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Evaluation of pulmonary functions of flour mill workers using Medspiror

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Abstract
Background: Pulmonary function tests (PFT) serve as a predictor of qualitative and quantitative assessment of health and it tend to have a relationship with worker's different physical and working parameters. Pulmonary functions generally determined by the strength of respiratory muscles and elastic recoil of the lungs but due to the regular working in flour mill, workers have a tendency to decreased pulmonary capacity.
Methods: Medspiror equipment was used for the experiment which recorded the standard determinants of pulmonary function which were FVC, FEV_1, PEFR and FEF 25-75%.
Results: There was a significant correlation between respiratory parameters with age of flour mill workers so as the age of the workers increases FVC, PEFR, FEF and FEV_1 decreases. There was a significant correlation between respiratory parameters with working years in flour mill hence the duration of employment increases FVC, PEFR, FEF and FEV_1 decreases.
Conclusions: Based on the results of the present study, it was concluded that flour mill workers were having increased risk of pulmonary function impairments. These results suggest that there is an urgent need to improve flour mill dust control measures.

Keywords: Pulmonary Function Tests, Flour Mill Workers, Respiratory Function and Medspiror

Introduction
Health hazards in the workplace form a major threat to a large proportion of the world's population. The work environment influences the protection and promotion of the health of workers by preventing and controlling the hazardous conditions to health and safety at work. Workers are highly exposed to harmful factors in their work environment such as dust, unfavorable climatic conditions, excessive noise and insufficient light. In flour mills of different cereals (barley, rice, maize, oats *etc*) workers are highly exposed to the allergies. Respiratory allergy to wheat protein is one of the most common causes of occupational asthma. Inhalation of flour dust can produce allergic reaction and chronic respiratory disorders such as sensitization and asthma. Respiratory symptoms and lung function impairment are among the most critical health effects associated with exposure to flour dust at flour mills. Considering the above fact in mind, the present investigation was taken with the objective of "Evaluation of Pulmonary Functions of Flour Mill Workers using Medspiror". Pulmonary function tests (PFT) can diagnose the asthma, allergies, respiratory infections, lung disease, chronic shortness of breath and chronic pulmonary disease. Thus, pulmonary function tests (PFT) evaluates the respiratory system, illustrate that how well the lungs are working, measure the lung volume, lung capacity, respiratory flow and identify the severity of pulmonary impairment. Pulmonary function tests also provide the information about certain lung disorders. Spirometer is the most common of the pulmonary function tests. The spirometer test is performed using a device called a medspiror which is broadly used by the healthcare professionals to assess the lung function. Medspiror measures the volume of air inspired and expired by the lungs and it is a accurate differential pressure transducer for the measurements of respiratory flow rates. Medspiror records the amount and rate of air that is inhaled and exhaled over a specified time. These measurements can help to find out if a person has lung problem.

Research hypothesis
In view of the presumed relationship and based on the objective of the present study, the

following hypothesis was formulated: H_0 1: There is no significant difference between the respiratory parameters and age of flour mill workers.

Methods

Flour mill workers working more than two years in the flour mill, falling in 25-35 years age category and having non-smoking habit were selected for testing lung function tests. Medspiror equipment was used for the experiment.

Pulmonary function tests are a group of tests that measure how well the lungs take in and release air and how well they move gases such as oxygen from the atmosphere into the body's circulation. Spirometry measure airflow by measuring how much air you exhale and how quickly, spirometry can evaluate a broad range of lung diseases. In a spirometry test, while you are sitting, you breathe into a mouthpiece that is connected to an instrument called medspiror. It records the amount and the rate of the air that you breathe in and out over a period of time. When standing, some numbers might be slightly different. The most important issue is to perform the test always while at the same positions.

For some of the test measurements, you can breathe normally and quietly. Other tests require forced inhalation or exhalation after a deep breath. Sometimes you will be asked to inhale the substance or a medicine to see how it changes your test results.

