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Respiratory Morbidity and Peak Expiratory Flow Rate among Rice Mill Workers in a Rural Area of South India

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ABSTRACT

Introduction: Workers in rice mills may suffer from exposure to grain dust and its adverse effects on various organs have been described. Pulmonary function tests have been beneficial in the early recognition of pulmonary dysfunctions. Objectives of this research were to study the respiratory morbidity and assess peak expiratory flow rate among the rice mill workers and the various factors influencing them.

Method: A cross sectional study was conducted among 105 workers of seven rice mills in an urban field practice area after taking written informed consent. Data was collected by interview method using Respiratory questionnaire based on the Medical Research Council and modified as per the study objectives. Weight, height, chest circumference and Peak expiratory flow rate was measured.

Results: Majority i.e. 53.33% of the subjects have Peak Expiratory Flow Rate (PEFR) less than 300 l/min and the mean PEFR is 294.0 l/min. Almost 47.6% of the participants had at least one of the respiratory morbidity symptoms. Majority of the workers having symptoms of respiratory morbidity have Peak Expiratory Flow Rate of < 300 l/min and this was found to be statistically highly significant.

Conclusion: Respiratory morbidity was quite prevalent in the rice mill workers as indicated by decreased Peak Expiratory Flow Rate (PEFR) and requires application of ergonomics at the work place.

Keywords: Respiratory morbidity, peak expiratory flow rate, rice mill workers, rural area

INTRODUCTION

Occupational respiratory disease can be defined as an acute or chronic disorder that arises from the inhalation of air-borne agents in the work place. Subjects with workplace exposure to organic dust have high prevalence of respiratory diseases [1]. It has been estimated that 10% to 15% of cases of asthma in adults are associated with occupational factors [2]. The diseases of the respiratory system induced by occupational dusts are influenced by the type of dust and duration of Exposure [3].

India is the 2nd biggest rice producing country and rice mill industry is the oldest and largest agro-based industry [4]. Workers in rice mills may also suffer from its more subtle effects for extended periods. Younger workers tend to be relatively more vulnerable because of their immature immunity systems [5].

Grain dust has a long history of association with disease, and its adverse effects on various organs such as eyes, nose, skin, lung and the airways have been described. Asthma has been well documented as being a result of exposure. However, few studies have been reported on the effect of rice husk dust exposure. General health may be seriously compromised by dust, and it can easily escape our casual attention [5].

Pulmonary function tests have been beneficial in the early recognition of pulmonary dysfunctions in patients considered to be normal on the basis of clinical and radiological examination [6]. A periodic measurement of lung functions would be a guiding principle to detect the lung abnormalities in the early stages. Among these lung function tests peak expiratory flow rate is a useful pulmonary function test [7].

Thus the present study was undertaken to study the respiratory morbidity and assess peak expiratory flow rate among the rice mill workers and the various factors influencing them.

METHODOLOGY

A cross sectional study was conducted in 2013 for a period of three months among seven rice mills under the urban field practice area of a teaching institution. Complete enumeration method was followed and thereby all the workers of these seven rice mills were enrolled in the study. The sample size constituted to 105. Workers having respiratory or neuromuscular diseases were excluded from the study.

Institutional Ethical committee approval was obtained and necessary permission was taken from the relevant authorities before initiating the process of data collection. Written informed consent was taken from the study participants after explaining them the nature and purpose of the study.

Respiratory questionnaire based on the Medical Research Council (UK, 1986) [8] modified as per the study objectives and local needs was used to record necessary information like socio-demographic profile and clinical history through interview.

Height measuring board and portable weight scale were used to measure height and weight of the subjects respectively. Measuring tape was used to measure chest circumference and chest expansion. Peak flow meter was used to record peak expiratory flow rate (PEFR) which is a person's maximum speed of expiration as measured with a peak flow meter, a small hand held device which measures the air flow through the bronchi and thus the degree of obstruction in the airways.

Data was compiled and analysed using SPSS statistical package version 19. Descriptive analysis was done by summarising continuous variables (mean, standard deviation, standard error) and categorical variables (relative frequency). Chi square test was used to study the association between respiratory morbidity and various factors influencing respiratory morbidity among the rice mill workers. $P < 0.05$ was considered statistically significant.

