

**Research Article**

## **STUDY OF EFFECT OF FLOUR DUST AND RICE HUSK DUST ON PULMONARY FUNCTIONS**

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### **ABSTRACT**

Due to increase in industrialization, air pollution is increasing day by day. The workers working in these industries suffer from various types of air way diseases like Pneumoconiosis, Farmer's Lung, Chronic bronchitis, pulmonary fibrosis and Asthma. So the present study was undertaken to study the effects of flour dust and rice husk dust on the lung functions. The present cross-sectional study was carried out to evaluate Pulmonary function tests FVC, FEV1, FEF 25-75, PEFR and MVV in Rice and Flour mill workers. This study includes 400 rice mill workers and 400 flour mill workers. On comparison it was found that there was highly significant ( $p < 0.001$ ) decline in FVC, FEV1 and MVV in rice mill workers as compared to flour mill workers. The values of respiratory parameters go on decreasing with increase in number of years of exposure to rice husk and flour dust. The PFT's were carried out with a computerized spirometer "Med-Spiror". The various data was collected, compiled, statistically analyzed and valid conclusions were drawn. Flour dust and rice husk dust causes chronic bronchial irritation which is responsible for the impairment of lung functions.

**Key Words:** *Pulmonary Functions, Rice Mill Workers, Flour Mill Workers, Forced Vital Capacity, Forced Expiratory Volume In First Second, Forced Expiratory Fraction, Peak Expiratory Flow Rate*

### **INTRODUCTION**

With civilization, industrialization is increasing day by day. As a result air pollution is increasing, leading to various lung diseases among which chronic obstructive lung diseases predominate. Subjects with workplace exposure to organic dust have high prevalence of respiratory diseases (Oxman et al, 1993). There is growing concern on the deleterious effects of organic dust on respiratory symptoms and functions of industrial workers. Acute and chronic respiratory effects of grain dust exposure can include such responses as Farmer's Lung (Pepys, 1969), Grain Fever Syndrome (Dopico et al, 1982), chronic bronchitis (Dosman et al, 1980) and asthma (Chan Yeung et al, 1979). Environmental assessment of grain factories showed the presence of biologically active endotoxins (Olenchock et al, 1984). The gram negative bacterial endotoxins can elicit profound immunotoxic and immunomodulating effects in vitro and in vivo (Morrison et al, 1978) and therefore can exacerbate adverse pulmonary reactions to grain dust. Rice Husk dust causes damage to bronchial passages, along with damage to the elastic component of alveolar walls. Rice husk dust contains some air borne endotoxins which cause inflammatory reactions in broncho-pulmonary system. Air-borne endotoxin is commonly present in a rice producing commune (Olenchock et al, 1984).

Wheat flour is a complex organic dust with a large diversity of antigenic or allergic components (Zuskin et al, 1998). The antigens involved can be wheat flour proteins, flour parasites, silica, fungi, insects or technical additives such as enzymes (Kollop-Sarda et al, 1994). Albumin and globulins appear to be the most important proteins contributing to immediate hypersensitivity reaction to wheat proteins (James et al, 1997). Many studies have shown that flour dust exposure causes respiratory symptoms and is associated with impairment of lung functions (Burstyn et al 1997, Bulat et al 2004, Elms et al 2003). Flour dust is an asthmagen and is known to cause sensitization, allergic rhinitis and occupational asthma among bakers and millers (Ross et al 1997, Jeffrey et al, 1999).

The flour dust and rice husk dust can be absorbed through the skin or swallowed but most frequently inhaled irritating the portal of entry and leading to various obstructive lung diseases. Measurement of

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dynamic lung functions is more important than of static lung volumes (Cotes JE, 1979). A large number of workers are engaged in flour and rice mills in Punjab. Lung function tests are beneficial in the early recognition of pulmonary dysfunctions even if the workers may be normal clinically.

