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Evaluation of Biomass Exposure-Associated Chronic Obstructive Pulmonary Disease at a Tertiary Care Hospital

Rao K, Vamshi K, Bhaskar L, Surendar Reddy K* and Waghray P

Department of Pulmonary Medicine, SVS Medical College & Hospital, Mahbubnagar, Telangana

***Corresponding author:** Surendar Reddy K

surendark918@gmail.com

Department of Pulmonary Medicine, SVS Medical College & Hoapital, Mahbubnagar, Telangana, India.

Tel: 9949316154

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Abstract

Context: Exposure to smoke from biomass fuel has been established as a causative factor of irreversible airway obstruction in recent GOLD update. India harbouring a vast majority of rural population may have significant population suffering from airway obstruction due to biomass exposure. Research on similarities and differences in airway disease produced by exposure to biomass fuel smoke while cooking vs. smoking tobacco may provide new insights on such entity. The study aims to evaluate women population presenting with COPD symptoms and their spirometry similarities with smoking related COPD.

Settings and design: It was a prospective study conducted in a tertiary care hospital.

Subjects and methods: Stable COPD patients presenting to chest OPD were taken as study group. Equal number of healthy controls were enrolled. COPD patients were subjected to detailed clinical evaluation and lung function test. History of biomass exposure was evaluated from both groups through self-reporting. Biomass related COPD patients were identified, and their prevalence and distinguishing features evaluated.

Results: Of 85 COPD patients, 43 (50.6%) had history of exposure to biomass. Patients with biomass-associated COPD were invariably females while others were males. The airflow limitation was similar in both groups.

Conclusion: BS-COPD constitutes a significant proportion of overall COPD prevalence. In view of its preponderance among females, biomass alternatives must be provided to rural population which can significantly reduce the burden of disease.

Keywords: COPD; Tuberculosis; Apnoea; Myocardial infarction; Lung volumes

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Introduction

Solid fuel burning viz. dung, wood, agricultural residues and coal is still prevalent as a means for cooking in most parts of world [1,2]. Under-developed countries and rural areas account for most of such biomass fuel use. The pollution level due to such use is often found to be much higher than accepted safe levels especially in indoor areas. Tobacco smoke and biomass smoke has a variety of pollutant resemblance with both forms of smoke being carcinogenic [1,3-6]. In countries like India, people from poor families and rural areas tend to use biomass for cooking and heating purpose due to unavailability of safer means. Such use of biomass has been associated with adverse impact on health of such individuals [7-12].

3.2 million deaths, and 111 million disability-adjusted life-years (DALYs) were reported in 2010 due to solid fuel use worldwide [13].

Women in rural areas are predominantly affected because of long exposure to biomass smoke while cooking. This associated with

closed indoors without proper ventilation makes them prone for developing chronic obstructive pulmonary disease (COPD) associated with biomass smoke inhalation.

Subjects and Methods

It was a prospective study conducted in a tertiary care hospital over a period of 6 months (April 2017 to September 2017). Eighty-five consecutive patients of stable COPD attending chest OPD were enrolled as cases. An equal number of healthy subjects with similar age and gender distribution were taken as controls. Informed consent was taken from all subjects. COPD patients with other pulmonary comorbidities such as obstructive sleep apnoea, interstitial lung disease, lung cancer, congestive heart failure, unstable angina, recent myocardial infarction, and acute exacerbation of COPD in the past 4 weeks were excluded from the study. The study was approved by the Institutional Ethics Committee. Detailed clinical history and medical examination were done with an emphasis on number of previous exacerbations, previous hospitalizations, tobacco smoke exposure, and occupational exposures to dust and smoke. Routine spirometry was performed as per the recent ATS guidelines using SPIROLAB 6000 PC-based Spirometer. Post-bronchodilator forced expiratory volume in 1 s (FEV1), forced vital capacity (FVC), and FEV1/FVC values were recorded based on which patients were categorized into four stages of airflow limitation as per recent GOLD guidelines **(Figure 1)**. In addition, FEF25-75 was also recorded to check for small airway disease **(Table 1).**

Patients were labelled as BS-associated COPD only if exposure to biomass is present and no other confounding factors such as TB, Smoking, other airway diseases are existing. Biomass index defined as number of hours of biomass smoke exposure per day multiplied by number of years of exposure was calculated in these patients.

