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RESEARCH ARTICLE

Effect of flour dust on forced vital capacity in flour mill workers

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ABSTRACT

Background: Flour milling involves the processing and grinding of cereals into flour. Exposures to flour occur in milling operations, where grain is processed into flour. The pulmonary function test is one of the important measures to assess respiratory efficiency. The present study was aimed to find out the effect of flour dust on forced vital capacity (FVC) in flour mill workers. **Aims and Objective:** The aim of the study was to evaluate the spirometric parameters in flour mill workers (FMW) and to compare the observed values of FMWs and bank office workers to provide health education and preventive measure to them. **Materials and Methods:** Effect of flour dust on FVC was recorded in 60 males FMWs and 60 males controlled groups of office worker included in this study, those are working in flour mill >2 years. Statistical analysis was performed by unpaired *t*-test and values shown in mean ± Standard deviation. **Results:** FVC of FMW is very much compromised when compared to office worker value. Observed value of FVC of FMW is 2.57 ± 1.05 and Office worker (OW) is 3.60 ± 0.67, Forced expiration volume in first second (FEV1) of FMW–1.92 ± 0.87 and OW–3.05 ± 0.49 FEV1/FVC of FMW–74.02 ± 17.31 and OW–85.74 ± data are analyzed with un-pair student *t*–test the *P* value is highly significant. **Conclusion:** From the study, we can conclude that statistically significant changes are seen in pulmonary function test parameters of FMWs. Moreover, these significant changes in pulmonary function test parameters may be due to the prolonged exposure of flour dust, to which FMW are constantly being exposed.

KEY WORDS: Flour Dust, Flour mill Workers, Forced Vital Capacity, Spirometry

INTRODUCTION

Flour milling involves the processing and grinding of cereals into flour. Exposures to flour occur in milling operations, where grain is processed into flour. Hence, the problem is a serious concern for small scale domestic flour. These types of small scale industries such as flour mills are seen everywhere in society. Moreover, as we know workers are never using any kind of protective equipment and their environmental condition at workplace is also compromised.[1] Dust particles which are inhaled and lodged in the lung irritate and set up an inflammatory reaction. Healing of this inflammation causes fibrosis leading to a reduction in the size of the lungs (functional) due to defective oxygen diffusion and impaired lung function.[2] The occupationally related lung diseases are most likely due to the deposition of dust in the lung and are influenced by the sort of dust, the period of exposure, the concentration, and size of the airborne dust in the breathing zone.[3] Pulmonary function testing is a widely used technique that offers a broad range of information about respiratory system disorder, and spirometry is one of the most sensitive and valuable pulmonary function tests. Spirometry measures airflow out of fully inflated lungs. Spirometry is the timed measurement of dynamic lung volumes and capacities during

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forced expiration and inspiration to quantify how effectively the lungs can be filled and emptied. Abnormal spirometry is an indicator of increased risk for premature death from all causes. Spirometry is a physiological test that measures how an individual inhales or exhales volumes of air as a function of time. Forced vital capacity (FVC) is the maximal volume of air which can be breath out as forcefully, rapidly, and completely as possible following a maximal inspiration. el Karim *et al*. carried out a study among 100 male flour mill workers (FMW).[4] FEV1 and FVC were significantly reduced in 58% of the exposed workers. Dhillon *et al*. also reported the reduction of mean values of FVC, FEV1, peak expiratory flow rate (PEFR), and maximum voluntary ventilation (MVV) and showed a dose response of years of exposure among FMW. Chronic bronchial irritation due to dust exposure was responsible for the obstructive type of pulmonary impairment of lung functions.[5] With maximal effort and in the absence of thoracic muscle weakness, decreased expiratory flow is almost invariably associated with increased airway flow resistance. Which may result from various lung defects such as decreased lung retractive force, increased bronchial compliance, narrowing of airways, and decrease in number airways. It is a sensitive index to distinguish between obstructive and restrictive disease.[6]

Aims and Objective

The aim of the study was (a) to evaluate the spirometric parameters in FMWs, (b) to compare the observed values of FMWs and bank office workers, and (c) to provide health education and preventive measure to them.

