A comparative study of lung functions in rice mill workers and non dust producing industrial workers

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Abstract

Background: Rice mill workers are potentially exposed to organic and inorganic dusts and synthetic chemicals mainly moldy hey or grain dust and silica that may have adverse effects on respiratory health. **Objective:** To determine the effect of rice mill exposure on lung function. **Methods:** This was a cross-sectional comparative type of study conducted among the rice-mill workers and workers other than dust producing industry in Rajshahi, Bangladesh. In this study 300 rice mill workers as exposed group (B) and 100 workers other than dust producing industry as controls (A) were selected purposively. Data were collected by a pre-tested partially structured interview schedule designed to record the background characteristics of the workers and their lung function test results. **Results:** Of a total 300 rice mill exposed workers, 286 (95.3%) workers had impaired lung function (FVC <80% and or FEV_1 <80%). On the other hand out of 100 non rice mill exposed workers, only 14(14.0%) workers had impaired lung function. Rice mill workers had a 32.53 (95% confidence interval (CI) 9.93-106.50) fold greater risk to impair their lung function than the workers worked other than rice mill. **Conclusion:** Rice mill workers should be advised to use tight facemasks during working hours as a routine and maximum necessary measures to control air pollution should be taken. And they should have periodic clinical and spirometric evaluation and those showing significant impairment in ventilatory functions should be advised to work in other non dust producing industries.

Key words: rice mill workers, lung function tests.

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Introduction

Functions of the lungs are absorption and elimination of O_2 and Co_2 in and or out from the lungs. By respiration the term is generally used, external respiration, the absorption of O_2 and elimination of Co_2, and internal respiration, the utilization of O_2 and production of CO_2 by cells.[1] Forced vital capacity (**FVC**), Forced expiratory volume in 1st second (**FEV_1**) Forced expiratory volume in 1st second/ Forced vital capacity% (**FEV_1/FVC%**) and Peak expiratory flow rate (**PEFR**) are done to assess the different functions which reflect performance of it.[2,3]

Nowadays, the significance of occupational hazards and need for protecting the health of industrial workers has been well recognized. Occupational pulmonary diseases are more widespread and more disabling than any other group of occupational diseases. The lung with its extensive surface area, high blood flow and thin alveolar epithelium is an important site of contact with substance in environment. The inhalation of dusts over a period of time leads to proliferation and fibrotic changes in lungs.[4-6]

Rice mill workers, who are involved in husking process, are directly exposed to enormous dust particles. They are potentially exposed to organic and inorganic dusts and synthetic chemicals mainly moldy hey or grain dust and silica that may have adverse effects on respiratory health. They might face impaired lung function due to long term exposure to dust. Several reports have suggested that unprotected dust exposure in the paddy husking process may lead to chronic bronchitis, dyspnoea, wheezing, sinusitis, eosinophilia, asthma, COPD, chest tightness, nasal bleeding, nasal catarrh etc.[7,8]

The pulmonary function tests have opened a new era towards scientific approach in diagnosis, prognosis and management of pulmonary disorders by the early recognition of their alteration in industry workers like rice mill workers who are constantly exposed to various dust pollutants and to institute protective and preventive measures to minimize the hazards of exposure to polluted environment[9]. This study intended to determine the effect of rice mill exposure on lung function in Rajshahi district and recommend the concerned authority to take necessary measures to reduce the problem.

Methods

This was a cross-sectional comparative type of study conducted in the department of Physiology, Rajshahi Medical College among the Rice-mills workers and workers other than dust producing industry in Sopura Industrial area of Rajshahi City Corporation, Rajshahi from July 2010 to June 2011. Total 400 industrial workers were selected purposively as sample units. Of the 400 industrial workers, 300 were rice mill workers (exposed group or group B) and 100 were workers other than dust producing industry (control group or group A). A pre-tested partially structured interview schedule was used to collect data from the workers The interview schedule was designed to record the background information (i.e. gender, age, weight, height and calculated BMI) of the workers and their lung function test results. The workers were firstly interviewed and then lung function tests viz forced vital capacity (FVC), forced expiratory volume in 1st second (FEV_1) and peak expiratory flow rate (PEFR) were determined by Spirometer maintaining proper procedures and steps. Verbal/written informed consent from the authorities of the industries and workers were obtained.

Data were entered in the computer and processed using SPSS for windows. Descriptive statistics such as frequency distribution, computation of percentage etc. were applied. Chi-square and Student's t-test were applied to observe the homogeneity between exposed and non-exposed group and the difference of lung function parameters between the two groups, and the association of participants' characteristics with their lung function status. Multiple logistic regression analysis was used to determine the independent effects of participants' characteristics on lung function.

Results

A total of 300 rice mill exposed workers, 151 (50.3%) workers were male and 149 (49.7%) were female. Among the rice mill non-exposed workers, the percentages of male and female were 70.0% and 30.0% respectively. The mean age and BMI of exposed group were 30.47 years and 20.8 respectively. On the other hand, those of control group were 38.49 years and 22.0 respectively. These background characteristics of the exposed and control groups were significantly differed from each other (Table 1).

Table 1. Background characteristics of the exposed and control groups.

Group	Gender		Age (year)	BMI (Kg/m^2)
	Male N (%)	Female N (%)		
Exposed group (n=300)	151 (50.3)	149 (49.7)	30.47 ± 9.32	20.8 ± 2.26
Control group (n=100)	70 (70.0)	30 (30.0)	38.49 ± 7.23	22.0 ± 1.92
Test statistic (t/x^2) value, df	11.73, 1		7.85, 398	4.76, 398
P value	<0.001		<0.0001	<0.0001

In the control group, the mean values of FVC, FEV_1 and PEFR were 3.72±2.13, 3.45±2.24 and 20.85±43.19 respectively. These lung function indexes were significantly lower among the exposed group (Table 2).

