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Analysis of the Pulmonary Function Status Among Brass Utensils Factory Workers

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ABSTRACT

Background and objectives: Occupational lung diseases are the major work-related illness. Not only the lengthen exposures, repetitive single exposure to the irritating or toxic substance can cause acute or chronic respiratory problem. Workers in metallurgical industry in the developing countries are repeatedly exposed to high concentrations of dusts and fumes that affect pulmonary function and cause chronic obstructive pulmonary disease (COPD). Results of the present study will help to add on the literature regarding the lung functions and its affection with the duration of exposure of different metals in Brass factory workers. So, the present study was conducted with an objective of determining the ventilatory capacity and presence any of chronic respiratory illness in brass factory employees using Pulmonary function test.
Methods: Participants with age of 20-60 years were selected on the basis of inclusion and exclusion criteria in Group A (n=100). Participants in Group B (n=50) were selected from the healthy individual with the same socio-economic condition and age. Pulmonary function test (PFT) was performed in all participants.
Results: The results from between group analysis using unpaired t test revealed significant difference between the two groups in FVC score ($t=4.45$, $p<0.05$), FEV1 score ($t=6.67$, $p<0.05$), FEV1/FVC score ($t=4.256$, $p<0.05$), FEF25-75% score ($t=7.163$, $p<0.05$) PEFR score ($t=10.205$, $p<0.05$).
Conclusion: The study concluded that there is significant reduction in pulmonary Functions FVC, FEV1, FEV1/FVC, FEF25-75%, PEFR value in brass ware factory workers when compared to control group. Also, exposure to brass metal dust and other environmental pollutants present in brass factory, adversely affects the respiratory system of the workers.

Keywords: Pulmonary function test, Brass Factory workers, Chronic Obstructive Pulmonary Disease.

INTRODUCTION

Occupational lung diseases are one of the major work-related illnesses. They are usually caused by long term exposure to irritating or toxic substance that may cause acute or chronic respiratory problem; however, repetitive single exposures can also generate chronic lung diseases. Many occupations like coal mine, cement factory, floor mill, wood dust industries are associated with adverse health effects, and the lung is one of the most vulnerable parts of the body to airborne hazards. [(1)] Occupational exposure plays a role in onset of several respiratory disease and lung function deficits. [(2,3,4)]

According to the national mortality statistics, pulmonary diseases are at third number as a cause of death after cardiovascular and malignant diseases.[(3)] A number of occupational studies have shown an interconnection between chronic respiratory diseases and exposure to dust, gas or fumes.[(5)] Workers in metallurgical industry, in the developing countries are repeatedly exposed to high concentrations

of dusts and fumes that affect pulmonary function and cause chronic obstructive pulmonary disease (COPD). Occupational dusts and chemicals can cause COPD when the exposure is sufficiently prolonged, such as that experienced in heavy industry or in mining. [4]

Brass ware manufacturing contains many stages done manually which may lead to frequent exposure of an alloy of copper in proportions of 60-70% and 20-30% of zinc. In addition, it may contain metals such as lead, tin, iron, manganese, arsenic, cobalt etc. which are being added intentionally sometimes to improve the quality of the alloy or may be present as impurities. [6], [7]

Figure: - 1: Worker working in the brass factory.

Jamnagar is a hub for brassware production in India. Jamnagar now has a vibrant full-fledged Rs.700 core industry with almost 4,500 units engaged in manufacturing brass-parts, with a product range of as many as10, 000 items. Out of total brass parts produced in India about 70% brass production is contributed from Jamnagar. [8]

Pulmonary function tests use a computerized Spirometer to assess all the parameters of the respiratory functions and give a fair idea about the respiratory health of an individual. Therefore, these changes can be observed even before the disease becomes symptomatic by a detailed assessment of pulmonary function tests parameters such as FEV1, FVC, FEF 25-75% etc. [9,10] The standard normal value roughly ranges from 80 to 120 % of the predicted values. [11]

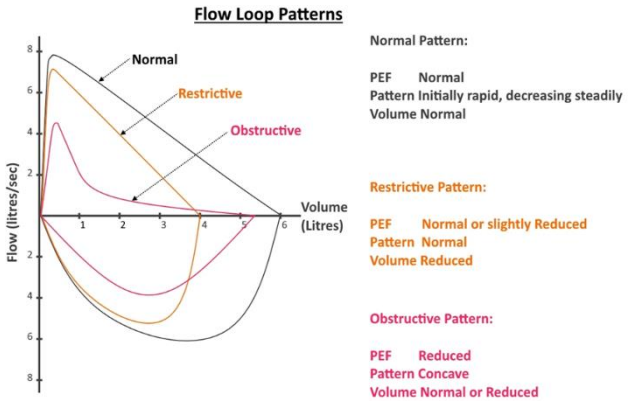

Figure 2: Flow volume loop of obstructive and restrictive disease compare with normal.

