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Original Research Paper

"PEFR (Peak Expiratory Flow Rate) - As A Screening Tool in Women Exposed to Biomass Fuel in Rural Maharashtra, India "

Medical Science

KEYWORDS : PEFR, Screening, Biomass, Rural, Lung Function, COPD

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ABSTRACT

Background:Around 3 billion people cook and heat their homes using open fires and simple stoves burning biomass (wood, animal dung and crop waste) and coal.

Rationale: Objective of this study was to screen the lung function of non smoking women exposed to biomass fuel for cooking.

Methods: 324 rural women were randomly selected within the age group of 18-60 years from 3 different villages. These subjects were interviewed with a standard respiratory questionnaire and their pulmonary functions were estimated using hand held Wright's Peak Flow meter.

Results: Our study estimated that majority of the population studied had abnormal lung function with masked respiratory symptoms.

Conclusion: PEFR (Peak expiratory flow rate) is an important tool to screen the population at risk due to biomass fuel exposure at an early stage.

INTRODUCTION

Biomass fuel still continues to be used in ~50% of homes worldwide, it is estimated that 3 billion people are exposed to indoor smoke from the burning of biomass fuel and are at risk for its adverse respiratory effects [1].

Following are the key facts as studied and published by World Health Organization[2]

Over 4 million people die prematurely from illness attributable to the household air pollution from cooking with solid fuels.

More than 50% of premature deaths due to pneumonia among children under 5 are caused by the particulate matter (soot) inhaled from household air pollution.

3.8 million premature deaths annually from non-communicable diseases including stroke, ischemic heart disease, chronic obstructive pulmonary disease (COPD) and lung cancer are attributed to exposure to household air pollution.

Socio-economic condition plays a major role in forced choice of biomass fuel as major source of cooking.

In developing countries, girls start cooking at the age 15 years and spend an average of 4 to 6 h daily in the kitchen, usually an enclosed space with poor ventilation. Therefore, during their lifetime, women are exposed to biomass smoke for 30 to 40 years, which is equivalent to 60,000 h of exposure [3].

The health hazard of biomass smoke is extensively studied and published worldwide and widely accepted.

Biomass smoke constituents are known to be toxic or have irritant effects on the respiratory tract and include particulate matter that are <10 microns in aerodynamic diameter (PM10), carbon monoxide (CO), nitrogen dioxide, sulfur dioxide, aldehydes (eg, formaldehyde), polycyclic aromatic hydrocarbons (eg, benzopyrene), volatile organic compounds, chlorinated dioxins, and free radicals [4].

In a recent study conducted in villages of Tamilnadu, daily average exposures to respirable particulate matter from combustion of biomass fuels in rural households were measured.

It was found in the study that concentrations of respirable particulate matter ranged from 500 to 2,000 μ g/ m3 during cooking in biomass-using households, and average 24-hr exposures ranged from 90± 21 μ g/ m3 for those not involved in cooking to 231± 109 μ g/ m3 for those who cooked. The 24-hr exposures were around 82± 39 μ g/ m3 for those in households using clean fuels (with similar exposures across household subgroups). Fuel type, type and location of the kitchen, and the time spent near the kitchen while cooking were the most important determinants of exposure across these households among other parameters examined, including stove type, cooking duration, and smoke from neighborhood cooking [5].

Pulmonary function testing is an important tool in detection of lung pathologies in population exposed to biomass fuel exposure. Earlier detection of lung pathologies by screening the population at risk can help in prevention of the disease progression.

Materials and Methods:

Study Population

324 rural women were randomly selected within the age group of 18-60 years from 3 different villages named Utroli, Wing and Bazarwadi of Pune and Satara District of Maharashtra in Western India. These villages were within the radius of 50 kms from city centre. These villages were free from industrial pollution and with negligible vehicular pollution and were selected for study to avoid the confounding factors.

These subjects were interviewed with a standard respiratory questionnaire based on multi- centre study "Indian study on Epidemiology of Asthma, Respiratory symptoms and Chronic Bronchitis [6] (INSEARCH)" which concluded that Asthma and Chronic Bronchitis in adults pose an enormous healthcare burden in India. Most of the associated risk factors are preventable.

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Pulmonary Function Test
Pulmonary function of these subjects was estimated using portable hand held Wright's Peak Flow meter. To ensure the accuracy of the reading, the devices were calibrated regularly. We excluded subjects with history of haemoptysis, current smokers and those with upper airway and lower airway infections and pregnant women.

As per standard guidelines, the height and weight were measured and the technique was explained and demonstrated prior to the testing. Best of three reading of PEFR (Peak expiratory flow rate) was recorded.

