjects

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Abstract

Background & Objectives: Chronic Obstructive Pulmonary Disease (COPD) is the illness with airflow obstruction caused by emphysema, chronic bronchitis, or a combination of both the disorders. It is the third leading cause of death worldwide. Between 20 and 40% of all COPD patients across the globe are never smokers. The primary objective of this study was to evaluate Pulmonary Function Tests (PFTs) in non-smoker COPD patients and compare their results with normal healthy subjects. The study also intended to check the variations in lung function of COPD patients living in urban & rural areas.

Materials & Methods: The study was conducted by performing PFTs in 50 non-smoker COPD patients (28 from urban & 22 from rural areas) & comparing them with 50 non-smoker healthy subjects of same age group excluding ex-smokers. Various parameters of PFTs like FVC, FEV1, FEV1/FVC, PEFR & MVV were assessed & compared. For statistical data analysis unpaired t-Test was applied.

Results: The mean values of PFT parameters such as FVC, FEV1, FEV1/FVC, PEFR & MVV are very significantly differed between COPD patients & healthy subjects ($p<0.01$). Although the data is not statistically significant between total COPD patients, urban & rural COPD patients, mean values of above PFT parameters are higher in total COPD patients than urban while higher in rural compared to total COPD patients ($p>0.05$). The mean values of above PFT parameters are not significant statistically between urban & rural COPD patients ($p>0.05$).

Conclusion: The study indicates that as compared to normal subjects, in patients of COPD there is great reduction in mean values for FVC, FEV1, PEFR, FEV1/FVC%, & MVV irrespective of their residing location which is suggestive of an increase air way obstruction with reduced values of various PFT parameters. The study also shows that there is no significant difference in mean values of various parameters between urban & rural areas.

Keywords: COPD, PFT, Urban, Rural.

INTRODUCTION

- Chronic Obstructive Pulmonary Disease (COPD) is the illness with airflow obstruction caused by emphysema, chronic bronchitis, or a combination of both the disorders.
- Chronic obstructive pulmonary disease (COPD) is the third leading cause of death worldwide, causing 3.23 million deaths in 2019. Nearly 90% of COPD deaths in those under 70 years of age occur in low- and middle-income countries.1
- According to epidemiological studies, between 20 and 40% of all COPD patients across the globe are never smokers.2 Therefore, even if smoking continues to be the leading COPD risk factor, other conditions must be considered too.
- The 2017 Global Burden of Disease study has estimated that smoking accounts for only 35% of the global COPD burden, most of which occur in high income countries3. The remaining 65% of the non- smoking COPD burden occurs mostly in the low- and middle-income countries of the world. Exposure to biomass smoke during cooking in poorly ventilated homes,4-6 high levels of ambient air pollution, occupational exposures to dust and gases, ambient ozone exposure, poverty, repeated respiratory tract infections during childhood, poorly controlled chronic persistent asthma and previous tubercular lung disease are also non- smoking risk factors for COPD.7-9
- Although cigarette smoking represents the most important risk factor, not all smokers develop COPD in their lifetime, which implies that genetic factors may be involved.10
- A study reported in a large general population in Austria that there are many other different environmental risk factors associated with low lung function, that they vary greatly in different age bins, and that they interact and accumulate with age in complex ways.11

- A combination of history, physical examination, and the use of objective measurements of airway obstruction diagnose COPD. Pulmonary function tests (PFTs) are noninvasive tests to determine how lungs are working. For current study by use of computerized spirometer, various parameters such as Forced Vital Capacity (FVC), Forced Expiratory Volume in First Second (FEV1), Ratio of FEV1 and FVC (FEV1/FVC), Peak Expiratory Flow Rate (PEFR) and Maximum Voluntary Ventilation (MVV) were measured in non-smoker COPD patients from both urban and rural areas & compared their results with healthy subjects.
- The basic aim of this study was to assess PFTs in non-smoker COPD patients and compare their results with normal healthy subjects. The efforts were also made to rule out the variations in lung function of COPD patients living in urban & rural areas.

