EFFECT OF DOMESTIC COOKING FUEL COMBUSTION ON PEAK EXPIRATORY FLOW RATES OF INDIAN FEMALES

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Abstracts: Background and Objectives: Routine exposure to domestic cooking fuels is an important source of indoor air pollution causing deterioration of lung function. Peak expiratory flow rate (PEFR) estimation helps to diagnose respiratory morbidity at an early stage. **Aims and Objective:** To study and compare PEFR of young females using different cooking fuels. **Materials and Methods**: The PEFR was measured in 50 adult females using biomass fuel as domestic fuel and compared with demographically matched 50 adult females using LPG as cooking fuel. PEFR was measured using Wright's peakflow meter. Three readings taken in the standing position and best taken as final**. Result**: PEFR is 392.87L/min in LPG users and 371.60 in subjects using biomass fuel as cooking fuel. PEFR in LPG users is 391.87 and 362.48 in bio mass fuel users, for the two groups involved in the process of cooking for more than ten years. This difference is highly significant statistically ($p<0.001$). There is not much variation in peak expiratory flow rates of the LPG users, with increasing duration of exposure**. Conclusion**: It was concluded that Peak expiratory flow rate of females using biomass fuel is less than that of females using LPG as domestic fuel, and this difference increases with increase in duration of exposure.
Key words: PEFR, Cooking fuel, Biomass, LPG, Indoor pollution.

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Introduction:

The majority of rural households in the developing countries use biomass fuel for cooking which produces levels of air pollution that far exceeds the health based standards for safety.[1-5] Smoke from biomass combustion produces a large number of air pollutants like particulate matter, carbon monoxide, nitrogen oxides, formaldehyde, benzene, poly-cyclic aromatic hydrocarbons and many other toxic organic compounds.[6] Biomass fuels are used mostly by poor people , predominantly in rural areas of developing countries due to its easy availability and mostly free of cost when compared to other fuels like LPG, electricity and kerosene stoves. Biomass contributes to one-fourth of the total energy consumed in India. About 17.5% of all Indian homes use LPG as their primary cooking fuel whereas 78% rely on biomass fuels[7] and another 3% on coal.[8] Globally 50% of the deaths from COPD in developing countries are contributed by biomass exposureand 75% of the women are sufferers.[6] Exposure to irritant gases produced during cooking on Chulha (indigenous-cooking stove where biomass is used as a fuel) is considered a primary cause of bronchitis and emphysema.[9] Different studies have reported biomass smoke asa cause of acute upper and lower respiratory infection[10,11],chronic bronchitis/ emphysema,[12] lung cancer[13] and nasopharyngeal carcinoma.[14]In the past studies have reported significantly lower peak expiratory flow rate as a percentage of predicted(PEFR%) in females using biomass as a cooking fuel, as compared to females using LPG for cooking.[15] So this study was done to study the effect of cooking fuel combustion on PEFR of healthy females. The PEFR test is a common, simple test that helps to diagnose and monitor lung problems, such as asthma and chronic obstructive pulmonary disease (COPD)**.** This test may also be performed at home to determine whether lung disorder treatments are working and to prevent conditions from worsening. Keeping continuous records of peak flow rates may also help the patient to determine whether environmental factors or certain pollutants are affecting his or her breathing**.**

Material and Methods:

This cross-sectional study was done on 100 subjects (50 each from biomass group and LPG

group). The study was done in an adjoining village near hospital. Females included for the study were in the age group of 25-50 years, non-smokers, using either biomass or LPG as their sole cooking fuel and having a minimum exposure of 10 years. Exclusion criteria were smokers, women suffering from chronic chest diseases and with spine or ribcage deformity. Each subject selected for the study was explained the purpose of the study and written informed consent was taken. The age, height and weight were taken for standardizing the readings. The subject was made to sit comfortably in a well lit room and procedure explained in vernacular as understood by the subject. PEFR was recorded by Mini-Wright peak flow meter (Clement and Clark) an instrument to record PEFR from 60–800 L/min. Each subject was asked to take deep breath and then blow into peak flow meter as hard and fast as he could with nose clipped. Three readings were recorded and the highest was taken as the representative value for a given individual. The same peak flow meter was used throughout this study. Recordings were taken in the standing position. Permission for the study was taken from the ethics and research committee of the institute. After recording the data, the parameter stated above was analyzed statistically by applying the Student's t-test and p-values <0.05 and <0.001 were considered statistically significant (S) and highly significant (HS), respectively.