The prevalence of BS-associated COPD and clinical characteristics were evaluated, and its different parameters were compared with TS-COPD patients **(Table 2)**.

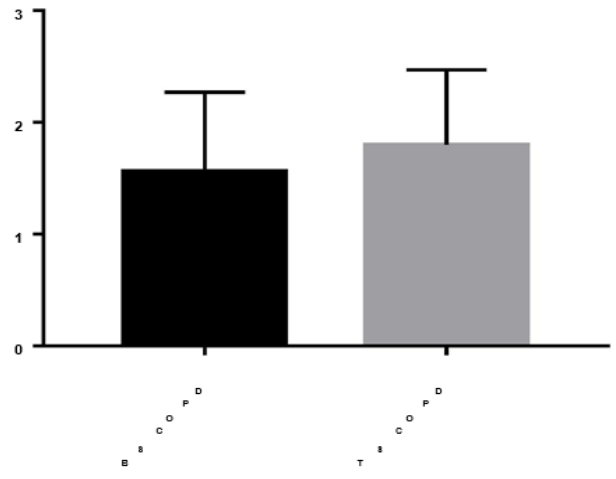

Figure 1 Comparison of FEV1 between both groups.

Table 1 Comparison of features between biomass-associated chronic obstructive pulmonary diseases with other chronic obstructive pulmonary disease.

	COPD (N=42)	Biomass (N=43)	P-Value
Age (Mean ± SD)	58.38 ± 11.15	54.14 ± 14.24	0.1307
BMI	20.45 ± 4.44	21.20 ± 4.07	0.4179
Cough	28.57%	69.76%	0.0002
Dyspnoea grades (MMRC)			
GRADE 1	7	20	0.9208
GRADE 2	16	17	
GRADE 3	10	5	
GRADE 4	9	2	
POST BD FEV1	1.797 ± 0.670	1.558 ± 0.710	0.1143
POST BD FVC	2.761 ± 0.953	2.724 ± 1.231	0.8767
POST BD FEF 25-75	2.288 ± 1.061	2.226 ± 1.114	0.7941
COPD grades			
MILD	12	16	0.8946
MODERATE	18	13	
SEVERE	6	9	
VERY SEVERE	6	6	
No. of hospitalizations	1.714 ± 0.742	1.535 ± 0.735	0.2661

Table 2 Correlation of forced expiratory volume in 1s and no of previous hospitalizations with different parameters in BIOMASS-associated chronic obstructive pulmonary disease.

FEV1			Biomass index	
Parameter	**Pearson coefficient**	**P-Value**	**Pearson coefficient**	**P-Value**
Age	-0.3523	0.0205	0.6077	0.0001
BMI	0.1896	0.2234	-0.08707	0.5788
No of hospitalizations	-0.7448	0.0001	0.2283	0.1408
Biomass index	-O.4394	0.0032	1	-
FEV1	1	-	-0.439	0.003

Statistical Analysis

Data was analysed by GraphPad Prism 7.01 version. Data was summarized by Mean ± SD for continuous data, and percentages for categorical data. The comparison between two groups was done by Unpaired t-test/Mann Whitney U test for continuous data. The association between variables was done by Chi-Square test/Fisher exact test/Proportion test for categorical data. All P-values less than 0.05 were considered statistically significant.

Results

A total of 85 patients were enrolled for the study. 43 were females and 42 were males. BS-COPD was found exclusively in females while TS-COPD in males. Mean biomass index was 89 among BS-COPD patients.

Comparison between tuberculosis-associated chronic obstructive pulmonary disease and other chronic obstructive pulmonary disease

BS-COPD patients were exclusively females while TS-COPD were males. The reason being women are more involved in domestic tasks especially cooking and prolonged working hours in kitchen causing them more exposure to biomass smoke. TS-COPD patients had predominant symptom of dyspnoea while in contrast BS-COPD patients complained of cough. (p=0.0002). There wasn't much statistical difference in spirometry parameters among both the groups (**Table 1**). In BS-associated COPD patients, on univariate analysis, BIOMASS INDEX showed positive correlation with age, and no. of hospitalizations **(Figures 2 and 3)**. FEV1 showed positive correlation with age. These signify that as biomass index increases quality of life detoriates as evident by BMI, no. of hospitalizations and FEV1 values.

Discussion

There isn't much documentation regarding the difference in pathogenicity between damage caused by tobacco smoke and biomass smoke [14,15]. The studies conducted revealed similar oxidative stress on exposure to tobacco smoke and biomass smoke in animal models [15-18].

