

Clinical and Functional Impairment in Pulmonary Function of Non-Smoking Women Exposed to Biomass Fuel During Cooking and it's Co-relation with Biomass – Index

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ABSTRACT

Introduction: Exposure to pollutants emitted from combustion of biomass fuel during cooking still remains a major global threat to public health, particularly among women living in under developed countries., Objectives: To assess the clinical and functional impairment on pulmonary function in non-smoking women using biomass fuel for cooking and its correlation with biomass index.

Material and methods: 100 women with history of exposure to biomass smoke who met the inclusion criteria and willing to take part in the study were enrolled. Data on demographics, biomass fuel used, respiratory symptoms and spirometry findings were recorded.

Results: The severity of dyspnea and functional impairment (assessed by spirometry) had a statistically significant correlation with biomass index with a P value of 0.04 and 0.004 respectively. Cow dung use had more respiratory impairment when compared with other biomass fuels.

Conclusion: Biomass exposure does have significant effects on lung function. Protective health measures in the form of improving stove designs, ventilation, switching over to clean energy sources such as LPG/ solar energy should be adopted.

Keywords: Biomass Fuel, Pulmonary Function, Spirometry

secondary was to assess the co-relation between clinical and functional impairment with biomass fuel index.

MATERIAL AND METHODS

Study was done in Tagore Medical College and Hospital Rathinamangalam (Dept of Pulmonary Medicine) for 6 months (Aug 2016- Jan 2017). This Cross-sectional study was done on 100 patients. Non- smoking women aged between 15 and 70 years attending pulmonary medicine OPD with respiratory symptoms with history of exposure to biomass smoke for >6 months (>2hours/day), willing to take part in the study were interviewed. Clinical impairment assessed using a standard clinical questionnaire derived from ATS- DLD -78A (American Thoracic Society- Division of Lung Diseases) developed by epidemiology standardization project committee. Questionnaire will be read out to the patient, translated into local language and sufficient time will be given to the patient to respond. This questionnaire will have 2 parts. The first part contains general demographic details and history required to decide on inclusion and exclusion criteria. Also parameters like Income status/ educational qualification / Ventilation facilities/ Biomass fuel used and hours of exposure will be included in this questionnaire. Part-II will be based on patient's presenting symptoms with severity of breathlessness as graded by MMRC scale (Modified Medical Research Council) for dyspnoea.⁵

Functional impairment

Assessed by a trained technician who performs spirometry with standard calibration in sitting position as recommended by ATS.⁶ 3 acceptable and 2 reproducible forced expiratory maneuvers are used for analysis. FEV1, FVC values will be expressed in liters/ min and FEV1/FVC ratio as percentage predicted reference values.

Inclusion Criteria

- H/O exposure to biomass smoke > 6 months (>2 hours/ day)
- Willing to take part in the study
- Age between ≥ 15 - ≤ 70 yrs.
- Women, Non- smokers

INTRODUCTION

Indoor air pollution in the form of exposure to biomass smoke is a risk factor for pulmonary diseases, particularly among women living in developing countries. Burning of biomass fuel has emerged as one of the top ten global threats to public health and responsible for 1.5million deaths annually.¹ Levels of exposure has been reported to be high among women and children since they spend most of their time indoors. Fuels like wood, animal dung, crop residue domestic waste, straw and grasses produce large quantities of smoke that contains RSPM, CO, N2O, PAH, etc.^{2,3} A National sample survey conducted in India (2013) showed that 80% of Indian rural population still uses biomass fuel for cooking. Cooking is still carried out in closed spaces with poor ventilation and girls even at the age of 15 spend around 2-3 hours a day in kitchen. Limited studies have been done so far in this field and almost all of them had reported a positive association between biomass fuel usage and structural/ functional changes in respiratory system.⁴ Considering the respiratory health risk due to the effect of these combustible products on rural women a cross-sectional study was conducted to study their effects on lung function.

