

## **Effect of Chronic Exposure to Flour Dust on Pulmonary Function Tests.**

Dr. Anju. A. Asia, Dr. Gajanan. G. Atram

Assistant Professor<sup>1</sup> Professor<sup>2</sup>

<sup>1</sup>(Department of Physiology, Government Medical College, Akola, Maharashtra, India

<sup>2</sup>(Department of Physiology, Government Medical College, Akola, Maharashtra, India )

### **Abstract**

**Objective:** To study the effect of flour dust exposure on respiratory symptoms and Pulmonary function tests in flour millers.

**Material and Methods:** The study was carried out in sixty flour millers chronically exposed to flour dust and sixty five non exposed control group . Work history and information on respiratory symptoms was recorded by a standard questionnaire followed by spirometric evaluation of pulmonary functions.

**Results:** Cough and breathlessness was more pronounced in workers, similarly wheezes was a commonly encountered sign .FEV1%, FVC, FEV3/FVC, MVV, PEFr showed a significant decline in workers.

**Conclusion:** A definite reduction in expiratory flow rates was observed. Periodic examination and Pulmonary function assessment can be helpful in implementing timely interventional measures and adopting preventive strategies.

### **I. Introduction**

Occupation related diseases have been known for decades, with the worker being ceaselessly exposed to the raw material that his job deals with. Raw material usually includes metals, minerals, biologic agents, chemicals, toxic gases, fumes etc. Epidemiological data suggests that apart from mishaps and injuries, pulmonary disability is the forerunner in the series of occupational hazards. Through the efforts of Bernardino Ramazzini (1), the father of Occupational Medicine, the vital question, "What is your job?" became part of any medical history, he was the first to record breathlessness among handlers of grain. Pneumoconiosis, a term coined by Zenker (2) refers to a group of diseases caused by inhalation of dust and the tissue reaction to its presence. One of the commonly encountered workplaces having abundant dust exposure is the flour mill. It is a complex organic dust comprising mainly of wheat and millets which have been ground by milling. Significance of spirometry as an important diagnostic tool in occupational respiratory diseases is well documented (3, 4, 5). In an occupational setting these tests are beneficial in the early recognition of lung dysfunction although workers may be clinically normal. Pulmonary function tests help to categorize pulmonary diseases in pathophysiologic terms, assess severity and weigh response to therapeutic intervention (6). In light of the existing knowledge this study was conducted to investigate the effects of long term exposure to flour dust on respiratory symptoms and lung functions of flour mill workers in Akola district.

### **II. Material And Methods**

The study population comprised of sixty male flour mill workers in the age group of 30-50 years. These workers worked for at least 8-9 hours per day, at various flour mills all over Akola, six days per week and were in the said occupation for more than 5 years. Subjects with any known cardiovascular /respiratory disease were excluded; similarly smokers and subjects having exposure to any pollutant/contaminant other than flour dust were excluded from the study. An equal number of unexposed subjects in the similar age group who matched the flour mill workers by socioeconomic status, height, weight, body mass index, place of residence were chosen as controls. Subjects were administered a standard questionnaire which included questions on work history and respiratory symptoms. Work history included duration of exposure, working hours, job description, working conditions, hygiene status and protective aids used. Symptoms were attributed to exposure if they were triggered while working in the mill and improved over the weekend or a holiday. General and systemic examination was then carried out and finally pulmonary function tests were carried out by spirometry.

