Effects Of Flour Dust On Computerized Spirometric Parameters In Flour Mill Workers

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Abstract: Background**:** The work environment seriously influences the organism of exposed human. The occupational hazards, such as dust, unfavourable microclimatic condition, and excessive noise and in sufficient light are most important. The occupation related lung diseases are most likely due to the deposition of dust in the lungs and are influenced by the short (types) of dusts, the period of exposure, the concentration and size of airborne dust in the breathing zone. Present study was undertaken to study the effect of flour dust on respiratory functions of exposed workers. Method**:** We evaluated 50 male subjects in the age group of 18-50 years consisting of 50 industrial workers from flour mills in different areas of Bhavnagar city. Computerized spirometric parameters of flour mill workers (FMW) were done by computerized software of pulmonary function test named "SPIROEXCEL"and compared with their predicted values. The various data were collected; compiled, statistically analyzed and valid Conclusion were drawn. Result: The present study results showed the mean values of FVC, FEV1, Mid expiratory flow rate, $FEF_{25\%}$, $FEF_{50\%}$, $FEF_{75\%}$, SVC, PEFR, and MVV were decreased in flour mill worker as compared with their predicted value, which were statistically significant. Conclusion: Flour dust causes chronic bronchial irritation which is responsible for causing restrictive type and restrictive plus obstructive mix type of pulmonary function impairment in flour mill workers.

Key Words: Occupational Hazards, Flour Mill Workers (FMW), Flour dust, Computerized spirometric parameters

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Introduction: since times immemorial, man has been the victim of occupational diseases, among which lung diseases are most common. Subjects with workplace exposure to organic dust have high prevalence of respiratory diseases[1]. There is a growing consensus on the deleterious effects of organic dust on respiratory symptoms and functions of industrial workers. Industrial dust inhalation over a long period leads to proliferative and fibrotic changes in lungs[2]. Flour dust is widely incriminated to cause such effects. Exposure to flour dust occurs across a range of food industries including grain mills, flour mills and bakeries.

Wheat flour is a complex organic dust with a large diversity of antigenic or allergic components[3].The antigens involved can be wheat flour proteins, flour parasites, silica, fungi, insects or technical additives such as enzymes[4]. Albumin and globulins appear to be the most important proteins contributing to immediate hypersensitivity reaction to wheat proteins[5]. Many studies have shown that flour dust exposure causes respiratory symptoms and is associated with impairment of lung functions[6]. Flour dust is an asthmagen and is known to cause sensitization, allergic rhinitis and occupational asthma among bakers and Millers[7]. The dust can be absorbed through the skin or swallowed but most frequently it is inhaled, irritating the portal of entry and leading to various obstructive lung diseases.

Measurement of dynamic lung functions is more important than that of static lung volumes[8]. Now it is well recognized that 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 and in the differential diagnosis of patients with a known pulmonary disease.

Materials and Method: The present study was carried out at pulmonary function test lab, department of physiology, Govt. Medical College, Bhavnagar,Gujarat. 50 male subjects

were included in this study who were working in Flour Mill in different areas of Bhavnagar city. All the individuals from Flour Mill workers were subjected to detailed history taking and clinical examination prior to spirometry.

INCLUSION CRITERIA: (1) Gender:- male. (2) Age:- 18 to 50 yrs. (3) Duration of work in Flour Mill atleast 3 years. (4) No history of any acute or chronic respiratory illness. (5) No history of smoking (6) Absence of use of any protective equipment at working place. (7) No history of any major chronic disease which may directly or indirectly affect respiratory functions.

The present study was carried out by computerized software of pulmonary function test named "SPIROEXCEL". Spiroexcel is a device that uses electronic and mechanical precision components and must be in the following ambient condition: Temperature maintained between 5˚C and 40 ˚C, relative humidity lower than 90%. Avoid using it in environment full of noxious smoke and excessive dust. Never set the instrument near any kind of heat and water source. All pulmonary function tests were carried out at a fixed time of the day to minimize the any diurnal variation[9].

Method: The experimental protocol was explained to all the subjects and written consent was obtained from them. Prior permission of institutional ethical committee of Govt. Med, college, Bhavnagar, was obtained.

Anthropometrical measurements including age, height and weight were recorded and BMI was calculated. Further a preliminary clinical examination was carried out on the subjects to rule out any medical problems.

