Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2014; 2(6B):2070-2074 **ISSN 2347-954X (Print)**
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(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com **DOI:** 10.36347/sjams.2014.v02i06.026

Research Article

A Study of the Peak Expiratory Flow Rate in Punjabi Women Using Different Cooking Fuels

Harpreet Kaur*[1], Jagseer Singh[2]
[1]Assistant Professor, Department of Physiology, Adesh Institute of Medical Sciences and Research, Bathinda, Punjab, India
[2]Assistant Professor, Department of Orthopaedics, Adesh Institute of Medical Sciences and Research, Bathinda, Punjab, India

***Corresponding author**
Harpreet Kaur
Email: drharpreet1981@gmail.com

Abstract: The present study was undertaken to study the Peak Expiratory Flow Rate of healthy non-smoking women of Punjab using biomass fuels for cooking. The values of PEFR of these women were also compared with that of healthy non-smoking women using Liquefied Petroleum Gas (LPG) for cooking. The influence of age, height and weight on their PEFR values was also studied. One hundred and fifty healthy non-smoking women in the age group of 20-50 years who were using biomass fuels for cooking were selected randomly from various regions of Punjab and their PEFR values were compared with those of one hundred and fifty healthy non-smoking women in the age group of 20-50 years, who were using LPG as the cooking fuel. Persons who gave history of wheezing, cardiovascular diseases or respiratory diseases were excluded from the study. The PEFR test was performed by using a mini Wright peak expiratory flow meter. The mean PEFR of the biomass fuel users was found to be less than that of LPG users in each group and the results were found to be highly significant ($p < 0.005$). This decrease of PEFR in biomass fuel users as compared to LPG users is probably due to their continuous exposure to indoor air pollutants which may have caused an adverse effect on their respiratory health. This study revealed that there was a significant decrease in the lung functions of the biomass fuel users as compared to those who use LPG as the cooking fuel.
Keywords: Peak Expiratory Flow Rate, biomass fuel, cooking, indoor air pollution, Liquefied Petroleum Gas, mini Wright peak flow meter.

INTRODUCTION

About half of the world's population in rural areas of developing countries is exposed to some of the highest levels of air pollution from burning of traditional biomass fuels such as wood, crop residues and cow dung for household cooking. Biomass accounts for more than 80% of domestic energy in India [1] and about 90% of biomass using households of the country use wood or animal dung as their primary cooking fuel [2].

In addition to particulate matter, burning of biomass emits smoke that contain high level of pollutants like carbon monoxide, oxides of nitrogen and sulphur, formaldehyde, benzene and benzopyrene which are hazardous for human health [3].

Association of exposure to biomass fuel with chronic bronchitis and chronic obstructive pulmonary disease is quite well established, particularly among women [4]. Wood smoke continues to be chemically active and cause damage to cells for upto 20 minutes, about 40 times longer than tobacco smoke [5].

Occupational asthma is the leading occupational respiratory disease [6]. It is characterized by reversible airway obstruction and bronchial hyper-responsiveness which occurs after exposure to dust, vapour, gas or smoke which are present at workplace [7]. It is important to recognize and treat respiratory obstruction at an early and irreversible stage for the prevention of permanent damage. Peak Expiratory flow rate (PEFR) is one such parameter that can be easily measured [8].

EXPERIMENTAL SECTION

One hundred and fifty healthy non-smoking women in the age group of 20-50 years who were using biomass fuels (wood, crop residues, cow dung etc.) for cooking were selected randomly from various regions of Punjab for the study. Only those women were included in the study that had been using biomass fuels for cooking for 10 years and used to cook for 3-4 hours per day regularly. Another group of one hundred and fifty healthy non-smoking women in the same age group who use LPG as the cooking fuel were enrolled as controls. Informed consent was taken from all the subjects and ethical clearance was taken from the institution. Persons who gave the history of wheezing, cardiovascular or respiratory diseases were excluded from the study. Healthy women who gave no previous history of respiratory or other illness and recurrent or persistent cough or expectoration were selected for the study.

The ages of the subjects were recorded in years. Their standing heights were measured in centimetres by making the subjects to stand barefoot on the floor against the wall, with their heels slightly separated and their buttocks in contact with the wall. Their weights were measured in kilograms with the subjects standing on a portable weighing machine without wearing shoes.

The PEFR was recorded by using mini Wright peak flow meter. The PEFR was measured when the subjects were comfortably seated. The instructions and the methods of carrying out the test were given/demonstrated to the subjects. Each subject made 3 PEFR manoeuvres and the highest value was recorded, since the parameter requires maximal effort. At the end of all the measurements, the subjects were grouped according to the ranges in the age, height and weight. The results were expressed as PEFR ± standard deviation (mean ± SD) while the student's 'T' test was used to determine the difference between the means. A p value of less than or equal to 0.05 was considered to be statistically significant. Younger females (<20 years) and older females (>50 years) were not included in the study, as extremely few of them satisfied the selection criteria for participation in the study, especially as regards their availability and capacity to co-operate adequately.

