RESEARCH FRONT

ISSN
(Print) 2320 – 6446, (Online) 2320 – 8341

USE OF BIOMASS FUEL AND REDUCED LUNG FUNCTION IN WOMEN WORKING IN THE FIELDS IN RURAL AREA OF RASULWADI FROM SANGLI DISTRICT

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Abstract

In developing countries Biomass fuels are extensively used for cooking. Half of the world's population uses solid fuels coal and biomass. On a global scale, the household use of solid fuels is the most important source of indoor air pollution. Indoor air pollution due to biomass fuel burning is the major problem in rural area of Sangli district. Majority of women uses biomass fuel for cooking and heating purposes in rural area of Sangli District. Due to easy availability of biomass fuel, while working in the field, women from rural area of Sangli district collects biomass fuel such as wood, agricultural waste for cooking and heating purpose. Total 200 women were participated in this study. 100 women who are working in the field using biomass fuel (Subject) for cooking and 100 women not working in the field using LPG (Control) for cooking. In subject women kitchens are not properly ventilated. Due to improper ventilation incomplete combustion of biomass fuel releases smoke. Smoke contains number of health damaging air borne pollutants, such as PM (Particulate matter), CO_2, NO_2, SO_2, formaldehyde and other organic compounds. Inhalation of such pollutants has been related to numerous respiratory problems such as COPD. COPD is the inflammation and swelling of the lining of the airways that leads to narrowing and obstruction of the airways. In COPD there is reduction in the lung function that is $FEV_1\% < 80\%$.

For the present study, rural area rasulwadi from Sangli district was selected. Survey of women working in the field using biomass fuel was done.

Spirometry was done in 200 women, (100 subject women and 100 control women). Forced expiratory volume per one second ($FEV_1\%$) and Forced Vital Capacity (FVC%) ratio of $FEV_1\%/FVC\%$ were recorded in each women.

Results : In this study we found that out of 100 subject women working in the field using biomass fuel 53 women had reduced lung function i.e. $FEV_1\% < 80$.

Key word – Biomass fuel, COPD, Forced expiratory volume per one second ($FEV_1\%$)

Introduction

In developing countries Biomass fuels are extensively used for cooking. Viegi, *et al.* (2004). Half of the world's population uses solid fuels coal and biomass. Desai, *et al.* (2004). On a global scale, the household use of solid fuels is the most important source of indoor air pollution. Smith, *et al.* (2004).

In rural India, nearly 90% of the primary energy is derived from biomass (wood 56%, Crop residue 16%, Dung 21%). Balkrishna, *et al.* (2002). Cooking is the most important activity contributing to Indoor air pollution. The majority of households in developing

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(Print) 2320 – 6446, (Online) 2320 – 8341

countries use biomass fuel for cooking. Incomplete combustion of biomass fuel release smoke which contain PM10, NO_2, SO_2, formaldehyde and other organic compounds.(Bruce, *et al.* 2000) In India approximately 500,000 premature deaths representing 6 to 7% of the national burden of disease, may be attributable to indoor pollution. Smith, K.R. (2000).

A large number of studies have found association of exposure to solid fuel smoke with COPD especially in women. Bruce, *et.al.* (1998); Dennis, et. al., (1996); Pandey, *et. al.* (1984). The use of biomass fuel mainly wood has been associated with impairment of pulmonary function i.e. reduction in FEV_1%. Saha, *et. al.* (2005); Regalado, *et. al.* (2006).

Wood, agricultural waste, dung cake are the major source of energy in India. In India agricultural wastes is abundant, easily available and lie in the field unutilized. This agricultural waste cannot be composted easily, end up as fuel. Hay, Paddy husk, wheat streaks, dried leaves of Mango, Jack fruit coconut palm and sugarcane branches and roots which annually pruned are used as fuel in rural area. In India a rural women who are working in the field uses such agricultural waste as a fuel for cooking and heating purpose.

Indoor air pollution due to biomass fuel burning is the major problem in rural area of Sangli district. Majority of women uses biomass fuel for cooking and heating purposes in rural area of Sangli District. Due to easy availability of biomass fuel, while working in the field, women from rural area of Sangli district collects biomass fuel such as wood, agricultural waste for cooking and heating purpose.