MATERIALS & METHODS:

- 50 non-smoker COPD patients were selected in the age group of 20-70 years from a tertiary care hospital. Among them 28 were from urban & 22 were from rural locations. 50 non-smoker healthy subjects of same age group were recruited as controls. Ex-smokers were excluded from the study. All the patients & healthy subjects were recruited after taking consent.
- A brief preliminary questionnaire & physical examination were carried out in each subject.
- The purpose & technique of measurements were explained to the subject with practical demonstration & were taken with their willingness to undergo present investigation.
- The spirometry was done by Computerized Spirometer (COSMED, KIT MICRO)

Each subject was instructed to fill his lungs as completely as possible by deepest possible inspiration & blow the air out in the mouthpiece with lips tightly closed as rapidly & completely as possible. The disposable mouth pieces were used every time. Efforts affected by cough & inadequate co-operation were excluded by careful personal observation. FEV1, FVC, FEV1/FVC, PEFR & MVV were studied. The software used for statistical analysis was MS Excel. The significance of the results was checked at 'p' value <0.01.

GOLD classification for COPD:12

GOLD classification	**Obstruction**	**FEV_1/FVC (%)**	**FEV_1**
1	Mild	<70	$FEV_1 \geq 80\%$ predicted
2	Moderate	<70	$50\% \leq FEV_1 < 80\%$ predicted
3	Severe	<70	$30\% \leq FEV_1 < 50\%$ predicted
4	Very severe	<70	$FEV_1 < 30\%$ predicted

RESULTS:

COPD Patients (n=50)

No.	**Parameters**	**Mean ± SD**
1	FVC (L)	1.27 ± 1.15
2	FEV_1 (L)	0.63 ± 0.71
3	PEFR (L/Sec.)	1.3 ± 1.85
4	FEV_1/FVC (%)	44.94 ± 19.55
5	MVV (L/Min.)	34.26 ± 36.92

Healthy subjects (Controls) (n=50)

No.	**Parameters**	**Mean ± SD**
1	FVC (L)	3.2 ± 0.8
2	FEV_1 (L)	2.42 ± 0.61
3	PEFR (L/Sec.)	5.78 ± 2.17
4	FEV_1/FVC (%)	82.4 ± 8.22
5	MVV (L/Min.)	112.97 ± 35.76

Urban COPD patients (n=28)

No.	Parameters	Mean ± SD
1	FVC (L)	1.21 ± 1.18
2	FEV_1 (L)	0.53 ± 0.63
3	PEFR (L/Sec.)	1.05 ± 1.55
4	FEV_1/FVC (%)	41.85 ± 18.37
5	MVV (L/Min.)	29.97 ± 37.4

Rural COPD patients (n=22)

No.	Parameters	Mean ± SD
1	FVC (L)	1.34 ± 1.12
2	FEV_1 (L)	0.75 ± 0.8
3	PEFR (L/Sec.)	1.61 ± 2.17
4	FEV_1/FVC (%)	48.88 ± 20.72
5	MVV (L/Min.)	39.71 ± 36.4

Figure 1.1: Mean values of various parameters in COPD patients & Healthy subjects (Controls)