Table-2: Comparison of lung function parameters between control and exposed group. (Control group =100 and Exposed group =300)

Parameter	Control group Mean ± SD	Exposed group Mean ± SD	Test statistic T value, df	P value
PVC (Litre)	3.72 ± 2.13	1.93 ± 1.12	-10.8, 398	0.000
FEV_1 (litre)	3.45 ± 2.24	1.80 ± 0.85	-10.72, 398	0.000
PEFR (Litre/sec)	5.41 ± 3.55	4.33 ± 1.76	-3.98, 398	0.000

Of a total 300 rice mill exposed workers, 286 (95.3%) workers had impaired lung function (FVC <80% and or FEV1 <80%). On the other hand out of 100 non rice mill exposed workers, only 14(14.0%) workers had impaired lung function. Exposure to rice mill, gender, age and BMI of the industrial workers were identified as significant correlates of their lung function status. A total of 300 rice mill workers, majority (95.3%) workers had impaired lung function. Among the non rice mill workers, it was only 14.0% (Table 3).

Table 3 Association of participants' background characteristics with their lung function status.

Factor	Status of lung function		Chi-square value	P Value
	Normal	Impaired		
Exposure to rice mill				
Exposed (n=300)	14(4.7)	286(95.3)	264.8	0.000
Non exposed (n=100)	86(86.0)	14(14.0)		
Gender				
Male (n=221)	64(29.0)	157(71.0)	4.12	0.042
Female (n=179)	36(20.1)	143(79.9)		
Age				
Up to 30 years (n=207)	22(10.6)	185(89.4)	47.26	0.000
>30 years (n=193)	78(40.4)	115(59.6)		
BMI				
<18.5 (n=38)	0 (0.0)	38(100.0)	23.06	0.000
18.5-24.9 (n=341)	100 (29.3)	241(70.7)		
>24.9 (n=21)	0 (0.0)	21(100.0)		

Rice mill workers had a 32.53 (95% confidence interval (CI) 9.93-106.50) fold greater risk to impair their lung function than the workers worked other than rice mill (Table 4). More than 79.0% of the female and 71.0% of the male workers had impaired lung function. The prevalence of impaired lung function among the younger (aged up to 30 years) workers was remarkably higher (29.8%) than the workers older than 30 years (Table 3). Younger age also showed significant log odds [11.18 (95% CI 3.36-37.21)] in comparison to older age(Table 4) to reduce the lung function. All of the workers having under and overweight had impaired lung function. It was 70.7% among the normal weight workers (Table 3). Gender and BMI were not identified as significant determinants of lung function (Table 4).

Table 4 Multiple logistic regression analysis: effects of rice mill exposure, age, gender and body mass index (BMI) on lung function.

Variable	Adjusted odds ratio [95% confidence interval (CI)]	P Value
Exposure to rice mill		
Exposed	32.53 (9.93-106.50)	0.000
Non exposed*	1.00	
Gender		
Male*	1.00	0.060
Female	.395 (0.150-1.041)	
Age		
Up to 30 years	11.18 (3.36-37.21)	0.000
>30 years*	1.00	
BMI		
<18.5*	1.00	1.00
18.5 24.9	0.00 (0.00-0.96)	
>24.9	2.69 (0.00-4.78)	

Discussion

In the present study the cases and controls were not matched for their background characteristics i.e. gender, age and BMI and the analysis suggested that case and control were heterogeneous groups. So, though bivariate analysis in this study suggested, exposure to rice mill dust was associated with impaired lung function, it did not insure the independent effect of exposure to rice husk on lung function, but multivariate

analysis suggested that exposure to rice mill dust impaired lung function.

The advent of pulmonary function tests have opened a new era towards the scientific approach in diagnosis, prognosis and management of bronchopulmonary disorders.[9] Many studies have been done in relation to pulmonary functions both in normal subjects and in workers exposed to different occupation dusthazards.[9-11] The results of these studies are indicating that workers of different dust industries are prone to respiratory dysfunctions while working in them. The present study findings suggested that with a progressive trend towards industrialization, like others workers of dust generating industries, there is also a definite increase in occupational lung diseases in rice mill workers.

In this study FVC, FEV1 and PEFR were significantly reduced in rice mill workers than that of the controls. It indicated that study subjects had both obstructive and restrictive type of lung impairment. This reduced FVC may be due to much more changes to the bronchii and elastic component of lungs resulting in restrictive type of lung impairment.[12] Decreased FEV1 indicated that exposure to dust causes early obstructive pulmonary impairment, which further increases with increase in number of years of exposure.[13] This may be due to release of air borne endotoxin which may cause inflammatory reaction in the bronchopulmonary system.[14] Reduced 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.[15]

Decreased 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 facility.[16] This exposure to industrial dust causes occupational air way obstruction which occurs due to chronic bronchitis occurring due to chronic irritation of air ways.[17]

Thus in concluding it can be seen that spirometric parameters in rice mill workers showed lower values than in the corresponding control subjects. The difference is statistically significant indicating that the air pollution at work site accelerated decline in lung functions. So workers should have periodical clinical and spirometric evaluation and those showing significant impairment in ventilatory functions should be readjusted in other sections of the industry where exposure to industrial dust is negligible. Workers should be advised to use tight facemasks during working hours as a routine and maximum necessary measures to control air pollution.

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