Total 200 women were participated in this study. 100 women who are working in the field using biomass fuel are considered as subject and women who are not working in the field using LPG for cooking are considered as control. Biomass fuel users are from low socio economic status and living in small pucca type of houses while LPG users are from medium economic status and living in concrete houses.

In biomass fuel users (Subject) women kitchens are not properly ventilated and in LPG users (Control) kitchens are properly ventilated. Due to improper ventilation incomplete combustion of biomass fuel releases smoke, which contains number of health damaging air borne pollutants, such as PM (Particulate matter), CO_2, NO_2, SO_2, formaldehyde and other organic compounds. Inhalation of such pollutants has been related to numerous respiratory problems such as COPD. COPD is the inflammation and swelling of the lining of the airways that leads to narrowing and obstruction of the airways. In COPD there is reduction in the lung function that is $FEV_1\% < 80\%$.

For the present study, from Sangli district rural area rasulwadi was selected which is 6 to 7 kms away from Sangli city. Survey of women working in the field using biomass fuel (Subject) for cooking was done. All women participated in this study are above 35 yrs of age using indoor kitchen for more than 15 yrs.

Materials and Method

- Survey of women working in the field (Subject) using chulla in rural area Rasulwadi was done.
- 100 women working in the field using chulla (Subject) and 100 women not working in the field using LPG (Control) were selected.
- Spirometry was done in 200 women, (100 subject women and 100 control women).

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(Print) 2320 – 6446, (Online) 2320 – 8341

- Forced expiratory volume per one second (FEV_1%). Forced Vital Capacity (FVC%). FEV_1%/FVC% were recorded
- Statistical analysis
  Method – Z calculated Test of significance based on null hypothesis was done.
  Z significance test was used. 'Z' value for control and subject was calculated, using formula based on null hypothesis to show significant difference between control and subject.

$$Cal\,|z| = \left[\frac{\overline{x1} - \overline{x2}}{\sqrt{\frac{\sigma 1^2}{n_1} + \frac{\sigma 2^2}{n_2}}}\right]$$

$\overline{x1}$ Mean of subject $\overline{x2}$ Mean of Control

$\overline{\sigma 1}$ Standard devaation of subject $\overline{\sigma 2}$ Standard devaation of subject

n1 = Number of observations of subjects

n2 = Number of observations of control

H0: There is no significant difference between control and subject women FEV_1.

V/s

H1: There is significant difference between control and subject women FEV_1.

Cal |Z| = > table Z = 1.96 at 5% level of significance.

∴ Reject H0

∴ There is significance difference between control and subject.

Observations – Results : In this study we found that out of 100 subject women working in the field using biomass fuel 53 women had reduced lung function i.e. FEV_1% < 80.

Data of Spirometry (FEV_1%, FVC%, FEV_1/FVC%) of Rural Women from Rasulwadi.

Sr No	CONTROL			SUBJECT		
	FEV_1%	FVC%	FEV_1/FVC%	FEV_1%	FVC%	FEV_1/FVC%
1	98.03	91.3	88.69	54.46	67.47	69.05
2	76.32	86.26	88.47	61.43	77.69	66.15
3	98.03	91.3	88.69	121.33	114.67	86.26
4	121.33	114.67	86.26	54.46	67.47	69.05
5	98.03	91.3	88.69	87.33	58.72	79.39
6	121.33	114.67	86.26	53.37	36.36	80.56
7	98.03	91.3	88.69	53.37	36.36	80.56
8	121.33	114.67	86.26	53.37	36.36	80.56
9	101.27	96.37	86.02	87.58	86.26	88.47
10	101.27	96.37	86.02	98.03	91.3	88.69
11	98.03	91.3	88.69	98.03	91.3	88.69
12	121.33	114.67	86.26	61.43	77.69	66.15
13	121.33	114.67	86.26	54.46	67.47	69.05
14	78	61.07	77.78	21.56	25.74	69.23
15	95.54	91.43	86.16	51.08	83.41	83.04
16	82.56	61.07	83.04	33.08	36.36	80.56