MATERIALS AND METHODS

The present study was carried out at the Department of Physiology, Shree M P Shah Government Medical College, Jamnagar, Gujarat. The study was approved by the Institutional Ethics Committee of Shree M P Shah Government Medical College, Jamnagar. 60 male subjects were included in this study; those are working in flour mill >2 years at a different area of Jamnagar city. 60 male controlled group of office worker such as bank worker, charter accountant, clerk, and doctor in different areas of Jamnagar city. All the individuals both from FMWs and from office workers are subjected to history taking and clinical examination before spirometry (pulmonary function test). The informed consent was obtained from each participant. Exclusion and inclusion criteria were based on apparently normal health status as per the following criteria.

Inclusion Criteria

The following criteria were included in the study:

1. Only male subject of 20 years–50 years age group.
2. Person must have worked in flour mill >2 years.
3. No any past or present history of major chronic disease such as tuberculosis, diabetes mellitus (DM), and hypertension.
4. No any history of smoking in the past or present.
5. Subject must not be using any protective equipment at the working place.

Exclusion Criteria

The following criteria were excluded from the study:

1. Subject with a gross abnormality of the vertebral column, thoracic cage, neuromuscular disease, anemia, DM, emphysema, asthma, tuberculosis, ischemic heart disease, malignancy, drug addict, smokers, and with H/O chest surgery confirmed by taking a detailed history and examine.
2. History of medications such as beta-blocker and steroid at the time of the study.

The present study was carried out by computerized spirometer name "SPIROLAB III" which is designed in such a way that it is easy and simple to operate and give highly accurate results. All the data were collected at a fixed time of the day esp. between 5 p.m.–7 p.m and 7 a.m.–9 a.m. Height in cms (nearest to 0.1 cms) without shoes, feet together, standing as tall as possible with the eyes level and looking straight ahead, and using an accurate measuring device.[7] Weight in kgs (nearest to 0.1 kgs) of the subject wearing light clothing and barefooted and empty bladder before lunch on a standardized weighing scale.[8] BHT: In a comfortable sitting position in which subjects were asked to hold breath by closing both nostrils voluntarily by pinching nose between his/her thumb and index finger. Spirometric parameters (FVC, FEV1, and FEV1/FVC): With the use of Spirolab III. Before recording, subjects were allowed to relax. They were asked to inhale and exhale into the disposable mouthpiece of the spirometer twice. After pinching nose and the lips were tightened around the mouthpiece to prevent leakage of air, as airflow must be through the mouthpiece to and from the lungs. The maneuvers were repeated thrice, and the best of the three readings was taken. At the end of the procedure, the instrument showed the detailed pulmonary function test value and readings and graphs, which were taken into consideration and noted down. Print of the record at the same time taken. The testing procedures were quite simple, non-invasive, and harmless from the subject's point of view. Following acceptability criteria were used for good quality results test performed before starting work. A sharp peak flow and an expiratory duration are greater than 6 s. Two or three acceptable maneuvers should be performed. There must have no cough, no leak, no obstruction in mouthpiece and have a good start. Persons are not exposed for at least 24 h before the test. Predicted values of all spirometric parameters for age and stature were generated in computerized Spirolab-III.

Statistical Analysis

Statistical analysis was done by "unpaired student *t*-test" with the help of "SPSS" statistical software and Microsoft office Excel 2007. Comparison of quantitative variables was analyzed by student *t*-test. $P < 0.05$ was considered significant.

RESULTS

Table 1 shows the mean and standard deviation of age, weight, height, and body surface area of the FMW and the office worker. Anthropological data comparison between FMWs and office workers indicates that there was not significant difference in height, weight, and body mass index of both groups.