Obtaining Spirometric parameters using "spiroexcel": All tests were recorded in sitting comfortable and relaxed position in chair on 11 A.M. Before lunch and with no any tight clothing which substantially restricts full chest and abdominal expansion. Subjects were explained and demonstrated about the procedure to be performed. They were allowed to do enough practice, as lung volume depends on subject making a maximal voluntary effort. Full series of tests takes time of about four to five minutes. The testing procedures ware quite, simple, non-invasive and harmless from subject's point of view. Only three maneuvers required to collect all data which are FVC, SVC and MVV.

For FVC maneuver, subject's nose was clipped and instructed to take maximum deep inspiration as much as possible and hold it, then mouth piece was kept firmly in the mouth between lips so as to avoid escape of any air, then asked the subject to blow out force fully and as fast and long as much possible in the mouth piece and by doing this value of FVC and its components were obtained. For MVV maneuver, the subject was asked to perform inspiration and expiration as fast and as deep as possible in the mouth piece for minimum of 15 seconds with nose was clipped. For SVC maneuver, the subject was asked to perform first three tidal respiration and one deep expiration and deep inspiration followed by other three tidal respirations in the mouth piece.

By doing above three maneuvers we obtained following actual and predicted values , Forced vital capacity (FVC) , Forced expiratory volume (FEV) , FEV1 / FVC ratio, Forced expiratory flow 25–75 % (FEF 25-75), FEF25% (L/S), FEF50% (L/S), FEF75% (L/S) and Maximal voluntary ventilation(MVV) L/min , slow vital capacity (SVC-L), Peak expiratory flow rate (PEFR-L/S).

Following acceptability criteria were used for good quality results: A sharp peak flow and an expiratory duration is grater then six seconds, Two or three acceptable maneuvers should be performed, The two highest FEV1 values from these acceptable maneuvers should be within 0.15L of each other, Graph must be free from artifacts, There must have no cough, no leak, and no obstruction in mouthpiece and have good start.

Predicted values of all Spiro metric parameters for age and stature were provided by the manufacturer of the spiroexcel. Statistical

analysis was done by "unpaired student t test" with the help of "Graph pad instate" statistical software and p value less than 0.005 taken as statistically significant.

Result & Discussion: Flour dust is a heterogeneous substance with respiratory sensitizing and irritating properties. Its exposure may induce acute or chronic respiratory ailments. This study was designed to investigate the effects of flour dust on the lung function in Flour Mill workers. The results of the present study (Table 2) showed a significant reduction in the mean values of FVC, FEV1, FEF25-75, PEFR, FEF25%, FEF50%, SVC and MVV in the Flour Mill workers as compared with their predicted values.

As per table 3 in 44% of flour mill workers the ratio of FEV1/FVC is increased and in 56% of flour mill workers it is decreased in comparison to their predicted values.

Table 1: Anthropological parameters of flour mill workers

Parameter	Flour Mill worker (Mean ± SD)
Age	36.36 ± 7.74
Weight	63.08 ± 10.95
Height	165.44 ± 5.45
BSA*	1.68 ± 0.13

*BSA- Body Surface Area

Fig 1: Age distribution in flour mill workers

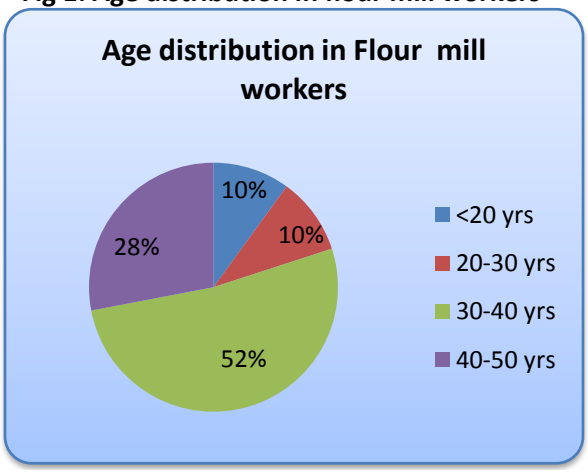

Table 2: Computerized spirometric parameters in flour mill workers

Parameters	Predicted Mean ± SD	Test Mean ± SD	% of Pred.	P value
FVC	4.19 ± 0.35	2.10 ± 0.78	50.12	<0.001*
FEV1	3.49 ± O.32	1.65 ± 0.52	47.28	<0.001*
PEFR	8.59 ± 0.51	3.30 ± 1.70	38.42	<0.001*
FEF25-75 %	4.22 ± 0.40	2.29 ± 1.22	54.27	<0.001*
FEF25 %	7.40 ± 0.35	2.95 ± 1.71	39.87	<0.001*
FEF50 %	4.69 ± 0.34	2.54 ± 1.49	54.16	<0.001*
FEF75 %	1.95 ± 0.27	1.64 ± 0.82	84.11	<0.001*
FEV1/FVC	79.96 ±1.89	76.28 ±16.64	95.39	= 0.457
SVC	4.08±0.61	2.19± 1.19	53.67	<0.001*
MVV	125.36± 9.95	34.66±20.32	27.64	<0.001*
* Statistically significant, **Pred.**=Predicted value				