Primary objective of the study was to assess the clinical and functional impairment on pulmonary function in non-smoking women using biomass fuel for cooking and presenting with respiratory symptoms to pulmonary medicine OPD and

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Exclusion criteria

- Smokers, pregnant women, LPG users, women using induction stoves
- Presence of systemic illness like CAD/ Malignancy
- Old treated PT
- Scoliosis/ HIV/ Acute Respiratory Infection
- Exposure to passive smoking at home

Working definitions

- Socio-economic status:
 - <5000/month – low income
 - 5000- 10000/month – middle income
 - >10000/month – high income
- Education:⁷
 - Illiterate – Not been to school
 - Prim. <10th std
 - High school – 10th -12th std
 - Graduate – Any Degree>12th std
- Overcrowding:⁸
 - WHO definition: Persons >9 yrs of age, not husband and wife and of the opposite sex are obliged to stay in a same room.
- Modified Medical Research Council (mMRC) Dyspnoea Scale for grading the severity of breathlessness during daily activities

Grade Symptom complex**Grade Symptom complex**

Grade	Symptom complex
0	I only get breathless with strenuous exercise
1	I get short of breath when hurrying on level ground or walking up a slight hill
2	On level ground, I walk slower than people of the same age because of breathlessness, or I have to stop for breath when walking at my own pace on the level
3	I stop for breath after walking about 100 metres or after a few minutes on level ground
4	I am too breathless to leave the house or I am breathless when dressing or undressing.

- Biomass index:⁹
 - Hours of exposure to biomass smoke during cooking × years of exposure.
 - < 30 hours yrs - Mild
 - 30 – 60 - Moderate
 - > 60 - Heavy
- Spirometry Findings:
Gold guidelines:⁵
 - FEV1/FVC <70% and
 - FEV1 >80% - Mild obstruction
 - 50 – 79% - Moderate obstruction
 - 30 – 49% - Severe obstruction
 - < 30% - Very Severe obstruction

STATISTICAL ANALYSIS

Data obtained from 100 women who had history of biomass fuel exposure and who met the inclusion criteria were analyzed statistically with the help of SPSS version 21. Comparison was made with the help of chi square test.

RESULTS

Population characteristics of the study group is depicted

in table-1. Mean age of study subjects were 42.30+12.81. Nearly 37% of them were housewives and 23% were made by occupation. Regarding socioeconomic status 3/4th of them belonged to low (41%) and middle (35%) income groups. The educational level of the subjects on an average was poor, where majority of them were either illiterates or have only been to primary school.

Overcrowding was observed among families of 47% subjects and approximately one half of them had indoor kitchen with inadequate ventilation. 44% used wood, 35% cow dung and 16% coal as cooking fuel and one half of them had >25 years of exposure to biomass smoke.

The biomass index in hour-years which was used to calculate the degree of exposure was mild in 45%, moderate in 37% and heavy exposure seen in 18% of subjects.

The most common presenting symptom to the OPD was cough (79%) followed by dyspnea (65%) and wheeze (52%) respectively.

Subjects who had moderate to heavy exposure to biomass smoke, had more severe dyspnea graded as per MMRC (odified Medical Research Council) scale and was found to be statistically significant (P value 0.04). (Table: 2)

Lower FEV1 values and hence more functional impairment was observed among subjects with moderate to heavy exposure

Age	Mean SD	42.30	12.81
		N	%
Occupation	Cook	14	14
	Maid	23	23
	HW	37	37
	Farmer	15	15
	Student	8	8
	Cooley	2	2
	Housekeeping	1	1
Socio economic status	Low	41	41
	Middle	35	35
	High	24	24
Education	Illiterate	29	29
	Primary	45	45
	High School	18	18
	Graduated	8	8
Overcrowding	Yes	47	47
	No	53	53
Kitchen	Out door	44	44
	Indoor	56	56
Ventilation	Adequate	55	55
	Inadequate	45	45
Biomass fuel type	Wood	44	44
	Cow dung	35	35
	Coal	16	16
	Sawdust	1	1
	Hay	4	4
Biomass duration	Mild	65	65
	Moderate	34	34
	Heavy	1	1
Biomass index	Mild	45	45
	Moderate	37	37
	Heavy	18	18