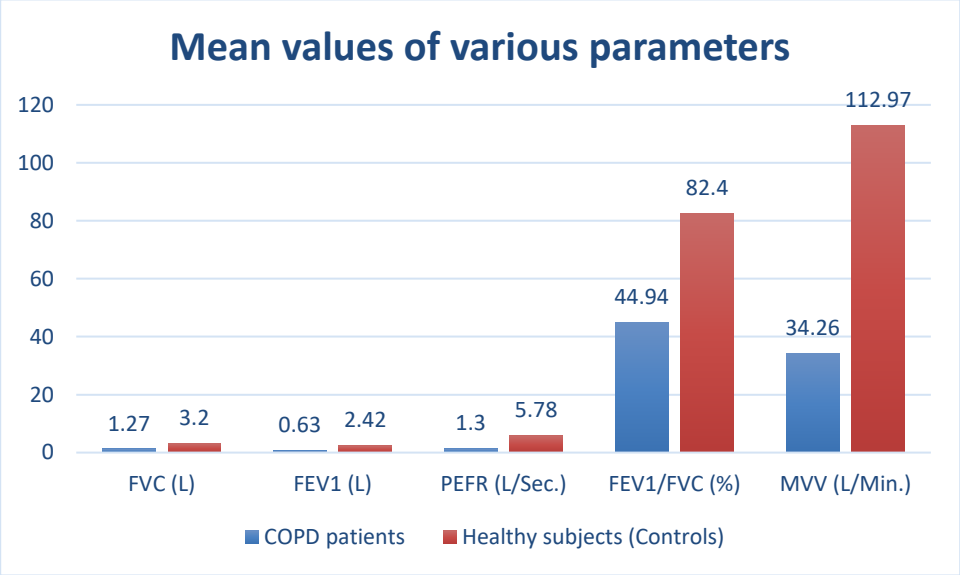


Figure 1.2: Mean values of various parameters in Urban & Rural COPD patients

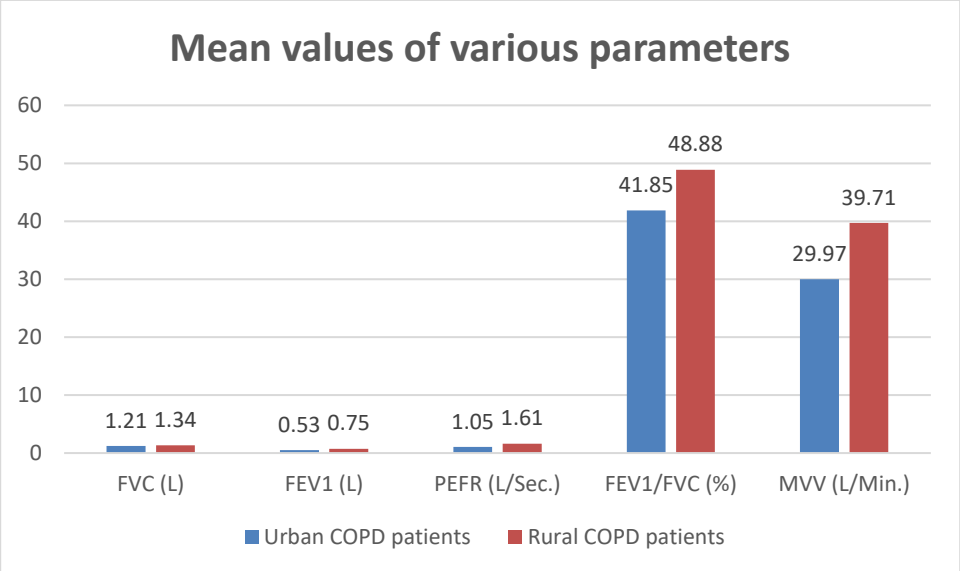


Figure 1.3: Mean values of various parameters in Rural, Urban & Total COPD patients