Table 3: Flour mill workers who have decreased or increased value of four lung function parameters

	Flour Mill workers (Total n=50)	
Parameter	% of subject Increase value of	% of subject Decrease value of
FVC	0%	100%
FEV1	0%	100%
FEV1/FVC(%)	44%	56%
PEFR	2%	98%

Table 4: Distribution of subjects according to ventilatory impairments of lung function

Ventilatory Impairments	Flour Mill Workers		
	Pure Obstruction	Pure Restriction	Obstruction plus Restriction
	0%	44%	56%

Study by Bohadana et.al.[10] Shows that regardless of exposure to relatively low concentration levels of inspirable flour dust, subjects working in the baking industry are at risk of developing respiratory symptoms and airway hyper responsiveness. Ijadunola et.al.[11] reported an increase in frequency of respiratory symptoms and decreased FEV1 in a group of workers exposed to grain and flour dust. In addition, Gimenez et.al[12] have observed that flour dust exposure causes cough, phlegm production and the decreased pulmonary function values among Flour Mill workers

compared to their matched controls. Similarly, Corzo and Naveda[13] reported a decrease in the values of PEFR, FEF25%, FEF75% and also demonstrated that the longer summative time of exposure to flour dust was associated with more diminished Spiro metric values. Awad et.al.[14] Also observed a significant decline in the lung function parameters, FVC and FEV1, in workers exposed to Flour dust compared to the control group.

Ige and Awoyemi[15] investigated the occupation induced lung function impairment in bakery workers as a result of exposure to grain and flour dusts. They reported that the mean values of FVC, FEV1, PEFR, and FEV1/FVC% in the bakery workers were significantly lower than those of the control subjects. Zodpey and Tiwari[16] reported that the PEFR value was significantly reduced in Flour Mill workers as compared to their controls. Shamssain[17] observed ventilatory function in non-smoking flour processing male bakery workers and reported that the exposed group had significantly lower forced expiratory indices than the control group. Mean percent predicted values for FEV1, FEV1/FVC%, FEF25%–75%, and PEFR were respectively, 52.72%, 4.61%, 45.73%, and 61.58% lower in the exposed group compared to their predicted value. Chen[18] divided the Flour Mill workers into high and Low exposure groups and observed that FEV1, FVC and PEFR were significantly decreased in the highly-exposed group. The finding indicates that exposure to high concentration of dust for a long period of time impairs the pulmonary function. In addition, Meo[19] studied the relationship between dose responses and duration of exposure on the lung function in Flour Mill workers and observed that FVC, FEV1, PEFR and MVV were decreased in Flour Mill workers compared to their matched controls.

The present study supports the findings of other researchers and suggests that Flour dust adversely affects the pulmonary function parameters. While discussing the pathophysiological aspects of a drop in the values of the aforesaid lung function parameters, FVC is decreased in pulmonary obstruction, emphysema, pleural effusion, pneumothorax, pulmonary edema and poliomyelitis. Similarly, the FEV1 value is low in obstructive lung diseases and in reduced lung volume. The decline in FEV1 is a convenient standard against which we can measure marked declines in subjects with the history of chronic obstructive pulmonary disease (COPD) or in subject exposed to environmental pollutants. Whereas, PEFR provides an objective assessment of functional changes associated with environmental and occupational exposures and determines acute or chronic disease processes. In patients with severe COPD, PEFR is persistently low and represents collapsing of large airways. In addition, MVV reflects the function of the entire ventilatory apparatus and depends upon the compliance of the thoracic wall and lungs, airway resistance and muscular force. MVV is profoundly reduced in patients with airway obstruction or emphysema.

