

Respiratory Morbidities and Pulmonary Function Tests of Rice Mill Workers in a City of Karnataka

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Abstract:

Background: Industrial dust inhalation over a long period leads to proliferative and fibrotic changes in the lungs. Rice being a staple food for Indians, many people are employed in rice mills. This population is at risk of exposure to grain dust which has a long history of association with diseases and adverse effects on various organs such as eyes, nose, skin, lung and the airways.

Methodology: A cross sectional study was conducted during May-June 2013, in five rice mills of Davangere city, Karnataka. A structured interview schedule was administered along with anthropometric measurements and respiratory functions using Helio's Spirometry.

Results: A total of 134 workers participated in the study, of which 108 were males and 26 females. Mean age of the participants was 35.89±11.55 yrs. The average values of FVC was 2.77±1.0 lit, FEV1 was 1.89±0.78 lit, FEV1:FVC ratio 72.41±27.12%, PEFR 3.15±1.41 lit. Females had significantly lower FVC, FEV1 and FEV1:FVC compared to males. FVC, FEV1 were found to be reducing with age. FVC was found to be significantly reducing with duration of work in the rice mills. At the time of the interview, **83(61.9%)** people complained of some respiratory morbidity. A total of 96(71.64%) people had abnormal spirometry reading, of which 49 suffered from obstructive disorders and 47 with restrictive disorders. However there was no significant association of FVC, FEV1, FEV1:FVC and PEFR with presence of any respiratory morbidity, smoking, usage of masks and BMI.

Conclusion: A higher number of people complained of some respiratory morbidity and 71.64% of the people had abnormal pulmonary function tests. FVC & FEV1 were found to be significantly low among females, older workers and increasing duration of work.

Key words: Pulmonary function tests, Respiratory morbidity, Rice mill workers

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 diseases¹. Many industrial processes produce air-borne contaminants and their most common route of absorption is by inhalation. Industrial dust inhalation over a long period leads to proliferative and fibrotic changes in the lungs². A large number of studies have been undertaken to assess the effect of dust on lung functions in various occupations. Reduction in respiratory functions is reported among cotton workers^{3,4}, coal miners^{5,6}, rice/flour mills⁷⁻¹¹ and grain elevators^{12,13}.

Rice is the most important crop of India and second most important one in the world. It is the staple food

for more than 3 million people in Asia, and India ranks next only to China in Paddy production (about 40% of total grains). Since paddy cannot be consumed raw and needs to be processed, more than 1.5 lack rice mills are functioning in India (2005-06), employing a significant number of population¹⁴. This population is at risk of exposure to grain dust which has a long history of association with diseases, and adverse effects on various organs such as eyes, nose, skin, lung and the airways either due to irritative effect or allergic reactions¹⁵. Rice husk is known to have high silica content¹⁶. This biogenic silica may cause pulmonary disease resembling asbestosis, namely pleural thickening, fibrosis and possibly bronchogenic carcinoma¹⁷. In fact Lim and colleagues (1984) studied on various clinical symptoms and signs, hematological and radiological findings among rice mill workers in Malaysian population, and proposed

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“Rice Millers' Syndrome”, as they found distinctive clinical, hematological and radiological findings among workers¹⁸. Davangere district in Karnataka is one of the major paddy growing areas, and it has the largest number of rice mills (about 365) in the state¹⁴. Therefore it is necessary to evaluate the health hazards in this group of workers, especially pulmonary dysfunctions, which can be identified early using pulmonary function tests.

Objectives:

1. To assess the pulmonary function tests among selected rice mill workers in Davangere city.
2. To assess the prevalence of respiratory morbidity among these rice mill workers.
3. To determine the factors associated with respiratory morbidity and reduction in pulmonary function tests among cases.

Methodology:

A cross sectional study was conducted among five conveniently selected rice mills in Davangere city situated in the central part of Karnataka. Ethical clearance was obtained from the Institutional Ethical Review Board. All the workers working in these selected rice mills aged >18 yrs and willing to participate were included in the study. People having known history of asthma or any other chronic diseases of respiratory system before the date of joining in the mill and pregnant women were excluded from the study. Data was collected during the period of May to June 2013. A pretested, semi-structured interview schedule was administered which consists of demographic details, occupational history, smoking habits, physical findings, anthropometric measurements using electronic weighing scale and non-elastic measuring tape. Pulmonary functions were measured using Helio's spirometer. These included Forced Vital Capacity (FVC), Forced Expiratory Volume in first second (FEV₁), FEV₁:FVC Ratio, Peak Expiratory Flow Rate (PEFR). Any person with spirometer reading showing FEV₁ <80% of the predicted normal for age and gender, FVC usually reduced but to a lesser extent than FEV₁ and FEV₁/FVC ratio reduced to <0.7 were considered to have Obstructive pulmonary disease and spirometer showing FEV₁ <80% of the predicted normal, FVC <80% of the predicted normal and FEV₁/FVC ratio being normal (i.e. >0.7) were diagnosed to have Restrictive pulmonary disease¹⁹. Participants were also asked to report respiratory morbidities like repeated cough, chest tightness, breathlessness, limitation of activity and disturbed sleep due to difficult respiration in the past one year. Respiratory

morbidity includes reported respiratory symptoms and obstructive or restrictive respiratory diseases found in Spirometry. Data was entered in Microsoft Excel sheet and analyzed for descriptive statistics, student t-test, ANOVA test and Chi square test using SPSS 17 version.