The standard predicted value based on American Thoracic Society normogram was taken into consideration and values below 80 percentile were regarded as abnormal values.

Statistical Analysis
The statistical analysis was done based on computer based software SPSS (Version 20.0) with help of university biostatician. The analytic method used for our study was based on Chi-square test and 2 -independent sample t test.

Results
Our study related the PEFR with various parameters obtained from INSEARCH questionnaire.

Around 70 % of population studied had no respiratory symptoms even though their PEFR was abnormal. (**Table 1).**

Windows v/s PEFR		PEFR		Total	p-value
		Normal	Abnormal		
Windows	Yes	251	71	322	= 0.049
	No	0	2	2	
Total		251	73	324	

Around 77 % of population had abnormal PEFR even in spite of having windows in their house. The limitation here was that we couldn't estimate the size of windows providing adequate ventilation.(**Table 2).**

PEFR was found to be abnormal in 73% of those who used biomass fuel in a separate kitchen. (**Table 3).**

Atopy and Family history, Environmental Tobacco exposure and Non-smoking tobacco were not related to PEFR values.

Table 2

Respiratory symptoms v/s PEFR		PEFR		Total	p-value
		Normal	Abnormal		
Respiratory Symptoms	Yes	93	7	100	< 0.001
	No	158	66	224	
Total		251	73	324	

Table 3

Separate Kitchen v/s PEFR		PEFR		Total p-value	
		Normal	Abnormal		
Separate kitchen	Yes	187	68	255	< 0.001
	No	64	5	69	
Total		251	73	324	

Discussion
More than half of the world's population use biomass fuel in various forms like wood, animal dung, crop waste and coal. World Health Organization has extensively studied the hazards of biomass fuel worldwide and has given alarming figures as mentioned above.

In India, extensive use of biomass fuel poses a major burden of COPD and other respiratory diseases. Planning commission data estimates up to 80 percent biomass fuel use as firewood in some northeastern states amongst others [7].

In our study, we studied a small population which showed alarming results. We found that majority of the population with abnormal lung function were respiratory symptom free. Early prevention is needed for further deterioration of lung functions in the population studied. Windows in house are of not standard size for proper ventilation, which further aids to the worsening of lung function.

WHO has noted following Interventions, which can be classified according to the level, at which they are effective: a) interventions on the source of pollution, b) interventions to the living environment, and c) interventions to user behaviour[8].

Interventions on the source of pollution
Alternative fuels
The largest reductions in indoor air pollution can be achieved by switching from solid fuels (biomass, coal) to cleaner and more efficient fuels and energy technologies such as:

Liquid petroleum gas (LPG)
Biogas
Producer gas
Electricity
Solar power
Improved stoves

In poor, rural communities where access to alternative fuels is very limited and biomass remains the most practical fuel, pollution levels can be lowered significantly by using improved stoves. These stoves, provided they are adequately designed, installed and maintained, are effective in reducing smoke because of better combustion, lower emission levels and potentially also shorter cooking times.

Interventions to the living environment
Improved ventilation of the cooking and living area can contribute significantly to reducing exposure to smoke. There are a number of ways to achieve better ventilation of the living environment including:

Chimneys
Smoke hoods (with flues)

Eaves spaces

Enlarged and repositioned windows (cooking window)

Interventions to user behavior
Changes in user behavior can also play a role in reducing pollution and exposure levels. For example, drying fuel wood before use improves combustion and decreases smoke production. Keeping young children away from smoke reduces exposure of this most vulnerable age group to health-damaging pollutants.

Such changes in user behavior are unlikely to bring about reductions as large as those expected from a fuel switch or the installation of a hood or chimney. However, they should be seen as important supporting measures for other interventions.

Screening of health is a early and cheap way to detect the incidence and prevalence of the disease in population. Earlier the detection of disease, faster is the reversibility and prevention of the disease progression.

COPD is a major national health burden worldwide and is the 3rdleading cause of death worldwide [9]. Its early prevention and management is the only way to win over this chronic disease.

Hand held Wrights Peak flow meter is a cheap and handy device which can be used to screen the lung function of the risk population where Spiro metric testing is a far hope due to remote location and lack of proper health facilities. Even though there are various limitations of peak flow meter including the reproducibility of the test results, the benefits weigh over the limitation.

Conclusion:

PEFR is an important tool to screen population at risk at an early stage from the population exposed to biomass fuel. Biomass fuel exposure is an important risk factor for poor lung functions. In rural areas non-standardized windows and kitchen designs leading to poor ventilation add to risk. Asymptomatic people were also found to have abnormal PEFR in our study.

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