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RESEARCH ARTICLE

Effect of rice mill dust on peak expiratory flow rate among rice mill workers of Mysore district

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ABSTRACT

Background: Inhalation of different pollutants exposed from the industries cause damage to the membrane structure and mechanical efficiency. This leads to an alteration in the functional properties of the lungs resulting in various respiratory diseases. **Aims and Objectives**: The present study was undertaken to assess the effect of exposure of rice husk dust on peak expiratory flow rate (PEFR) among rice mill workers in Mysore District. **Materials and Methods**: The comparative cross-sectional analytical study was conducted during December 2013–December 2014 in various rice mills in Mysore district. The study was conducted on 50 non-smoking rice mill workers aged 18–45 years were selected as a study group and 50 healthy, age, sex, and anthropometrically matched subjects of same socioeconomic status who were not exposed to rice mill industries were selected as control group. Computerized spirometer (RMS-Helios 401 and Transducer No.400-666) was used to measure PEFR. The data were analyzed using SPSS 20, and the level of significance was set at $P < 0.05$, applying unpaired *t*-test, ANOVA, and Pearson's correlation coefficient. **Results:** The mean PEFR was significantly ($P < 0.001$) lower among rice mill workers (5.65 ± 1.84) than the controls (8.11 ± 1.41). The PEFR was found to significantly decrease with an increase in the length of exposure to rice mill dust ($P = 0.03$). **Conclusion**: Our study showed that duration of exposure has a direct relationship with the reduction in PEFR.

KEY WORDS: Rice Mill Dust; Peak Expiratory Flow Rate; Rice Mill Workers

INTRODUCTION

Rice has been the main staple food for more than half the world population. Rice mill workers are exposed to organic and inorganic dust and also rice husk which is known to have a high silica content that may have an adverse effect on respiratory system.[1] With civilization, industrialization is increasing day by day. As a result, air pollution is increasing leading to various respiratory diseases. This is due to the organic dust generated from such industries have a high prevalence of lung diseases.[2] Inhalation of different pollutants exposed from the industries cause damage to the membrane structure and mechanical efficiency. This leads to an alteration in the functional properties of the lungs resulting in various respiratory diseases.[3,4]

The pulmonary function test is one of the measures to assess the respiratory efficiency and permits accurate, reproducible assessment of the functional state of the respiratory system and allow quantification of the severity of disease, thereby enabling early detection as well as assessment of the natural history and response to therapy. These tests are important for clinical, diagnostic, and prognostic values. Until now plenty of work has been done to assess the pulmonary function test in health as well as in diseases. Many research works have

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been performed to study the effects of smoke and dust on respiratory function.[5-7]

PEFR is an accepted index of pulmonary function and is widely used in respiratory medicine. Measurement of PEFR is simple, non-invasive, rapid, and economical method to assess the strength and speed of expiration in L/min. It is used to detect the reduction in pulmonary function associated with narrowing of airways.[8] The present study was undertaken to evaluate and compare dynamic pulmonary function, i.e. PEFR among subjects exposed to rice mill dust (cases) with those who are not exposed to it (control group) and to evaluate the correlation between duration of work exposure and change in PEFR.

MATERIALS AND METHODS

The study was approved by the ethics committee of our institution. This study was conducted on rice mill workers and controls from December 2013 to December 2014 in various rice mills in Mysore with the help of a computerized Spirometer.

The author visited various rice mills in Mysore city during this time and interviewed 100 rice mill workers.

In a similar way age, sex, and anthropometrically matched 50 healthy subjects of same socioeconomic status who were not exposed to rice mill industries with a mean age of 33.92 ± 9.68 years (range 19–50 years) were selected as control group. The control group was composed primarily the office workers, and attenders from college and hospital were selected.

Subjects who were smokers or exposed in any industry other than rice mill industry (cotton spinning mill workers, flour mill workers, paint industries, farmers, bakers, welders, petrol pump workers, and cement factory workers), those with any known congenital or musculoskeletal defects, endocrine disorders, cardiopulmonary disorders, and any systemic disease which affects the lung functions, and those who had undergone chest or abdominal surgeries were excluded from the study.

A detailed history was taken to decide whether to include them in the study or not on the basis of the exclusion criteria. All the participants were questioned with regard to smoking cigarettes, bidis, hookah and other tobacco products and chewing tobacco, ghutka, or betel nut products. A questionnaire (based on the British Medical Research Council recommendation and modified for the use in India) was used to collect information regarding their name, age, economic background, and work experience in present occupation, and all subjects selected for study underwent through clinical examination (general and systemic). Anthropometrical parameters such as age, height in cm, and weight in kg were measured. Weight was measured to the nearest 0.5 kg using a digital scale and height was measured to the nearest 0.5 cm using Stadiometer with barefoot.

Respiratory Questionnaire

A questionnaire was used to assess respiratory symptoms such as cough, sputum, breathlessness, wheezing, chest tightness, and occupational history such as place of work, duration of work in years, daily hours of working, type of work, questions about using gloves, a mask, or ventilation during work and whether it reduced the intensity of work-related symptoms.