Lung volume measurement can be done in two ways:

- The most accurate way is to sit in a sealed, clear box that looks like a telephone booth (body plethymosgraph) while breathing in and out into a mouthpiece. Change in pressure inside the box help determine the lung volume.
- Lung volume can also be measured when you breathe nitrogen and helium gas through a tube foe a certain period of time. The concentration of the gas in a chamber attached to the tube is measured to estimate the lung volume.

Analysis of pulmonary function tests

Spirometer was performed on an electronic spirometer. All pulmonary function tests were carried out at a fixed time of the day (9 am-1pm) to minimize any diurnal variation. The apparatus was calibrated daily and operated within the ambient temperature range of 20-25°C. The detailed history and anthropometric data of the respondents were taken and to record the amount and rate of air that is inhaled and exhaled, respondent breaths into a mouthpiece. The respondents were asked to breathe normally or to take deep breath and blow the air quickly out of the lungs. A recording device measures the amount of the inhaled and exhaled and the time taken during each breath. The respiration rate was measured three times.

On the basis of the documented history of respondents as age, height, weight and smoking habits the predicted values of forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), peak expiratory flour rate (PEFR) and forced expiratory flour (FEF 25-75%) were documented and pre and post values were measured after test performance. Documented values were calculated by the standard formulae originally programmed in the spirometer.

Statistical analysis

The statistical analysis was done using the mean and standard deviation (S.D.). The value of coefficient of correlation was also calculated to find out the relationship between age and respiratory function while the significance of correlation coefficient was tested by t-test.

Results

Results (Table 1) regarding mean and S.D. of age, height, weight and duration of the employment in flour mill was as 30.91 ± 9.25 years, 52 ± 7.18 cms, 159.83 ± 7.01 kgs. and 5.75 ± 2.63 years, respectively.

Table 1: Respondent's age, height, weight and duration of the employment in flour mill

S. No.	Parameters	Mean ± S.D.
1.	Age (in years)	30.91 ± 9.25
2.	Height (in cms)	52 ± 7.18
3.	Weight (in kgs)	159.83 ± 7.01
4.	Duration of employment (in years)	5.75 ± 2.63

Data revealed (Table 2) the variations of FVC, FEV_1, PEFR and FEF before, during and after activity at flour mill.

Table 2: Assessment of respiratory parameters of flour mill workers

Units	Parameters	Before activity		During activity		After activity	
		Mean	S. D.	Mean	S. D.	Mean	S. D.
Liters	FVC	42.82	47.15	52.87	56.91	44.58	49.57
	FEV_1	35.23	41.41	41.61	46.40	37.18	42.84
Liters/sec	PEFR	25.46	34.88	30.34	37.49	27.68	36.41
	FEF 25-75	51.57	54.15	57.92	70.59	32.19	45.28

There was a significant correlation (Table 3) between respiratory parameters with age of flour mill workers therefore the null hypothesis was rejected and alternative hypothesis was accepted. It means that as the age of the workers increases FVC, PEFR, FEF and FEV_1 decreases.

Table 3: Correlation between age and respiratory parameters of flour mill workers

S. No.	Parameters	r value	Calculated t value	df	Table value of t	Interpretation
1.	Age and FVC	0.97	12.75	10	2.228	Significant at 5% level of significance
2.	Age and PEFR	0.80	4.20	10	2.228	Significant at 5% level of significance
3.	Age and FEF	0.95	9.67	10	2.228	Significant at 5% level of significance
4.	Age and FEV_1	0.93	7.91	10	2.228	Significant at 5% level of significance

There was a significant correlation (Table 4) between respiratory parameters with working years in flour mill hence the null hypothesis was rejected and alternative hypothesis was accepted which shows that as the duration of employment increases FVC, PEFR, FEF and FEV_1 decreases.