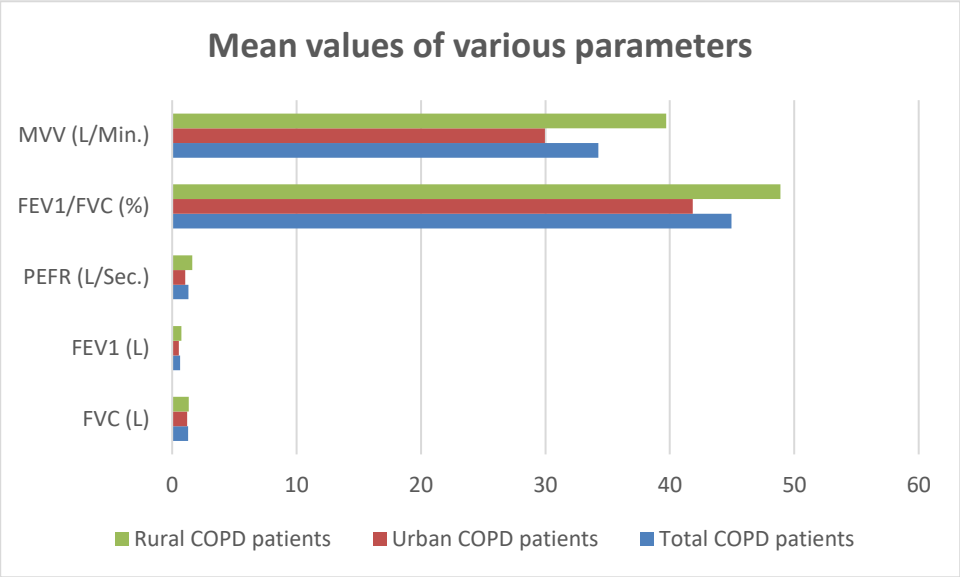


Figure 1.4: Urban COPD patients (n=28)

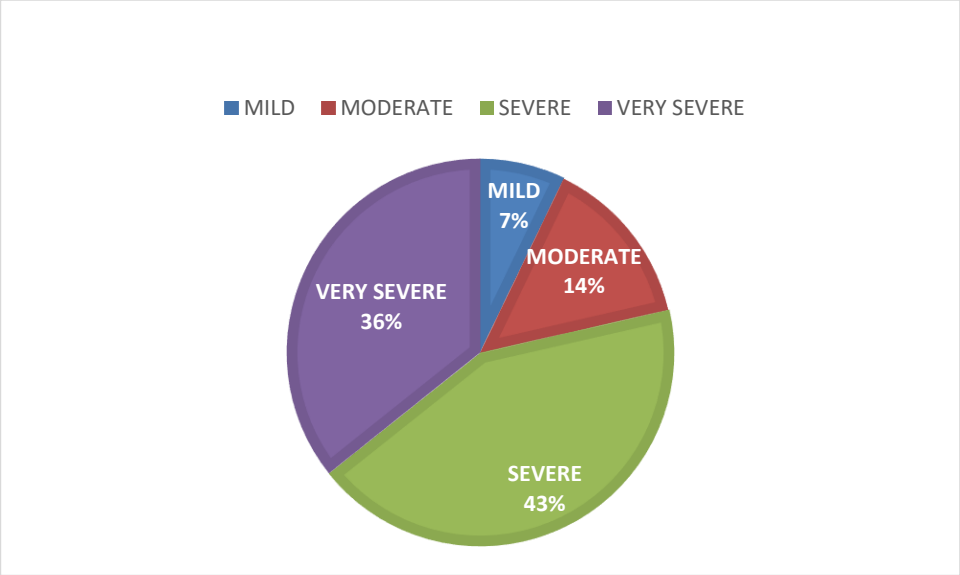
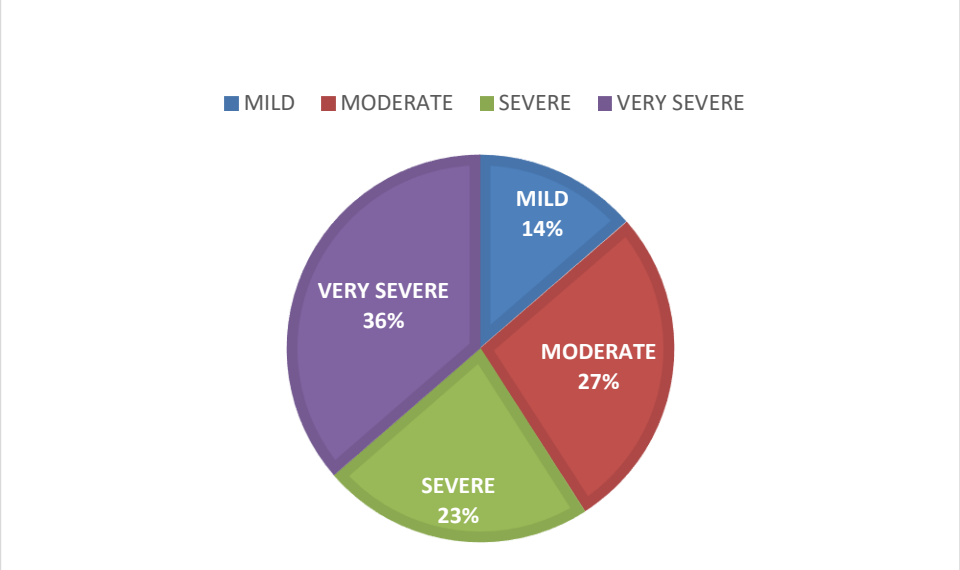