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Sr No	CONTROL			SUBJECT		
	FEV1%	FVC%	FEV1/FVC%	FEV1%	FVC%	FEV1/FVC%
17	101.27	96.37	86.02	33.08	36.36	80.56
18	121.33	114.67	86.26	33.08	36.36	80.56
19	101.27	96.37	86.02	61.43	77.69	66.15
20	121.33	114.67	86.26	101.27	96.37	86.02
21	121.33	114.67	86.26	21.56	25.74	69.23
22	87.58	86.26	88.47	54.46	67.47	69.05
23	98.03	91.3	88.69	53.37	54.82	80.56
24	101.27	96.37	86.02	53.37	36.36	80.56
25	87.33	58.51	79.39	92.79	90.32	86.16
26	92.79	91.43	86.16	121.33	114.67	86.26
27	121.33	114.67	86.26	33.08	36.36	80.56
28	82.56	61.07	83.04	33.08	36.36	80.56
29	87.33	90.66	79.39	33.08	36.36	80.56
30	105.18	102.62	86.38	33.08	36.36	80.56
31	87.33	58.51	79.39	78.4	72.15	85.96
32	83.04	61.07	83.04	70.94	65.56	91.14
33	98.03	91.3	88.69	51.82	72.77	83.04
34	87.58	86.26	88.47	92.79	91.43	86.16
35	98.03	91.3	88.69	121.33	114.67	86.26
36	121.33	114.67	86.26	87.33	58.51	79.39
37	98.03	91.3	88.69	87.58	86.26	88.47
38	121.33	114.67	86.26	98.03	91.3	88.69
39	101.27	96.37	86.02	98.03	91.3	88.69
40	101.27	96.37	86.02	50.7	53.92	87.27
41	98.03	91.3	88.69	87.58	86.26	88.47
42	121.33	114.67	86.26	101.27	96.37	86.02
43	121.33	114.67	86.26	80.42	91.43	86.16
44	79	61.07	78.95	121.33	114.67	86.26
45	92.31	91.43	85.71	81.14	70.66	83.04
46	83.04	61.07	83.04	42.74	39.34	93.46
47	101.27	96.37	86.02	61.43	77.69	66.15
48	121.33	114.67	86.26	92.79	91.43	86.16
49	101.27	96.37	86.02	121.33	114.67	86.26
50	121.33	114.67	86.26	87.33	58.51	79.39
51	82.56	61.07	83.04	87.33	95.38	79.39
52	101.27	96.37	86.02	87.58	86.26	88.47
53	121.33	114.67	86.26	71.19	72.7	84.39
54	101.27	96.37	86.02	68.8	73.9	80.1
55	121.33	114.67	86.26	74.64	76.61	78.63
56	121.33	114.67	86.26	94.3	125.37	88.69
57	87.58	86.26	88.47	57.08	61.99	79.17
58	98.03	91.3	88.69	52.4	71.25	83.04
59	101.27	96.37	86.02	74.64	75.29	78.63
60	92.79	91.43	86.16	101.27	96.37	86.02
61	121.33	114.67	86.26	57.08	61.99	79.17
62	79	61.07	78.95	54.46	67.47	69.05
63	87.33	90.66	79.39	94.3	125.37	88.69
64	105.18	102.62	86.38	54.46	67.47	69.05