Table 4: Correlation between duration of employment and respiratory parameters of flour mill workers

S. No.	Parameters	r value	Calculated t value	df	Table value of t	Interpretation
1.	Working years and FVC	0.84	4.90	10	2.228	Significant at 5% level of significance
2.	Working years and PEFR	0.88	5.91	10	2.228	Significant at 5% level of significance
3.	Working years and FEF	0.78	3.90	10	2.228	Significant at 5% level of significance
4.	Working years and FEV_1	0.76	3.86	10	2.228	Significant at 5% level of significance

Discussion

Purposive sampling technique was used to select the sample from the population for the present study thus flour mill workers working more than two years in the flour mill, falling in 25-35 years age category and having non-smoking habit were selected for testing lung function tests. Smoking is the main risk factor for the increased lung function decline in adults so the non smokers were selected to find out the lung function parameters in flour mill workers without affected by smoking habit of workers. Behera *et al*. (2013) [2] also concluded in their study on pulmonary function test of smokers that smoking affects all the parameters of the PFT. It was observed that the mean and standard deviation of FVC and FEV_1 before and during work was 42.82±47.15 litres, 52.87±56.91 litres and 35.23±41.41 litres, 41.61±46.40 litres, respectively. The mean and standard deviation of PEFR and FEF was found as 25.46±34.88 litres/seconds, 30.34±37.49 litres/seconds and 51.57±54.15 litres/seconds, 57.92±70.59 litres/seconds, respectively. The mean and standard deviation of FVC and FEV_1 after work was calculated as 44.58±49.57 litres, 37.18±42.84 litres, respectively. The mean and standard deviation of PEFR and FEF was found as 27.68±36.41 litres/seconds, 32.19±45.28 litres/seconds, respectively. These observations clearly show the significantly lower values of pulmonary functions after activity in flour mill workers. Forced vital capacity of workers who had not started work in the morning was better than after working of eight hours. Chen (1992) [3] concluded that FEV1, FVC and PEFR were significantly lower in the heavily exposed flour mill workers. Nayak *et al.* (2013) [6] also resulted that flour duct causes chronic bronchial irritation which is responsible for the restrictive type and restrictive plus obstructive mix type of pulmonary function impairment in flour mill workers. Similarly, Corzo and Naveda (1998) [4] reported a decrease in the PFR, FEF in their study on workers engaged in wheat processing industry and also demonstrated that the summative time of exposure to flour dust was associated with more diminished spirometric values. Results of the present study further indicated that there was a significant correlation between respiratory parameters with age of flour mill workers therefore the null hypothesis was rejected and alternative hypothesis was accepted. It means that as the age of the workers increases FVC, PEFR, FEF and FEV_1 decreases. Pulmonary functions as the lung volume and lung capacities which may vary according to age, height and body weight of the worker. Results of present study shows that there was a significant correlation between respiratory parameters with working years in flour mill hence the null hypothesis was rejected and alternative hypothesis was accepted which shows that as the duration of employment increases FVC, PEFR, FEF and FEV_1 decreases. Heavy concentration of flour duct over a longer period of time impairs lung function to a significant level. Deshpande *et al.* (2015) [5] also resulted in their study on flour mill workers that the workers with less than five years exposure to flour dust have less lung function impairment than the flour mill workers exposed to 6-10 years which shows the reduction in pulmonary function. Workers exposed to flour dust at flour mill during milling, mixing and transfer activities have more likely to develop pulmonary disease.

Conclusion

The respondent's age, weight and height were 30.91 ± 9.25, 159.83 ± 7.01 and 52 ± 7.18 respectively. The mean and S.D. of working years of respondents in the flour mill was 5.75 ± 2.63. Respiratory parameters show the significantly lower values of pulmonary functions after activity in flour mill workers. There was a significant correlation between respiratory parameters with age of flour mill workers therefore the null hypothesis was rejected and alternative hypothesis was accepted. It means that as the age of the workers increases FVC, PEFR, FEF and FEV_1 decreases. There was a significant correlation between respiratory parameters with working years in flour mill hence the null hypothesis was rejected and alternative hypothesis was accepted which shows that as the duration of employment increases FVC, PEFR, FEF and FEV_1 decreases.

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