Table-1: Population characteristics of women exposed to biomass smoke: (N= 100)%

Symptoms	N	%
Cough	79	79
Sputum	45	45
Dyspnoea	65	65
Wheeze	52	52

Table-2: Respiratory symptoms (N = 100)

Biomass index	G0	G1	G2	G3	G4		
Mild	10(22.2)	5(11.1)	15(33.3)	11(24.4)	4(8.9)	2.763	0.043
Moderate	8(21.6)	7(18.9)	9(24.3)	10(27.0)	3(8.1)		
Heavy	4(23.5)	1(5.9)	6(35.3)	5(29.4)	1(5.9)		

Table-3: Degree of dyspnoea (MMRC- scale) v/s biomass index

	Mild obstruction	Moderate obstruction	Severe obstruction	Normal	Mild restriction		P value
Biomass index	n(%)	n(%)	n(%)	n(%)	n(%)	26.910	.004
Mild	22(48.9)	12(26.7)	4(8.9)	6(13.3)	1(1.1)		
Moderate	9(24.3)	13(35.1)	15(40.5)	0(0)	0(0)		
Heavy	1(5.6)	7(38.9)	9(50.0)	1(5.6)	0(0)		

Table-4: Lung function (GOLD FEV1 Stage) v/s Biomass index

to biomass smoke when compared with those who had mild exposure (Table:3) and was also found to be highly statistically significant (P value 0.004).

An additional observation was that subjects who used cow dung had more severe obstruction (FEV1- 30-49%) when compared with those using coal or wood as cooking fuel with a P value of 0.001 (Table: 4).

DISCUSSION

In our study mean age of the study subjects were 42.3012.81. Majority of them had a low educational qualification and belonged to lower socioeconomic group. One half of them had overcrowding, indoor kitchen with inadequate ventilation.

In a study conducted by Torres et al and Heffner et al it was estimated that indoor air pollution created by biomass smoke in houses which had overcrowding and poor ventilation, was responsible for increase in respiratory problems leading onto COPD, allergic rhinitis and bronchial asthma.^{10,11}

Approximately 50% of them had been exposed to biomass smoke for >25 years and the predominant cooking fuel used was wooden log followed by animal dung and coal. A study conducted by Bilir et al also showed that women in rural areas spent around 4-6hrs per day in kitchen and majority of them had >30 years of exposure.¹² Smith et al did a pilot village study in various parts of India and revealed that women still rely principally on wood, animal dung and crop residue for cooking fuel.¹³

Cough and dyspnea were the predominant respiratory symptom for which patient sought medical attention. A study done by Sharath Chandra et al in belagavi village near Karnataka also reported cough as the common presenting symptom.¹⁴

There was a statistically significant correlation observed between the severity of dyspnea with degree of exposure to biomass smoke (P value 0.04) and between FEV1 values assessed by spirometry with degree of biomass exposure (P value 0.004).

A study done by Vipin Bihari et al among rural women in UP had similar findings where there was a significant decline in FEV1 values in women who had increased exposure to biomass

smoke.⁷ Hulya et al in his study also found out that women with biomass exposure for >60 hour-years had low FEV1 values and more functional impairment (P value 0.001), a finding similar to our study.⁹

Cow dung users had more severe functional impairment than other biomass fuel with a P value of 0.001 which is a similar finding observed in a study done at Turkey⁹, but Kurmi et al in his study had concluded that using wood had more respiratory impairment than other fuels.¹⁵

Recommendations

Rural areas must be upgraded with separate kitchen, adequate ventilation, better design of stoves and a switch over to cleaner fuels such as natural gas and solar energy. Young adults have to be targeted thereby long term effects and morbidity due to biomass smoke can be minimized.

CONCLUSION

Regular assessment should be made in high risk areas where biomass exposure is intense and protective health measures to be undertaken to raise the awareness of hazards related to biomass smoke particularly in rural areas.

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