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Sr No	CONTROL			SUBJECT		
	FEV_1%	FVC%	FEV_1/FVC%	FEV_1%	FVC%	FEV_1/FVC%
65	87.33	58.51	79.39	54.46	67.47	69.05
66	82.56	61.07	83.04	92.79	91.43	86.16
67	98.03	91.3	88.69	121.33	114.67	86.26
68	87.58	86.26	88.47	51.82	74.35	83.04
69	98.03	91.3	88.69	67.02	63.68	88.73
70	121.33	114.67	86.26	21.56	25.74	69.23
71	98.03	91.3	88.69	73.94	75.78	82.25
72	121.33	114.67	86.26	80.08	72.47	92.79
73	101.27	96.37	86.02	42.74	39.34	93.46
74	92.79	91.43	86.16	92.79	91.43	86.16
75	82.56	61.07	83.04	50.7	67.07	87.27
76	101.27	96.37	86.02	121.33	114.67	86.26
77	121.33	114.67	86.26	67.02	63.68	88.73
78	101.27	96.37	86.02	54.46	67.47	69.05
79	121.33	114.67	86.26	61.43	77.69	66.15
80	87.58	86.26	88.47	73.94	75.78	82.25
81	98.03	91.3	88.69	87.33	58.1	79.39
82	106.67	96.37	86.02	21.56	25.74	69.23
83	87.33	90.66	79.39	87.58	86.26	88.47
84	92.79	91.43	86.16	94.3	125.37	88.69
85	121.33	114.67	86.26	94.3	125.37	88.69
86	82.56	61.07	83.04	51.64	71.25	83.04
87	87.33	90.66	79.39	101.27	96.37	86.02
88	105.18	102.62	86.38	92.79	91.43	86.16
89	87.33	58.51	79.39	121.33	114.67	86.26
90	82.56	61.07	83.04	79.75	72.47	92.79
91	98.03	91.3	88.69	101.43	71.25	83.04
92	87.58	86.26	88.47	96.02	91.43	86.16
93	87.33	58.51	79.39	121.33	114.67	86.26
94	92.79	91.43	86.16	87.33	58.1	79.39
95	82.56	61.07	83.04	87.58	86.26	88.47
96	121.33	114.67	86.26	94.3	125.37	88.69
97	121.33	114.67	86.26	94.3	125.37	88.69
98	98.03	91.3	88.69	51.64	61.07	83.04
99	101.27	96.37	86.02	101.27	96.37	86.02
100	101.27	96.37	86.02	21.56	25.74	69.23
Mean	100.67	92.69	85.61	73.62	75.38	81.96
Var.	196.47	322.90	8.00	725.32	709.49	53.58
Sqrt	3.04	3.21	0.78			
Z	8.91	5.39	4.64			

Above table represents observations on spirometry of control and Subject women in the village Rasulwadi. 100 women using LPG (Control) and 100 women using chulla (Subject) from village Rasulwadi were selected for the study of spirometry. The mean values of FEV_1%, FVC%, FEV_1/FVC% of control women are 101.67, 92.69 and 85.61 respectively, while mean values of FEV_1%, FVC%, FEV_1/FVC% Subject women are 73.62, 75.38 and 81.96 respectively. These values are shown at the base of each row in the table. The calculated Z value of FEV_1%, FVC%, FEV_1/FVC% based on null hypothesis are at the last of

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(Print) 2320 – 6446, (Online) 2320 – 8341

each row in the table. The calculated Z value of FEV_1% is 8.91, FVC% is 5.39 and FEV_1/FVC% is 4.64 respectively. All these calculated Z values are greater than table value 1.96 hence there is significant difference in FEV_1%, FVC%, FEV_1/FVC% of control and Subject women. The result is significant at 5% level of significance.

Discussions –

This study shows that risk of, use of biomass fuel and reduced lung function in women working in the field in rural area of rasulwadi from Sangli district. The study population was 200 households. 100 biomass fuel users and 100 LPG users. All women were above 35 yrs age using indoor kitchen for more than 15 years. When we analyzed results of spirometry, we found that 53 women had reduced lung function (FEV_1% < 80).

For statistical analysis Z calculated test based on null hypothesis was used. Results of statistical analysis were significant at 5% level of significance. The calculated Z value of FEV_1% is 8.91, FVC% is 5.39 and FEV_1/FVC% is 4.64 respectively. All these calculated Z values are greater than table value 1.96 hence there is significant difference in FEV_1%, FVC%, FEV_1/FVC% of control and Subject women. The result is significant at 5% level of significance.In this study out of 100 subject women 53 women had reduced lung function . Dutt, *et al*. (1996) studied effect of indoor air pollution on respiratory system of women using different fuels for cooking in an urban slum of Pondicherry and reported that lung functions FEV_1%, FVC%, FEV_1/FVC% were significantly lower in bio fuel users compared with both kerosene and LPG users. Other studies, (Zelikoff, *et al*. (2002); Dennis, *et al.* (1996); Ekici, *et al.* (2005)) confirmed that, people exposed to biomass smoke, have a high risk for developing airflow obstruction with significant reduction of FEV_1%, FVC%, FEV_1/FVC%.

Our results are similar with results of Dutt *et al;* Zelikoff, *et al.*; Dennis, *et al.*; Ekici, *et al.*

Conclusion

Use of biomass fuel causes adverse effect on lung function, this could be due to exposure to air pollutants emitted through biomass fuel combustion and inadequate ventilation. Use of improved (smokeless) stoves reduces the level of indoor air pollution.

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