Figure 1.5- Rural COPD patients (n=22)



DISCUSSION:

As shown in figure 1.1 mean of FVC is 1.27 L in COPD patients which is very low as compared to mean of FVC of normal subjects (3.2 L). The forced expiration causes higher than normal transpulmonary pressure so that bronchiolar collapse, obstructive lesions, and air trapping are all exaggerated. Similarly, mean of FEV1 is 2.42 L in normal persons while in COPD subjects, it is 0.63 L. The mean value of PEFR is markedly reduced in COPD patients (1.3 L/S) as compared to normal subjects (5.78 L/S). Subjects with obstructive disease may develop an initially high flow rate before airway closing occurs but afterwards it may decrease. Mean of FEV1/FVC% is 82.4% in normal subjects while in COPD group, it is 44.94%. A normal individual can expire 50% to 60% of the FVC in 0.5 second, 75% to 85% in 1 second, 94% in 2 seconds, and 97% in 3 seconds. Finally, from the above data, the mean value of MVV is also low in COPD subjects (34.26 L/Min) as compared to normal (112.97 L/Min). MVV measures the status of the respiratory muscles, the compliance of the lung-thorax system, and the resistance offered by the airways and tissues. MVV is decreased greatly in subjects with moderate to severe obstructive disease.

For statistical analysis unpaired t-Test was applied. After comparing the above data statistically for COPD patients and controls, 'p' value is <0.01 for all the parameters i.e., FVC, FEV1, FEV1/FVC%, PEFR and MVV. Which means that these results are highly significant. It interprets that mean values of above parameters are very significantly differ between COPD patients & controls.

From our study, mean of FVC in normal is 3.2 L. This result is quite comparable with the study of Kamat SR et al.13 They got 3.36 L mean FVC in normal subjects of India. In our study, we got 1.27 L mean FVC in COPD. Which means, there is marked reduction in FVC in COPD patients.

In the study Pakkala et al.14 found in healthy non-smoker male subjects that because of the effect of automobile pollution there is significant decline in various PFT parameters who reside in high traffic density urban areas compare to relatively traffic free rural areas.

In our study, when the data was compared for total COPD patients with urban COPD patients the mean values of all the PFT parameters are higher than urban while reverse trend was seen in rural (figure 1.3). However, the data was not significant when compared statistically by applying unpaired t-Test (p>0.05).

In urban areas among COPD patients 2 (7%) had mild, 4 (14%) had moderate, 12 (43%) had severe & 10 (36%) had very severe obstruction (figure 1.4). While in rural areas 3 (14%) had mild, 6 (27%) had moderate, 5 (23%) had severe & 8 (36%) had very severe obstruction (figure 1.5).

After comparing the above data statistically for urban and rural areas, 'p' value is >0.05 for all the parameters i.e., FVC, FEV1, FEV1/FVC%, PEFR and MVV. Which means that these results are not significant. It interprets that mean values of above parameters are not significantly differ between urban & rural locations.

CONCLUSION:

Our study indicates that as compared to normal subjects, in patients of COPD there is great reduction in mean values for FVC, FEV1, PEFR, FEV1/FVC%, & MVV irrespective of their residing location which is suggestive of an increase air way obstruction with reduced values of various PFT parameters.

The study also shows that there is no significant difference in mean values of FVC, FEV1, PEFR, FEV1/FVC%, & MVV between urban & rural areas. Our study also suggests that mean values of total COPD patients, urban & rural COPD patients are not comparable. To decide the role of urban and rural background in PFTs the further studies with large sample size are advised.

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