## MATERIALS AND METHODS

The present study was conducted in the premises of rice and flour mills, Amritsar, Punjab. Eight hundred industrial workers in the age group of 20-50 years, consisting of 400 industrial workers from Rice mills and 400 from Flour mills were taken. In all the subjects a detailed history including history of smoking and general physical examination was done. Persons having asthma or chronic infections of lungs, having persistent cough, treated recently for any respiratory illness were excluded. They responded favourably to our appeal for cooperation in carrying out these investigations. Once the subject was included in the present investigation, none was subsequently rejected except when he was unable to give the desired cooperation in the experimental procedures. The research protocol was approved by local ethical committee and informed consent obtained from each subject prior to inclusion in the study.

Among the pulmonary functions Forced vital capacity (FVC), forced expiratory volume in one second ( $FEV_1$ ), peak expiratory flow rate (PEFR), mean forced expiratory flow during the middle half of Forced Vital Capacity ( $FEF_{25-75}$ ), Maximum voluntary ventilation (MVV) was done with spirometer. The ventilatory tests were carried out with a computerized spirometer 'Medspiror'. It was designed to be used with electromechanical pneumotach. Volume detection was done by pneumotach sensor and flow detection by volume differential method. Its overall accuracy is within  $\pm 1\%$  and its range for volume is 0-10 liters and for flow is 0-20 liters/second. Testing procedures were quite simple, non-invasive and harmless from subject's point of view. Only two manoeuvres were required to accumulate all test data, a Forced Vital Capacity and Maximum Voluntary Ventilation. The readings were taken in the standing position. Body surface area was read from 'Normogram' of Dubois and Dubois (1916) formula.

## RESULTS

### Physical Parameters

There was no significant difference between the mean age, height, weight and B.S.A. of rice mill and flour mill workers as shown in Table number 1.

**FVC (Forced Vital Capacity):** Table number 2 shows the mean and standard deviation of FVC in rice mill workers and flour mill workers as  $1.30 \pm 0.30$  and  $1.62 \pm 0.44$  respectively. It also shows that there is a highly significant decline in rice mill workers when compared with that of flour mill workers. Table number 3 and 4 show progressive decline in FVC in rice mill workers with increase in number of years of exposure which is highly significant ( $p < 0.001$ ). There is highly significant decline in FVC in flour mill workers with increasing duration of exposure as shown in Table no. 5 and 6.

**$FEV_1$ :** The mean values observed for both rice and flour mill workers are  $1.30 \pm 0.30$  and  $1.59 \pm 0.44$  respectively having highly significant lower values in rice mill workers. There is highly significant decline in  $FEV_1$  with increase in number of years of exposure both in rice and flour mill workers as shown in Tables 3, 4, 5 and 6.

**PEFR:** Table no. 2 shows the mean, S.D. of PEFR in rice mill workers ( $4.29 \pm 0.83$ ) and flour mill workers ( $4.15 \pm 1.10$ ) and difference is non-significant. Table no. 3 and 4 show decrease in PEFR in rice mill workers which is non-significant initially, gradually it becomes significant with increasing duration of exposure. The decline in flour mill workers is highly significant in last group as shown in Table no. 6.

**$FEF_{25-75}$ :** The mean and S.D. values of  $FEF_{25-75}$  in rice mill and flour mill workers are found to be  $2.82 \pm 0.77$  and  $2.75 \pm 0.79$  respectively as shown in Table no. 2. The decline is non-significant in flour mill workers. Table no. 3 and 4 show that there is progressive decline in  $FEF_{25-75}$  in rice mill workers with increase in number of years of exposure though statistically non-significant. Table no. 6 shows a highly significant decline in  $FEF_{25-75}$  in flour mill workers with more than 10 years of exposure when compared with workers with 6-10 years of exposure.