Result:

Demographic details of the two groups have been shown in Table no. I. This table shows that there is non-significant variation in age, height, weight and B.S.A. in the two groups i.e. subjects using LPG or biomass fuel as domestic fuel for cooking. That means these two groups are comparable. This table also shows the duration of cooking i.e. approximately 18 years in both the groups so duration of exposure is same. Table no. 2 shows Peak expiratory flow rates of both the groups. There is non-significant variation in the Peak expiratory flow rates of females in the two groups in 0-5 years of cooking duration group. That might be because of lesser duration of exposure and younger age of the subjects. This difference in PEFR becomes significant (p<0.05) as the duration of exposure to biomass fuel combustion increases, 392.87L/min in LPG users and 371.60 in subjects using biomass fuel as cooking fuel. PEFR in LPG users is 391.87 and 362.48 in bio mass fuel users, for the two groups involved in the process of cooking for more than ten years. This difference is highly significant statistically (p<0.001). There is not much variation in peak expiratory flow rates of the LPG users, with increasing duration of exposure.

Table:1 Demographic data of the two groups

Parameter	Group I(LPG, n=50)		Group II(Biomass fuel, n=50)		p-value
	Mean	±SD	Mean	±SD	
Age (years)	33.14	9.02	34.56	8.50	>0.05^{NS}
Height(cm)	166.40	7.74	164.35	6.56	>0.05^{NS}
Weight(kg)	67 .08	8.35	63.88	8.78	>0.05^{NS}
B.S.A($m^{2)}$	1.71	0.14	1.73	0.13	>0.05^{NS}
Duration of cooking (years)	18.4	7.9	18.04	8.4	>0.05^{NS}

NS-Non-significant

Table:2:PEAK EXPIRATORY FLOW RATES (L/min) of two groups

Duration of cooking	**Group I(LPG, n=50)**		**Group II(biomass, n=50)**		**p-value**	**Significance**
	Mean	**SD**	**Mean**	**SD**		
0-5yrs	**394.62**	**±41.77**	**390.48**	**±40.42**	**>0.05**	**NS**
6-10yrs	**392.87**	**±40.66**	**371.60**	**±38.42**	**<0.05**	**S**
>10yrs	**391.87**	**±30.56**	**362.48**	**±33.68**	**<0.001**	**HS**

Discussion:

In rural India use of unprocessed biomass such as wooden sticks or dung cake is used for household cooking. This produces indoor air pollution of varying levels. One study had found statistically significant reduction in FVC,FEV_1 , $FEF_{25-75\%}$ and PEFR in biomass users.[16] In our study also there is significant reduction in PEFR with increasing duration of exposure to biomass fuel combustion. These findings are consistent with airflow obstruction which might have occurred due to inflammation of airways upon exposure to fumes while cooking. Malik had reported that exposure to fumes of biomass could result in impairment of ventilatory functions of lungs[17]. Our study also included asymptomatic healthy females, upon inquiring about respiratory symptoms they were noted to have problems likecough, sneezingand breathlessness having no noteworthy effect on their daily routine.

One previous study reported that improved ventilation and outdoor cooking causes less exposure to biomass fumes leading to better health conditions and absence of significant decrease in lung functions.[17]We also observed in our study that significant decrease in PEFR was observed in 20% females who used to cook indoors.

Socio economic status of the females also effects the lung functions by effecting the type of fuel used. [18] In our study, we also found that low income group females were using biomass as cooking fuel. Educational status has significant effect on choice of cooking device and fuel used. Females without having educational qualification were indulged in cooking with traditional use of chullah and biomass.

Conclusion:

This study concludes that there is early lung function impairment in females using biomass as cooking fuel. Peak expiratory flow rate is a simple and sensitive test to detect obstructive changes in the respiratory tract. Exposure to high concentration of pollutants generated by the biomass fuel could be the possible cause of lung function impairment.

Implications:

Adverse effects of biomass fuel combustion on lungs can be prevented by educating women, improving ventilation of the cooking area, outdoor cooking and by using clean fuels like LPG etc.

Acknowledgment: we want to thanks all the subjects who spared their valuable time to participate in this study.

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Disclosure: No conflicts of interest, financial, or otherwise are declared by authors