Pulmonary Function Test

After written informed consent, initial interviews and clinical examination, 50 apparently healthy male rice mill workers with a mean age of 33.14 ± 9.64 years (range 19–50 years) with a mean duration of exposure 7.92 ± 5.47 years (range 1–22 years) were selected. These rice mill workers worked without using any personal protective measures. Computerized Spirometer (RMS-Helios 401 and Transducer No. 400-666) was used to measure respiratory function tests. The subjects were informed about the whole maneuver before performing a pulmonary function test. All PFT were carried out at a fixed time of the day to to minimize any diurnal variation. All the subjects were made familiar with the instrument and the procedure for performing the test. The data of the subject as regards to name, age, height, weight, sex, and date of performing the test were fed to the computer before the study. Under all aseptic precautions, the test was performed within the subject in sitting position with using nose clips.

The test was repeated 3 times after rest, of which the best readings were considered.

RESULTS

The age of the subjects in the study ranged between 25 and 50 years. They were grouped into workers who are exposed to rice mill dust and controls who were not exposed. The results were expressed as the mean ± standard deviation (SD). Statistical techniques such as student *t*-test for two group comparisons and ANOVA for multiple group comparisons were used for analyzing data. Table 1 shows no significant difference in age, height, weight, and BMI between rice mill workers and control subjects indicating samples were homogeneous in nature. The actual value of PEFR (L/s) in rice mill workers was 5.65 ± 1.84 and controls were 8.11 ± 1.41. There was a statistically significant decrease in the level of PEFR (L/s) in rice mill workers when compared to controls ($P < 0.001$) [Table 2]. It was observed that the level of PEFR (%) decreased with increase in duration of exposure. There

Table 1: Anthropometric parameters of study group compared with their matched controls

Basic characteristics	Rice mill workers (*n*=50)	Controls (*n*=50)	Significance	
			t	*P*
Age in years	32.96±8.12	33.52±6.63	0.37	0.70, NS
Height (m)	158.7±0.99	159.94±0.07	0.70	0.48, NS
Weight (Kgs)	60.14±8.23	62.66±9.66	1.403	0.16, NS
BMI (kg/m2)	24.10±5.26	24.53±3.67	0.48	0.63, NS

All the values are mean±SD, *n*=50 in each group. SD: Standard deviation, NS: Nonsignificant

was a statistically significant decrease in the level of PEFR (%) with an increase in duration of exposure to rice mill dust ($P < 0.05$) [Table 3].

DISCUSSION

PEFR as a measurement of ventilatory function was introduced by Hadorn in 1942 and was accepted in 1949 as an index of spirometry. By definition, it is "The largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration, expressed in liters/min (BTPS)." The PEFR is an effort dependent parameter emerging from the large airways.[9]

The present study showed PEFR in rice mill workers was 5.65 ± 1.84, which was significantly ($P < 0.001$) lower as compared to unexposed controls (8.11 ± 1.41). These observations highlight that PEFR capacity of workers gets reduced as they exposed to dust. When PEFR was correlated with exposure time, it was observed that the reduction in PEFR exhibited a significant ($P = 0.03$) positive correlation with duration of exposure. Several studies have suggested that unprotected dust exposures in agricultural settings may lead to respiratory disorders. Rice mill workers are potentially exposed to organic and inorganic dust and rice husk that may contain a large number of contaminants including silica, fungi and their metabolites (aflatoxins), bacterial endotoxins, and insects. Therefore, the workers who work for more than 8 h daily in this type of mills are at high risk of inhaling the spores or fragments of mycelium containing aflatoxins.[10] Chronic exposure to rice mill dust impairs lung function, and the length of this exposure determines the extent of the respiratory problems.[11] Decrease in PEFR is probably due to hypertrophy of mucosal cells due to irritation by grain dust and smoke resulting in the increased secretion of mucous and formation of mucosal plugs which cause obstruction to the exhaled air.[12]

Dhillon *et al.* carried out a study on PEFR and compared rice mill workers and controls. They found out that reduction in PEFR was significantly high with exposure to more than 10 years.[13] In another study by Tirthankar Ghosh, a total of 120 rice mill workers from three districts of Karnataka were included in this study, and they found the lower levels of PEFR when compared to controls.[14] The findings of our study are in agreement with those of the study by Prakash[15] Meo[16] and Zodpey and Tiwari.[17] A study by Bhat and Rangaswamy revealed a significant decrease in the PEFR within 1 year of exposure.[18]

Table 2: Comparison of PEFR (L/s) of the study group and control

PEFR	???
Study group	5.65±1.84
Control	8.11±1.41
T-test	7.51
P value	0.00*

All the values are mean±SD, *n*=50 in each group, *$P<0.05$.
PEFR: Peak expiratory flow rate, SD: Standard deviation

Table 3: Comparison of PEFR with relation to duration of exposure to rice mill dust

Duration of exposure	*n*	PEFR
1–10	19	6.15±1.61
11–20	20	5.83±1.91
>20	11	1.65±0.03
ANOVA	*P*	0.03*

All the values are mean±SD, n=50 in each group, *$P <0.05$.
PEFR: Peak expiratory flow rate, SD: Standard deviation

CONCLUSION

The present study was undertaken at various rice mills in Mysore district which revealed the significant decrease in PEFR in rice mill workers (5.65 L/min). Our study also showed that duration of exposure to rice mill dust has a direct relationship with the reduction in PEFR. The findings of our study are in agreement with the other studies conducted on such group of workers. Based on the findings it is advisable that rice mill workers and their employers adopt preventive measures such as the use of respiratory protective devices such as masks and proper ventilated workplaces.

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