Results:

A total of 134 workers participated in the study, of whom majority were males. Mean age was 35.89 ± 11.55 yrs. Table 1 explains other socio-demographic details of the participants along with their occupational history with respect to the current job.

Participants were asked about repeated history of any respiratory morbidity in the past one year, 44 (32.83%) reported cough, 32 (23.88%) reported breathlessness, 30 (22.38%) reported limitation of activity, 25 (18.65%) reported chest tightness and 16 (11.94%) reported disturbed sleep due to respiratory problem. Over all 83 (61.9%) workers reported at least one of the above mentioned morbidity symptoms in the past one year.

Study participants were examined for anthropometry and pulmonary function tests. Mean BMI was found to be 21.69 ± 3.36 kg/cm² and ranged from 15.41–33.05 kg/cm². Majority were in the normal range, followed by obesity in 26 (19.4%), underweight in 21 (15.67%) and overweight in 18 (13.43%) participants. Table 2 shows the mean values of Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV₁), FEV₁:FVC Ratio & Peak Expiratory Flow Rate (PEFR).

Based on the Spirometry readings, participants were categorized into three groups, Normal, Obstructive and Restrictive pulmonary diseases. It was found that 96 (71.64%) participants had abnormal readings, of whom 49 (36.57%) had obstructive and 47 (35.07%) had restrictive pulmonary diseases.

Associated factors: Table 3 shows that as the age and duration of work in rice mills increase mean FVC and FEV₁ were found to be reducing and females showed lower FVC & FEV₁ values compared to males. No significant association was found with the usage of personal protective equipments, history of smoking, reported respiratory morbidity and BMI. Table 4 showed that majority of the workers who worked for <5 yrs had obstructive type of disease and those who worked for 5–10 yrs showed restrictive type of disease. There was no significant association between the reported respiratory morbidity with age, gender, duration of work, use of PPEs at work or smoking history. However women found to have higher prevalence of reported respiratory morbidity than men. None of the above mentioned symptoms individually also had significant association with the variables

considered above except for cough with smoking history ($p < 0.001$).

Discussion:

The study clearly shows that FVC decreases as the age and duration of work increases. Though we did not compare with the general population, previous literature⁹ showed that the lung function tests among rice mill workers were lower than the general population. An older study in Davangere mill workers itself showed that FVC, FEV₁, PEFR & FEV₁:FVC were significantly reduced in smokers & with increased duration of work⁸. Another study conducted by Meo SA²⁰ showed a significant reduction of FEV₁, FVC, PEFR & MVV among the workers who worked more than 5-8 years similar to the present study findings. Study by Ye et al.²¹ among rice grain workers showed that there was an association between chronic grain-dust exposure and chronic airway obstruction. While the present study showed that almost half of those who worked < 5 yrs showed obstructive respiratory disease and more than half of those who worked for 5-10 yrs showed restrictive respiratory disease. FVC goes on decreasing with increasing duration of exposure to rice husk dust²². The decrease in FVC may be due to much more changes to the bronchi and elastic component of lungs resulting in restrictive type of lung impairment²³. Decrease in FEV₁ shows that exposure to dust causes early obstructive pulmonary impairment which further increases with increase in number of years of exposure²⁴. This may be due to release of air borne endotoxin which may cause inflammatory reaction in the bronchopulmonary system²⁵.

The present study showed lower FVC among mask users compared to non users which was probably due to higher number of women (54%) using masks compared to men (13%) and overall pulmonary function tests were significantly lower among women. Study done in flour mill workers in Egypt showed a significantly higher prevalence of cough, expectoration, breathlessness and reduced respiratory volumes among exposed group than non exposed ones. The pulmonary functions deteriorated with increasing duration of exposure and heavily exposed work than lightly exposed²⁶. Another study conducted among rice mill workers by Seema P in Tumkur district of Karnataka showed higher prevalence of respiratory morbidity like cold, persistent cough with sputum with increasing duration of work¹¹. Though more than half workers complained of some respiratory morbidity in the past one year, there was no significant association found with the duration of work, smoking history, age

or gender in the present study. Study conducted by Razlan Musa¹⁰ in Malaysia among rice mill workers showed that chest tightness was the most common symptom followed by morning phlegm, shortness of breath, and morning cough. Both age and duration of employment had significant relationship with shortness of breath whereas smoking had relationship with morning phlegm and morning cough, while the present study showed association of cough with smoking but not with any other variables.