Individuals with BSCOPD have elevated levels of malonaldehyde and superoxide dismutase in comparison to healthy population. This has an inverse correlation with FEV115. Increased elastolysis activity of macrophages14 and of serum C-reactive protein19 is found in both TS-COPD AND BS-COPD [19-21].

Ramirez-Venegas et al. conducted a study on both the entities and found many similarities and important differences. In contrast to their study, which asserted that airflow obstruction was less severe in BS-COPD than TS-COPD, we found that it was of same degree [22].

Padmavati et al. identified co-pulmonale and pulmonary artery hypertension as important complication of biomass exposure. Mild to moderate PAH was found in many patients in their study. Abnormalities of small pulmonary arterioles with intimal thickening was concluded as possible hypothesis in causing PAH in these patients [23].

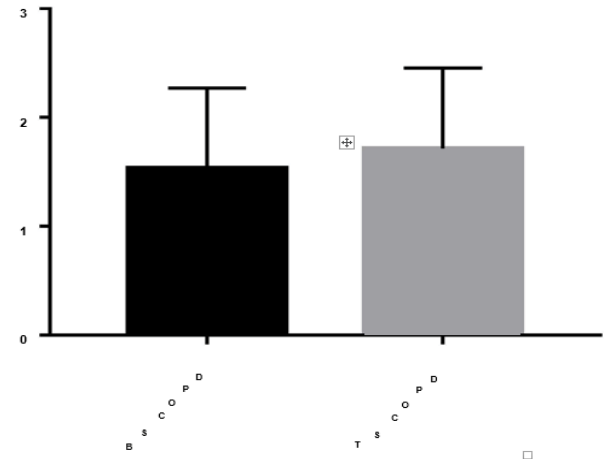

Figure 2 Comparison of no. of hospitalizations between both groups.

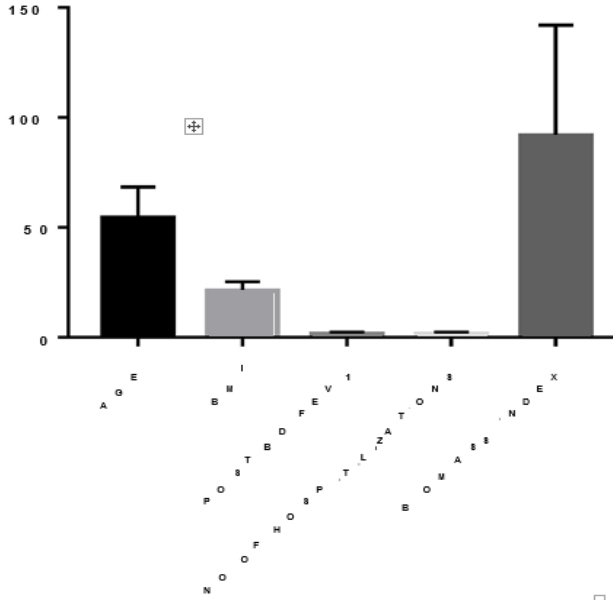

Figure 3 Correlation matrix.

Jordi Olloquequi et al. compared TS-COPD, BS-COPD and patients with exposure to both the factors. They found physiological and inflammatory differences between both groups. BS-COPD group had elevated IgE levels in blood suggesting a role for Th2 response in the pathogenesis [24].

Many other studies conducted on biomass revealed its status as an important risk factor in causing COPD. Lin-ling Cheng et al. evaluated clinical characteristics, co-morbidities and exacerbation risk in both groups and concluded there was no statistically significant difference in between these groups. In keeping with this study, we found similar grades of airway obstruction though we didn't evaluate other parameters mentioned.

Some limitations of this study must be mentioned. Due to many exclusion criterion, the study sample size was small and so variation in results was limited. Evaluation of lung volumes, inflammatory mediators, co-morbidities would have clearly demarcated the differences between both groups, but we felt that limited resources and small sample size, would hamper the result [25].

Conclusion

BS-COPD may constitute significant proportion of overall COPD prevalence and is neglected often. Using cleaner energy for cooking and avoiding biomass fuel burning significantly improves the quality of life in rural women. Larger observational and epidemiological studies are need of hour to establish it as a risk factor for COPD and thereby educating people towards need of clean energy.

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