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**Table 1: Showing Anthropometric Measurements**

Parameters	Rice mill workers	Flour mill workers
AGE(Years)	33.14±9.02	34.56±8.50
Height(cm)	166.40±7.74	168.31±6.52
Weight(kg)	63.88±8.35	66.37±7.13
BSA(m <sup>2</sup> )	1.71±0.14	1.75±0.11

**Table 2: Showing Mean, Standard Deviation, T Value and P Value With Statistical Significance Of Respiratory Parameters Between Rice Mill And Flour Mill Workers**

Units	Parameters	Rice mill workers		Flour mill workers		t value	P value	Significance
		M	S.D.	M	S.D.			
Liters	FVC	1.30	±0.30	1.62	±0.44	6.02	<0.001	HS
	FEV <sub>1</sub>	1.30	±0.30	1.59	±0.44	5.46	<0.001	HS
Liter/sec	PEFR	4.29	±0.83	4.15	±1.10	1.02	>0.05	NS
	FEF <sub>25-75</sub>	2.82	±0.77	2.75	±0.79	0.64	>0.05	NS
L/min	MVV	48.92	±17.07	68.40	±17.21	8.06	<0.001	HS

**HS:** Highly Significant  $p < 0.01$ ,  $< 0.001$

**S:** Significant  $p < 0.05$

**NS:** Non-significant  $p > 0.05$

**Table 3: Showing Mean, Standard Deviation, T Value And P Value With Statistical Significance Of Respiratory Parameters Between Rice Mill Workers With 0-5 Years And 6-10 Years Of Exposure**

Units	Parameters	Rice mill workers 0-5 years of exposure n=84		Rice mill workers 6-10 years of exposure n=92		t value	P value	Significance
		M	S.D.	M	S.D.			
Liters	FVC	1.68	±0.11	1.47	±0.06	8.05	<0.001	HS
	FEV <sub>1</sub>	1.68	±0.10	1.47	±0.06	8.63	<0.001	HS
Liter/sec	PEFR	4.82	±0.67	4.57	±0.40	1.54	>0.05	NS
	FEF <sub>25-75</sub>	3.07	±0.56	2.99	±0.53	0.49	>0.05	NS
L/min	MVV	52.29	±19.52	46.35	±14.28	1.17	>0.05	NS

**HS:** Highly Significant  $p < 0.01$ ,  $< 0.001$

**S:** Significant  $p < 0.05$

**NS:** Non-significant  $p > 0.05$

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**Table 4: Showing Mean, Standard Deviation, T Value And P Value With Statistical Significance Of Respiratory Parameters Between Rice Mill Workers With 6-10 Years And More Than 10 Years Of Exposure**

Units	Parameters	Rice mill workers 6-10 years of exposure n=92		Rice mill workers more than 10 years of exposure n=224		t value	P value	Significance
		M	S.D.	M	S.D.			
Liters	FVC	1.47	±0.06	1.09	±0.22	8.18	<0.001	HS
	FEV <sub>1</sub>	1.47	±0.06	1.09	±0.22	8.18	<0.001	HS
Liter/sec	PEFR	4.57	±0.40	3.97	±0.88	3.15	<0.05	S
	FEF <sub>25-75</sub>	2.99	±0.53	2.65	±0.89	1.72	>0.05	NS
L/min	MVV	46.35	±14.28	48.71	±17.25	0.58	>0.05	NS

**HS:** Highly Significant  $p<0.01$ ,  $<0.001$

**S:** Significant  $p<0.05$

**NS:** Non-significant  $p>0.05$

**Table 5: Showing Mean, Standard Deviation, T Value And P Value With Statistical Significance Of Respiratory Parameters Between Flour Mill Workers With 0-5 Years And With 6-10 Years Of Exposure**

Units	Parameters	Flour mill workers 0-5 years of exposure n=80		Flour mill workers 6-10 years of exposure n=124		t value	P value	Significance
		M	S.D.	M	S.D.			
Liters	FVC	2.05	±0.12	1.89	±0.06	6.39	<0.001	HS
	FEV <sub>1</sub>	2.00	±0.17	1.86	±0.12	3.48	<0.001	HS
Liter/sec	PEFR	4.78	±0.78	4.71	±0.66	0.34	>0.05	NS
	FEF <sub>25-75</sub>	3.07	±0.57	3.18	±0.44	1.21	>0.05	NS
L/min	MVV	74.10	±17.34	70.19	±15.87	0.84	>0.05	NS

**HS:** Highly Significant  $p<0.01$ ,  $<0.001$

**S:** Significant  $p<0.05$

**NS:** Non-significant  $p>0.05$

**MVV:** Table no. 2 shows that there is highly significant decline in MVV in rice mill workers when compared with that of flour mill workers ( $p<0.001$ ). Table no. 3,4,5 and 6 show that there is progressive decline in MVV in rice mill and flour mill workers with increase in number of years of exposure though statistically non-significant ( $p>0.05$ ).