RESULTS AND DISCUSSION

The present study was conducted on 150 healthy females in the age group of 20-50 years from various regions of Punjab, who used biomass fuels for cooking for at least 10 years and used to cook for 3-4 hours per day regularly. The results obtained were compared with those of 150 healthy females in the same age group who used Liquefied Petroleum Gas for cooking. The mean PEFR of the study subjects (272.27 ± 58.85 lpm) is less than that of control subjects (395.87 ± 56.81 lpm) (Table1 and Fig.1).

Table 1: Comparison of mean and SD of PEFR in study and control subjects

subjects	Range of PEFR (in lpm)	Mean ± SD of PEFR (in lpm)	't' value	'p' value	significance
study	150 - 400	272.27 ± 58.85	-18.51	<0.005	HS
control	270 - 510	395.87 ± 56.81			

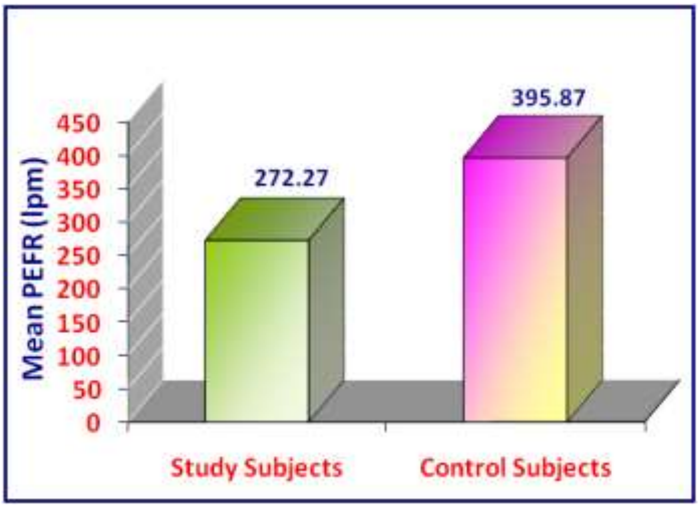

Fig. 1: Bar diagram showing comparison of mean PEFR of study and control subjects

Also, according to the age, height and weight divided in different groups, the mean PEFR of biomass users was found to be less than that of LPG users in each group and the results were found to be statistically highly significant. The decrease of PEFR in biomass fuel users was probably due to their continuous exposure to indoor air pollution which may have caused an adverse effect on their respiratory health.

PEFR and age

The present study revealed that the mean PEFR in study subjects has decreased with increasing age. The results were in accordance with the studies conducted by Jain *et al*. [9] and Rao *et al*. [10]. On comparing the mean PEFR of study subjects with control subjects in the three age groups, mean PEFR of study subjects was found to be less than that control subjects in each group and results were found to be statistically highly significant (p< 0.005) as shown in Table 2 and Fig. 2.

Table 2: Comparison of mean and SD of PEFR in study and control subjects according to age groups

Age group (in yrs)	Study		Control		't' value	'p' value	S
	No. of sub.	Mean ± SD of PEFR (in lpm)	No. of sub.	Mean ± SD of PEFR (in lpm)			
20 - 30	58	321.90 ± 41.99	56	429.64 ± 48.65	-12.67	<0.005	HS
31 - 40	53	262.08 ± 37.54	52	398.65 ± 50.37	-15.77	<0.005	HS
41 - 50	39	212.31 ± 37.59	42	347.38 ± 37.68	-16.14	<0.005	HS

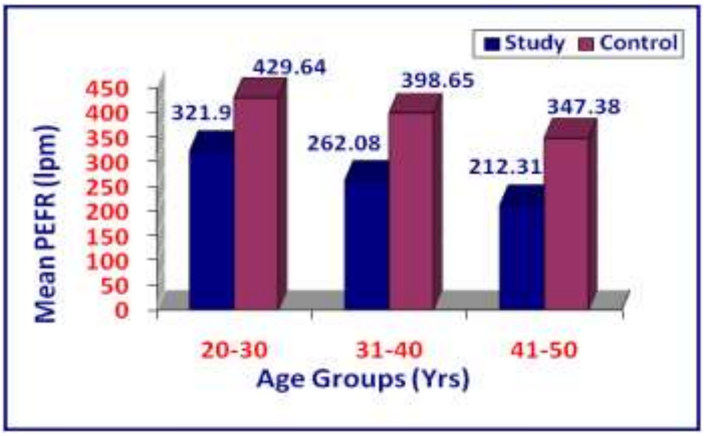

Fig. 2: Comparison of mean and SD of PEFR in study and control subjects according to age groups

PEFR and Height

This study showed that there was an increase in the PEFR of the study subjects with an increase in height. The observation is consistent with the studies conducted by Dikshat *et al*. [11]. When the mean PEFR of the study subjects was compared with that of control subjects according to three height intervals, the mean PEFR of study subjects was found to be less than that of control subjects in each interval and the results were found to be statistically highly significant as shown in Table 3 and Fig. 3.