It was observed that the FVC of FMW was very much compromised when compared to office worker value. The observed value of FVC of FMW is 2.57 ± 1.05 and the observed value of office worker was 3.60 ± 0.67 and when data were analyzed with unpaired student *t*–test, *P* value is highly significant. The observed value of force expiratory volume in one second of FMWs was 1.92 ± 0.87 and observed value in office worker was 3.05 ± 0.49, and it was highly significant. FEV1/FVC in FMWs was 74.02 ± 17.31, and it was significantly reduced as compared to office worker (85.74 ± 8.54, $P = 0.001$). Overall spirometric parameters in FMWs were reduce as compared to office workers Table 2.

During the study, it was observed that the FMWs were not taking any precautionary measures to prevent dust exposure during working hours. The standing positions of these workers were very close to the grinding machines.

DISCUSSION

This study was carried out to analyze the lung function abnormalities in FMWs using spirometry. FMW and the office worker were comparable for anthropological data (height, weight, and body mass index). The FVC of FMW (2.57 ± 1.05) was significantly reduced as compared to office worker (3.60 ± 0.67). The forced expiratory volume in 1 s was also significantly compromised in FMW (1.92 ± 0.87) as compared to office worker (3.05 ± 0.49). FEV1/FVC ratio in FMWs was 74.02 ± 17.31 which was also significantly reduced as compared to office worker (85.74 ± 8.54). Therefore, overall spirometric parameters in FMWs were reduced as compared to office workers. This fall in FVC among workers may be due to the accumulation of dust particles in the lung airways. Such an accumulation reduces the force which can be applied by the subject during the exhalation and inhalation effort.

Dr. S Dhillon observed a significant difference in the FVC of FMWs (1.62 ± 0.44) and control group (2.60 ± 0.75). FEV1 in worker (2.22 ± 0.55) was also significantly compromised than the control group (1.59 ± 0.44).[5] Kherde *et al*. also reported that mean PEFR values in the workers 6.44 ± 1.45 L/s were significantly reduced than in controls 7.18 ± 1.15 L/s.[9] Chen divided observed that exposure to a high concentration of dust for a long period of time impairs the pulmonary function.[10] In addition, Meo observed that FVC was decreased in FMWs compared to their matched controls.[11]

FMWs were not taking any precautionary measures to prevent dust exposure, and they were also standing very close to the grinding machines. As a result, they are continuously exposed to a heavy concentration of flour dust. Flour dust is a heterogeneous substance with respiratory sensitizing and irritating properties. Its exposure may induce acute or chronic respiratory ailments.[12]

Table 1: Anthropological parameters

Parameters	FMW	OF
Age	42.15±7.86	33.77±9.38
Weight	167.55±5.92	165.82±8.79
Height	61.42±12.85	61.65±11.72
BMI	21.84±4.38	22.40±3.65

FMW: Flour mill worker, OF: Office worker

Table 2: Comparison of FVC between FMW and OW

Parameters	FMW	OW	*t*-test	*P*-value
FVC	2.57±1.05	3.60±0.67	6.36	0.001
FEV1	1.92±0.87	3.05±0.49	8.67	0.001
FEV1/FVC	74.02±17.31	85.74±8.54	4.70	0.001

FMW: Flour mill worker, FVC: Forced vital capacity, FEV1: Forced expiration volume in first second, OW: Office worker

Limitation of Study

In our study, the sample size was small so further research should be conducted with a larger sample size. We did not measure other spirometric parameter such as PEFR and MVV.

CONCLUSION

From the present study, we can conclude that statistically significant changes were seen in pulmonary function test parameters of FMWs due to the prolonged exposure of flour dust. It is advisable, therefore, that health risk should be reduced by the mutual collaboration between health officials, mill workers, and mill management with the improvement of ventilation and use of individual protective devices and periodic health check-up.

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