Decrease in various lung function parameters in rice mill workers may be due to exposure to industrial dust, poor ventilation, non-use of face masks and lack of proper exhaust facility²⁷.

Conclusion:

Lung volumes decrease with increasing age and lower among females. Pulmonary function tests were found to be deteriorating with increasing duration of work, initially obstructive changes and long time workers showing restrictive changes. Usage of personal protective equipments was very low. Therefore we recommend workers should have periodical clinical and spirometric evaluation and those showing significant impairment in pulmonary functions should be readjusted in other sections of the industry where exposure to industrial dust is negligible. Workers were advised to use tight facemasks during working hours as routine and maximum necessary measures to control air pollution.

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Table 1: Socio-demographic profile and occupational history of the participants

Total participants	134
Males	108 (80.6%)
Females	26 (19.4%)
Mean age	35.89 ± 11.55 yrs
Range	18 70 yrs
Education	
Uneducated	46 (34.33%)
Primary	49 (36.57%)
Secondary	19 (14.18%)
> Secondary schooling	20 (14.92%)
Smoking history	
Present	38 (28.3%)
Absent	96 (71.7%)

Mean duration of smoking (n = 38)	8.96 ± 6.05 yrs
Occupational history Mean duration of work Range	10.66 ± 8.67 yrs 4 months 35 yrs
History of PPEs (masks) Present Absent	28 (20.9%) 106 (79.1%)

Table 2: Pulmonary function tests

Lung function tests	Mean	SD	Range
FVC	2.77 lit	1.0	0.5-5.53 lit
FEV1	1.89 lit	0.78	0.15-3.89 lit
FEV ₁ :FVC Ratio	72.41 %	27.12	4-100 %
PEFR	3.15 lit	1.41	0.64-7.31 lit

Table 3: Mean differences in pulmonary function tests among different socio-demographic profiles and occupational exposure

Variable		FVC Mean in liters (SD)	FEV1 Mean in liters (SD)	FEV ₁ : FVC Ratio Mean in percent (SD)	PEFR Mean in liters (SD)
Age	18 – 25 yrs	3.32(0.73)	2.37 (0.71)	73.92 (21.62)	3.71(1.26)
	26 – 35 yrs	2.93(0.86)	2.05 (0.79)	72.54(26.50)	3.19 (1.63)
	36 – 45 yrs	2.69 (1.32)	1.75 (0.66)	74.0 (27.82)	2.93(1.13)
	> 45 yrs	2.10 (0.68)	1.31(0.53)	69.24(22.48)	2.83(1.27)
	P value	< 0.001	< 0.001	0.90	0.11
Gender	Males	2.99(0.96)	1.97 (0.83)	68.82 (28.42)	3.14 (1.47)
	Females	1.86 (0.56)	1.54(0.42)	87.34(25.30)	3.19 (1.17)
	P value	< 0.001	0.013	0.002	0.88
Duration of work	< 5 yrs	3.28 (0.67)	1.98 (0.95)	60.92 (27.11)	3.0 (1.58)
	5 – 10 yrs	2.64 (0.84)	2.1 (0.63)	82.67 (20.27)	3.54 (1.30)
	> 10 yrs	2.46 (1.14)	1.69 (0.68)	75.35 (27.82)	3.04 (1.32)
	P value	< 0.001	0.035	0.001	0.184
Usage of PPEs	Present	2.34 (0.86)	1.74 (0.48)	80.5 (25.4)	3.20 (1.29)
	Absent	2.89 (1.01)	1.92 (0.84)	70.28 (27.28)	3.14 (1.45)
	P value	0.01	0.26	0.07	0.84
History of smoking	Present	2.83 (0.95)	1.81 (0.82)	66.89 (29.01)	3.01 (1.57)
	Absent	2.75 (1.02)	1.92 (0.77)	74.6 (26.18)	3.21(1.35)
	P value	0.66	0.48	0.13	0.46

Table 4: Determinants of different morbidities based on pulmonary function tests

Exposure		Morbidities based on pulmonary function tests			Total	Significance (P value)
		No morbidity	Obstructive	Restrictive		
Duration of work	< 5 yrs	9 (20.5%)	22 (50.0%)	13 (29.5%)	44 (100%)	0.018
	5 – 10 yrs	9 (27.3%)	6 (18.2%)	18 (54.5%)	33 (100%)	
	>10 yrs	20 (35.1%)	21 (36.8%)	16 (28.1%)	57 (100%)	
Usage of mask	Absent	31 (29.2%)	40 (37.7%)	35 (33.0%)	106 (100%)	0.625
	Present	7 (25.0%)	9 (32.1%)	12 (42.9%)	28 (100%)	
History of smoking	Absent	29 (30.2%)	30 (31.3%)	37 (38.5%)	96 (100%)	0.123
	Present	9 (23.7%)	19 (50%)	10 (26.3%)	38 (100%)	
Total		38 (28.4%)	49 (36.6%)	47 (35.1%)	134	

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