RESULTS

The study shows that majority of the study subjects are males. About 30.47% subjects belong to the age group of 26-35 years and the mean age of the study participants is 34.33 years (S.D=11.070). The mean height and weight of the subjects is 157.73 cm and 53.74 kg respectively. The mean body mass index of the study population was 21.15 kg/m^2. Out of 105 subjects, 25 (23.8%) smoke some form of tobacco and 44.8% admitted of consuming alcohol. The mean chest circumference in inspiration and expiration was 87.2 cm and 84.8 cm respectively. The mean chest expansion of the study subjects is 2.4 cm (S.D. =0.98cm). Mean duration of work of the subjects is 5.31 years (S.D.=0.5 years). Labourer and non-labourer groups constitute 75.2% and 24.8% respectively. Symptoms suggestive of respiratory morbidity are present in 69.38% workers working in the rice mills for more than 5 years and only 28.57% workers working for less than 5 years had respiratory morbidity. This difference is significant statistically (P value < 0.001).

According to chart 1, majority i.e. 53.33% of the subjects have Peak Expiratory Flow Rate (PEFR) less than 300 l/min and the mean PEFR is 294.0 l/min. There was no statistical significant difference between age and PEFR. Majority of the females (77.14%) have PEFR less than 300 l/min and this difference was found to be statistically highly significant. The odd's of having PEFR less than 300 l/min was 20% less in males (P value <0.001). Statistically significant difference was not seen between smoking and PEFR, duration of work and PEFR. The odds of having PEFR less than 300 l/min is 67% less among those working for less than 5 years.

Almost 47.6% of the participants had at least one of the respiratory morbidity symptoms. Cough (39%) is the predominant symptom of the workers, 36.2% gave history of shortness of breath, 34.3% complained of wheeze and 29.5% complained of chest tightness. Among the workers who gave history of dyspnoea, 36.2% had grade 1 dyspnoea, 32.8% had grade 2 dyspnoea and 17.1% had dyspnoea of grade 3 (modified Medical Research Council grading of dyspnoea)[22]

Majority (62.5 %) of the participants in the age group of 26-35 years had respiratory morbidity. Majority of the females (60%) gave history of symptoms of respiratory morbidity but lesser proportion of males (41.42%) gave such history.

Table 1: Association between Peak Expiratory Flow Rate (PEFR) and various factors (N=105)

Factors	Categories	PEFR (l/min) (%)		Total (n=105)(%)	P value	OR	95% CI
		<300 (n=56)	>300 (n=49)				
Age Group	15 – 35 yrs	32 (53.33)	28 (46.67)	60 (100)	1.00	1	0.461-2.169
	>35 yrs	24 (53.33)	21 (46.67)	45 (100)			
Gender	Male	29 (41.42)	41 (58.57)	70 (100)	0.001	0.209	0.516-0.0851
	Female	27 (77.14)	8 (22.85)	35 (100)			
Duration of work	<5 years	33(49.25)	34(50.74)	67(100)	0.266	0.632	1.06-0.376
	>5 years	23(60.52)	15(39.47)	38(100)			
Type of work	Labourer	42 (53.16)	37 (46.83)	79 (100)	0.952	0.972	0.399-2.364
	Non-labourer	14 (53.84)	12 (46.15)	26 (100)			

Table 2: Association between respiratory morbidity and various factors (N=105)

Factors	Categories	Respiratory morbidity (%)		Total (n=105) (%)	P value	OR	95% CI
		Present (n=50)	Absent (n=55)				
Age group	15-35 yrs	30(50)	30(50)	60(100)	0.573	1.25	0.575- 2.715
	>35 yrs	20(44.44)	25(55.56)	45(100)			
Gender	Male	29 (41.42)	41 (58.57)	70 (100)	0.072	0.471	0.206-1.077
	Female	21 (60)	14 (40)	35 (100)			
Duration of work	<5 yrs	16 (28.57)	40 (71.42)	56 (100)	<0.001	0.176	0.075-0.411
	>5 yrs	34 (69.38)	15 (30.61)	49 (100)			

Table 3: Association between peak expiratory flow rate (PEFR) and respiratory morbidity

Respiratory morbidity	PEFR (l/min) (%)		Total (n=105) (%)
	<300 (n=56)	>300 (n=49)	
Yes	36 (72)	14(28)	50 (100)
No	20 (36.36)	35(63.63)	55 (100)