Table 3: Comparison of mean and SD of PEFR in study and control subjects according to height intervals

Height intervals (in cms)	Study		Control		't' value	'p' value	S
	No. of sub	Mean ± SD of PEFR (in lpm)	No. of sub	Mean ± SD of PEFR (in lpm)			
145 - 153	40	235.50 ± 51.88	32	339.69 ± 38.98	-9.42	<0.005	HS
154 - 162	70	269.43 ± 50.82	70	387.86 ± 45.90	-14.47	<0.005	HS
163 - 173	40	314 ± 52.76	48	445 ± 37.76	-13.54	<0.005	HS

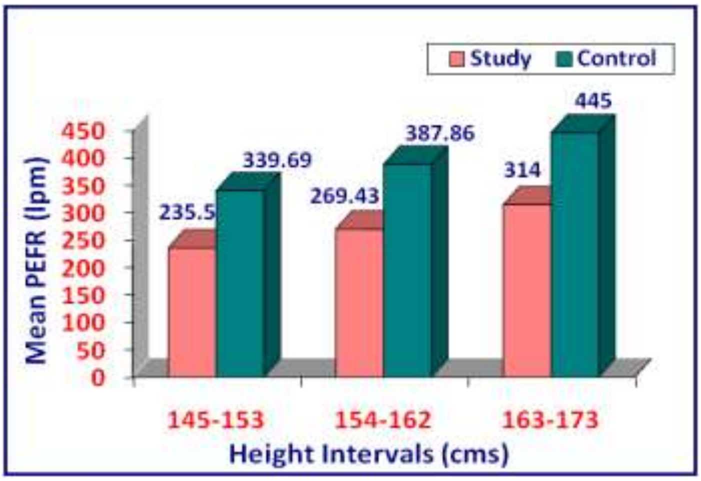

Fig. 3: Comparison of mean and SD of PEFR in study and control subjects according to height intervals

PEFR and weight

PEFR was found to be positively co-related with weight. This observation is consistent with the studies conducted by other authors like Amin and Pandey [12]. When the mean PEFR of study subjects was compared with that of control subjects according to three weight groups, the mean PEFR of study subjects was found to be less than that of control subjects in each group and the results were found to be statistically highly significant as shown in Table 4 and Fig. 4.

Table 4: Comparison of mean and SD of PEFR in study and control subjects according to weight groups

Weight groups (in kgs)	Study		Control		't' value	'p' value	S
	No. of sub.	Mean ± SD of PEFR (in lpm)	No. of sub.	Mean ± SD of PEFR (in lpm)			
<52	57	251.75 ± 57.23	49	383.67 ± 51.63	-12.38	<0.005	HS
52 - 61	63	283.81 ± 52.07	79	391.77 ± 60.02	-11.29	<0.005	HS
>61	30	287 ± 65.82	22	437.73 ± 34.36	-9.79	<0.005	HS

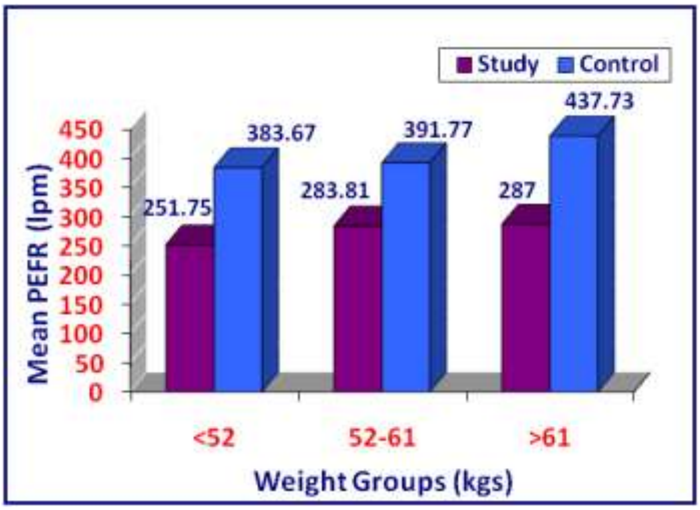

Fig. 4: Comparison of mean and SD of PEFR in study and control subjects according to weight groups

CONCLUSION

According to the age, height and weight which were divided in different groups, the mean PEFR of the biomass fuel users was found to be less than that of LPG users in each group and the results were found to be statistically highly significant. This decrease of PEFR in biomass fuel users was probably due to the continuous exposure to the indoor air pollutants which may have caused an adverse effect on their respiratory functions.

There are many ways to reduce the indoor air pollution. Some of the interventions are:

- Better stove design
- Better ventilation
- Switch to cleaner fuels like LPG
- Chemical treatment of some fuels e.g. coal
- Reduce the size of fuel pieces
- Separate cooking and sleeping/living areas
- Keep children away from smoke.

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