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**Table 6: Showing Mean, Standard Deviation, T Value And P Value With Statistical Significance Of Respiratory Parameters Between Flour Mill Workers With 6-10 Years And With More Than 10 Years Of Exposure**

Units	Parameters	Flour mill workers 6-10 years of exposure n=124		Flour mill workers more than 10 years of exposure n=196		t value	P value	Significance
		M	S.D.	M	S.D.			
Liters	FVC	1.89	±0.06	1.28	±0.39	8.68	<0.001	HS
	FEV <sub>1</sub>	1.86	±0.12	1.26	±0.40	8.16	<0.001	HS
Liter/sec	PEFR	4.71	±0.66	3.55	±1.12	5.25	<0.001	HS
	FEF <sub>25-75</sub>	3.18	±0.44	2.35	±0.85	5.05	<0.001	HS
L/min	MVV	70.19	±15.87	64.94	±17.52	1.36	>0.05	NS

**HS:** Highly Significant  $p < 0.01, < 0.001$

**S:** Significant  $p < 0.05$

**NS:** Non-significant  $p > 0.05$

### DISCUSSION

Pulmonary function tests have been very much helpful in the diagnosis of pulmonary diseases. By evaluating various lung function parameters i.e. FVC, FEV<sub>1</sub>, PEFR and MVV, it is usually possible to diagnose the underlying pathophysiology of various lung diseases. Our study showed decreased FVC in rice mill workers. FVC goes on decreasing with increasing duration of exposure to rice husk dust (Singh et al, 1988). The decrease in FVC may be due to much more changes to the bronchii and elastic component of lungs resulting in restrictive type of lung impairment (Mathur and Dixit, 1999). Decrease in FEV<sub>1</sub> shows that exposure to dust causes early obstructive pulmonary impairment which further increases with increase in number of years of exposure (Rao et al, 1991). This may be due to release of air borne endotoxins which may cause inflammatory reaction in the broncho pulmonary system (Bose et al, 1997). Some previous studies (Kapoor et al, 1989) also showed decrease in FEF<sub>25-75</sub> as collaborated by our study. 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 (Taytard et al, 1988). Workers exposed to area of maximum dust concentration are more vulnerable to impairment of expiratory flow (Zodpey and Tiwari, 1998).

The underlying mechanism of air way obstruction in flour mill workers may be due to the formation of specific IgE leading to immunological reactions which can be immediate, late or dual (Morrison and Ulevitch, 1978) or materials being employed cause a direct liberation of broncho constrictor substances (Chanyeung et al, 1979). Decrease in FVC and FEV<sub>1</sub> may be due to obstructive impairment which further increases with increase in number of years of exposure, in other words there is a dose exposure relationship (Meo, 2004 and Yach et al, 1985). Decrease in PEFR is highly significant in case of flour mill workers suggesting involvement of larger airways (Singh et al, 1986).

MVV also showed a highly significant decline in rice mill workers as compared to flour mill workers. MVV is considered to be a good guideline of the mechanical efficiency of the lungs. So decreased values of MVV in rice mill workers indicates that grain dust causes decreased mechanical efficiency of lungs (Bose et al, 1997).

The results of the present study support paying attention to working conditions in flour and rice mills. To reduce or eliminate harmful effects of air-borne particles in various industries, spirometry should be an

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integral part of a health care programme. Ideally the provision of appropriate monitoring programmes in industry should be an integral part of primary health care initiatives developed for working place with growing industrialization in India especially Punjab. Periodic health check ups are equally important. Thus concluding the discussion it can be seen that spirometric parameters in rice mill workers showed lower values than in the corresponding flour mill workers. 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 should be taken.

### Conclusion

Lung functions showed lower values in rice mill workers as compared to flour mill workers. Secondly all respiratory parameters decreased with increasing duration of exposure to flour dust and rice husk dust.

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