OR (95% CI) 4.5 (1.969- 10.279), p value <0.001

The odd's of having respiratory morbidity was 47% less in males. The odd's of having respiratory morbidity was 17% less among those working for less than 5 years. Respiratory morbidity was observed among 13 (52%) smokers and majority i.e., 43 (53.75%) of the non-smokers did not have any respiratory morbidity. But this difference was not statistically significant (P value >0.05). Majority of the workers (72%) having symptoms of respiratory morbidity have Peak Expiratory Flow Rate of < 300 l/min and only 36 % of the workers without any respiratory morbidity have. Those having respiratory morbidity have 4.5 odds of having Peak Expiratory Flow Rate of <300 l/min. (P <0.001)

DISCUSSION

In our study, majority of the subjects are males 70 (66.67%), similar to a study conducted in Tumkur rice mill [9] in which 80% were males. About 32 (30.47%) subjects belong to the age group of 26-35 years and the mean age of the study participants is 34.33 (S.D=11.07).

The mean body mass index of the study population was 21.15 kg/m^2. This indicated that the subjects were in normal category as per WHO [10]. The mean chest expansion of the study subjects is 2.4cm±0.98cm. Mean chest expansion of males and females are 2.66±0.99cm and 1.87±0.71cm respectively. These values are lower than the normal chest expansion for a health adult male and female i.e., about 2.5cm and 5cm respectively [11].

Majority (63.8%) of the workers has been working for less than 5 years and mean duration of work of the subjects is 5.31±0.5 years. In a similar study conducted by Sukhjinder et al. [6] majority of the subjects were exposed to rice husk dust for more than 5 years.

Maximum (53.33%) subjects have Peak Expiratory Flow Rate (PEFR) less than 300 l/min and the mean PEFR is 294.0 l/min ± 7.75. This is in contrast to a cross sectional study conducted in Tumkur (India) in which only 26.67% of the rice mill workers had PEFR <300l/min [9]. Taytard et al. noted the 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 mucus and formation of mucosal plugs which cause obstruction to the exhaled air [12]. Majority of the females (77.14%) have PEFR less than 300 l/min. This was statistically significant (P<0.001). This is in accordance with a study conducted in China, which revealed that there exist sexual and age differences in respiratory muscle strength and pulmonary function [13].

Higher proportion of smokers (56%) had PEFR <300l/min than non-smokers (52.5%). Smoking tended to lower duty cycle and FEV1/FVC [13].

Mean Peak Expiratory Flow Rate (PEFR) of those exposed for <5 years and >5 years is 306.18 l/min and 271.69 l/min respectively. This implies that there is a decrease in PEFR of the workers with increase in duration of work in the rice mills; howev-

er this difference is not statistically significant (P >0.05). The result was similar to a study conducted by Vijayanath Itagi [14] which showed a decrease in PEFR with increase in duration of exposure but the difference was not statistically significant. The mean PEFR of labourers is lower (286.20 l/min) than that of non-labourer (317.69 l/min). According to Zodpey et al., workers exposed to area of maximum dust concentration are more vulnerable to impairment of expiratory flow [15].

Of the 105 rice mill workers, 50 (47.6%) had at least one of the respiratory morbidity symptoms. Exposure to grain dust increases the risk of developing chronic cough [16]. Lim et al. suggested that the clinical and haematological findings in the rice mill workers may be linked to both non-specific irritation and allergic responses to rice husk dust [17].

Greater proportion of workers (69.38%) exposed to rice husk dust for more than 5 years had respiratory morbidity than those exposed for less than 5 years (28.57%). Similar association between duration of work and respiratory morbidity was demonstrated in a study conducted among rice mill workers at Tumkur [9].

Majority of the workers (72%) having symptoms of respiratory morbidity have Peak Expiratory Flow Rate less than 300 l/min. As per studies conducted in flour mill workers [15] and handloom workers [18] in Nagpur and in silica exposed workers in Gujrat[7], PEFR was significantly reduced in those having respiratory morbidity.

CONCLUSION

Respiratory morbidity was quite prevalent in the rice mill workers as indicated by decreased Peak Expiratory Flow Rate (PEFR) and higher prevalence of symptoms of occupational asthma. Lower values of PEFR in rice mill workers exposed to rice husk dust for longer duration suggests that dust exposure has an effect on pulmonary function test. Increase in duration of working at rice mill, increases the lung damage causing both airway obstruction and interstitial involvement. Further epidemiological and pathological studies involving large number of rice mill workers should be carried out which will lead to better understanding of the problems and improvement of work design. The study recommends the application of ergonomics at the work place by providing masks, raising awareness among the workers and management, periodic examination of the workers and appropriate management.

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