Spirometry was performed on all participants using computerized pulmonary function test machine with pneumotach flow sensor. Instrument was properly calibrated. Subjects were adequately instructed, test was

performed in sitting position with the nose clip in position and using a properly fitting mouthpiece. Three or more tracings were recorded and tracing with maximum effort was selected. Parameters measured were forced vital capacity- FVC, forced expiratory volume in one second- FEV1, forced expiratory ratio- FEV1/FVC%, FEV3/FVC%, Peak expiratory flow rate- PEFR, Maximum voluntary ventilation- MVV. Data appears as actual value, predicted value, and percent predicted i.e. actual value/predicted value × 100 .All the measured values were at BTPS. Results were expressed as percentages of predicted values according to the standard guidelines(7) .Statistical analysis for comparison between the two groups was done by unpaired ‘t’ test, using Microsoft excel ,p value <0.05 & 0.001 was considered significant or highly significant respectively. . Written informed consent was obtained from all participants prior to the study. The study design was approved by the local ethical committee.

### III. Results

60 flour millers and 65 unexposed subjects were examined .The mean age of the workers was 35.5 ± 8.5 years while that of the control group was 38.6 ± 10.3 years, the difference being statistically non significant . None of the workers used any protective aid. Respiratory symptoms were significantly different for both the groups, breathlessness and cough being predominantly present in the flour mill workers .Similarly wheezes was a commonly encountered finding in mill workers (Table no. 1). Flour mill workers had lower FVC (L), FEV1% compared to controls with statistically significant differences. PEFR and MVV values showed a decline in the flour mill group. (Table no. 2)

**Table no. 1**

Respiratory symptoms and Clinical signs	Control (%)	Mill workers (%)	p value
Cough	7	72	< 0.001**
Breathlessness	10	59	< 0.001**
Chest pain	2	3	> 0.05
Wheezes	2	60	< 0.001**

**Table no. 2**

Parameters	Control Group		Flour Mill Workers		P Value
	Mean	S.D.	Mean	S.D.	
Fvc (L)	3.57	0.11	3.04	0.20	< 0.001**
Fev1/Fvc (%)	86.3	5.96	67.4	11.8	< 0.001**
Fev3/Fvc (%)	94.65	12.2	92.49	11.8	< 0.001**
Pefr(L/Sec)	6.36	0.172	5.78	0.17	< 0.05*
Mvv(L)	109.36	16.62	80.25	13.11	< 0.05*

\*\*- Highly significant, \*- Significant

### IV. Discussion

The present cross sectional study was carried out in flour millers and non-exposed healthy subjects. Flour dust is a heterogenous organic substance possessing irritant and sensitizing properties. Dust comprises of cereal particles and may contain contaminants, bacterial endotoxins, insects, mites, pesticides, herbicides etc. In our study particles were mainly that of wheat and millets. Respiratory symptoms were significantly higher in the

mill workers as compared to controls. This finding is in agreement with similar studies on flour mill workers who found inspirable flour dust increasing the frequency of respiratory symptoms and correlated it to the long period of exposure (8,9). Longer duration of employment was associated with higher the prevalence of allergic symptoms. Chen(8) divided the flour mill workers into heavy and light exposure group, he found decrease in values of FVC, PEFr, FEV1 similarly he also found that a high concentration of dust for long time impairs pulmonary function. Post et al (10) noticed an annual decline in FEV1, MMEFR and related to occupational exposure to flour dust. Shamsain et al (11) noted that respiratory symptoms and ventilatory function reduced in non-smoking flour processing bakery workers. Zuskin et al found significant reduction in ventilatory capacity in exposed workers (12), H A Mohammadein et al (13) found correlation with work related respiratory disorder and duration of employment, site of work and age. A B Singh et al observed that although age did not influence incidence of cough and rhinitis but it affected incidence of breathlessness (14). Zodpey and Tiwari reported decline in PEFr (15). Corzo and Naveda (16) found spirometric changes due to high concentration of wheat dust and longer summative time of exposure to flour dust was associated with decreased spirometric values.