If we try to identify the subject according to ventilatory impairment, it shows that most of the subject from flour mill workers 44% shows restrictive type of lung function impairment and 56% of workers shows mix restrictive plus obstructive type of impairments (table 4)because the decrease in FVC and MVV indicates a restrictive impairement whereas decrease in FEV1, FEF25-75, PEFR indicates an obstructive impairment.

Conclusion: Flour dust causes chronic bronchial irritation which is responsible for the restrictive plus obstructive type of pulmonary impairment of lung functions. The problem of effects of flour dust is of importance in that it highlights the need to reduce exposure and shows the magnitude of the effect on the population at risk. Because the dust exposure can lead to lung function impairments. It is advisable therefore, that health risk should be reduced by the mutual collaboration between health officials, mill management and their workers in the area of implementation of protective measures, such as improvement of ventilation and use of individual protective devices.

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References:

1. Oxman AD, Muir DCF, Shannon HS, Stock SR, Hnidzo E, Langi HJ. Occupational dust exposure and chronic obstructive pulmonary disease. American Review of RespiratoryDiseases 1993; 148 : 38-48.
2. Boyd W, Henly K, London. Text book of Pathology 1977; 721.
3. Zuskin E, Kanceljak B, Schachter EN, Godnic-Cvar J. Mustabegovic, J. and Budak, A. Respiratory function and immunological status in cocoa and flour processing workers. Am. J. Ind. Med 1998; 33(1): 24-32.
4. Kolopp-Sarda MN, Massin N, Gobert B et al. Humoral immune responses of workers occupationally exposed to wheat flour. Am J Ind Med 1994; 26: 671-9.
5. James JM, Sixbey JB, Helm RM et al. Wheat a-amylase inhibitor: A second route of allergic sensitization. J Allergy Clin Immunol 1997; 99: 239-44.
6. Burstyn I, Teschke K, Kennedy SM. Exposure levels and determinants of inhalable dust exposure in bakeries. Ann Occup Hyg 1997;41: 609–24.
7. Ross DJ, Keynes HL, McDonald JC. Surveillance of work-related and occupational respiratory disease in the UK. Occup Med 1997; 47: 377–81.
8. Cotes JE. Lung function assessment and application in medicine. 4th ed.Blackwell Scientific Publications 1979 ; London.
9. J W Glinmeyer, J J Lafante, R N Jones, R J Rando and H Weil: Cotton dust and across shift change in FEV1 as predictors of annual changes in FEV1 .A M J Resp Crit Care Med 1994; 149,584-590
10. Bohadana AB, Massin N, Wild P, Kolopp MN, Toamain JP. Respira-Tory Symptoms And Airway Responsiveness In Apparently Healthy Workers Exposed To flour Dust.Eur Respir J 1994;(6):1070–6.
11. Ijadunola KT, Erhabor GE, Onayade AA, Ijadunola MY, Fatusi AO, Asuzu MC. Prevalence Of Respiratory Symptoms Among Wheat flour Mill Workers In Ibadan, Nigeria Am J Ind Med 2004; 45(3):251–9.
12. Gimenez C, Fouad K, Choudat D, Laureillard J, Bouscaillou P, Leib E. Chronic And Acute Respiratory Effects Among Grain Mill Workers. Int Arch Occup Environ Health 1995; 67(5):311–5.
13. Corzo G, Naveda R. Spirometry In Workers In A Wheat-Processing In-Dustry. Invest Clin 1998; 39(3):175–87.
14. Awad El Karim MA, Gad El Rab MO, Omer AA, El Haimi YA. Respiratory And Allergic Disorders in Workers Exposed to Grain And flour Dusts. Arch Environ Health 1986; 41(5):297–301.
15. Ige OM, Awoyemi OB. Respiratory Symptoms and Ventilatory Function Of The Bakery Workers In Ibadan, Nigeria. West Afr J Med 2002; 21(4):316–8.
16. Zodpey SP, Tiwari RR. Peak Expiratory flow Rate In flour Mill Workers. Indian J Physiol Pharmacol 1998; 42(4):521–6.
17. Shamssain MH. Respiratory Symptoms And Pulmonary Function In flour Processing Workers In The Baking Industry. Am J Ind Med 1995; 27(3):359–65.
18. Chen P. The Effect Of Grain Dust On Non-Specific Bronchial Hyper Reac-Tivity. Zhonghua Jie He He Hu Xi Za Zhi 1992; 15(1):28–30.
19. Meo SA. Dose Responses of Years of Exposure on Lung Function In flour Mill Workers. J Occup Health 2004; 46:187–191.

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