The most sensitive indicator of obstructive pattern of impairment is FEV1/FVC%. Our studies point towards a mixed pattern of impairment in flour millers with reduction in FVC accompanied by mild obstruction as FEV1% ranges between 60-70%. Since FVC and FEV1 are determined principally by manoeuvres in which expiration is forceful and rapid therefore physical processes which decrease elastic recoil or increase airflow resistance or increase airway wall compliance will decrease flow rates that can be normally achieved. In turn, airway resistance increases in event of narrowing which could be the result of either contraction of bronchial smooth muscle or thickening of airway walls. Grain dust damages bronchial passages and elastic component of the alveoli. Putative mechanisms for bronchoconstriction being hypersensitivity, inflammation and reflex bronchoconstriction. Seeds, pollens, parasitic fungus, spores, grain mite act as allergens causing wheat allergy (17). Inhaled antigen combines with immunoglobulin E releasing a primary mediator like histamine resulting in bronchospasm. Immunologic responses to flour exposure in bakers and mill workers have been reported (18,19,20). Alveolar macrophages secrete platelet activating factor which secretes a bronchoconstrictor substance, in addition to leukotrienes and prostaglandins (21). This is an immediate hypersensitivity reaction which subsides rapidly after cessation of exposure or use of bronchodilators. Secondly, bronchoconstriction can be ascribed to persistent bronchial inflammation making the airways hyperresponsive. A proinflammatory substance endotoxin lipopolysaccharide produces its bronchial effects through release of proinflammatory cytokines causing proliferation of macrophages and reduced airway calibre. Low grade infection in chronic dust exposure triggers an inflammatory response with subsequent fibrosis and decreased elasticity of lung tissue(20). Finally, reflex bronchoconstriction on stimulation of sensory receptors in the airways by irritants and certain chemicals mediated by cholinergic pathways causes bronchoconstriction.

This is a physiologic rather than pathologic reaction, narrowing of airways enhances airflow turbulence increasing the rate of particle deposition into tracheobronchial region from where they are cleared out efficiently by the ciliary mechanisms. Bronchoconstriction tends to prevent entry of respirable particles into alveolar regions. Airflow obstruction is also attributed to increasing amounts of mucus secretion as chronic airway irritation results in hypertrophy and hyperplasia of mucus glands. The interplay of these factors namely hypersensitivity; inflammatory response and mucus secretion lead to bronchoconstriction and thereby obstruction to airflow. Obstruction and loss of elastic recoil are the principal factors responsible for decreased flow rates (22,23). For the present study decreased expiratory flow rates can be attributed to obstruction of the airways. Results of our study are inclined towards a mixed pattern of pulmonary impairment as FVC is lowered accompanied by mild obstruction since FEV1/FVC lies in between 60-70%. Our results tally with those of Gimenez C, Fowad K (24) who found a decline in expiratory volumes. S Bose, F Roohi (25) found a decline in FEV1 in Dal mill workers with an obstructive trend of impairment in workers exposed for a duration exceeding five years. Moira Chan Yeung and Robert Wong observed a large decline and it was attributed to inclusion of symptomatic subjects (26).

Findings of PEFr are in accordance those of Gimenez C, Fowad K (24) indicating decline in PEFr before their workshift. Bronchospasm causes the airways to collapse more easily than normal airways reducing the maximal expiratory flow. Lower values for MVV was seen in Dal mill workers (25), rice mill workers (26,27,28). The reduced airway patency in the workers of our study lowers the MVV. To summarize FVC, FEV1, PEFr and MVV are determined principally by events during forced expiration and would decrease with decline in maximal flow rates.

## **V. Conclusion**

Although PFT's were not correlated directly with duration in this study, yet all workers exposed for more than 5 years demonstrated a definite decline. Grain dust has the potential to cause damage to tracheobronchial tree in form of obstruction with minimal restriction as evidenced by reduction in pulmonary functions. Flour mill workers must undergo a pre employment and periodic medical surveillance test, these will identify susceptible workers preventing further significant deterioration and aid in improvement of the present condition. Preventive technical strategies recommended include use of respirator, masks, local exhaust ventilation ,general hygienic measures and a follow up schedule comprising of pulmonary function tests, X ray chest and sputum examination at least once a year.

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