Evidences are lacking regarding the lung functions status among Brass Factory workers in Jamnagar. There is a need to find out the dose response of dust & metal fumes exposure on pulmonary functions among workers in brass factory and additionally, to minimize possible health risks for brass factory workers by providing them with information about exposure of metal dust and related hazards and to protect workers of brass factory from disabling respiratory disease. Results of the present study will further help to add on the literature regarding the lung functions and its affection with the duration of exposure of different metals in Brass factory workers.

MATERIALS & METHODS

This cross-sectional study was conducted on 150 Male having 20-60 years of age, with the same socioeconomic condition using the simple convenient sampling. In the **Group A,** 100 subjects were selected from brass factory workers and in **Group B,** 50 normal healthy individuals (non-factory workers) were selected according to inclusion and exclusion criteria.

Criteria for selection:

Inclusion criteria for Group A:

1. Subjects working in brass utensil factory >5 years.
2. Working hours more than 5 hours per day.
3. Age 20 to 60 years.
4. Gender: Male.
5. Able to understand & follow the instructions.

Inclusion criteria for Group B:

1. Normal healthy individual who are willing to participate
2. Age 20 to 60 years
3. Gender: Male
4. Able to understand & follow the instructions.

Exclusion criteria for both the groups:

1. Already have any major respiratory conditions.
2. Smokers.
3. Acute heart disease like MI (Acute chest pain).
4. Subject with chest and spinal deformity.
5. History of recent surgery.
6. Any neurological/musculoskeletal condition

Subject preparation & measurement procedure of PFT:

Study was conducted after taking ethics approval from the institutional ethics Committee. Written informed consent was taken after the explanation of the study motive. Firstly, all the subjects were oriented towards the study and general assessment of all the subjects which included subject's height, weight, age, smoking history & occupation history was taken before performing Pulmonary Function Test. PFT was taken using RMS spirometer HELIOS 702 and windows version XP.

The detailed theoretical explanation of how to perform the test was given to all the subjects. Followed by a practical demonstration given by the model.

Subjects were given enough number of trials till they were clear about the procedure and confident to perform the test. After that three trials were given for each procedure and best trial was selected. Rest of 30 seconds to 1 minute or till the subjects feels comfortable was given between each trial. The trial was considered "unacceptable" if it showed evidence of cough, early termination of expiration or inconsistent effort.

Different parameters of PFT like FEV_1%, FVC%, FEV_1/FVC, $FEF_{25-75\%}$ and PEFR% for both the groups were taken for the analysis and also the machine showed the results in form of printed graphs showing one of the 4 patterns: Normal, obstructive, restrictive or combined.

STATISTICAL ANALYSIS

All statistical analysis was done by online calculator for t test and Microsoft excel. Mean and standard deviation (SD) were

calculated as a measure of central tendency and measure of dispersion respectively. Comparison of FEV1%, FVC%, FEV1/FVC, FEF25-75% and PEFR% between the groups was done using unpaired t test.

RESULT

Mean and standard deviation of age in group A is 36.62 ± 7.76 years and in group B is 34.16 ± 8.76 years. The mean and standard deviation of BMI in group A is 21.08 ± 3.43 kg/m^2 and in group B is 22.79 ± 2.69 kg/m^2.

Table 1: independent t test for comparisons of FEV_1%, FVC%, FEV_1/FVC, $FEF_{25-75\%}$, PEFR% between Group A and Group B

Variable	(MEAN ± SD)		t value	P value	Result
	Group A	Group B			
FEV_1%	89 ± 19.56	109.12 ± 11.87	6.67	<0.05	Significant
FVC%	92.53 ± 19.07	106.14 ± 13.60	4.45		
FEV_1/FVC	79.09 ± 11.52	86.42 ± 5.45	4.256		
$FEF_{25-75\%}$	63.2 ± 20.30	86.5 ± 15.23	7.163		
PEFR%	54.72± 17.6	82.26 ± 11.52	10.205		

The result shows significant difference in FVC%, FEV_1%, FEV_1/FVC, $FEF_{25-75\%}$ and PEFR as the p value is <0.05 between Group A and Group B.

DISCUSSION

The present study was designed to find out the effect of exposure to metal dust on pulmonary functions in brass part factory worker. Pulmonary function test (FVC, FEV_1, FEV_1/FVC, $FEF_{25-75\%}$, PEFR) were taken for both the groups. The baseline of the demographic data did not show significant difference between the subjects in two groups indicating homogeneity of subjects. Result showed that there is significant reduction in pulmonary functions (FVC, FEV_1, FEV_1/FVC, $FEF_{25-75\%}$, PEFR) of Group A when compared with Group B. The changes in the parameters of Pulmonary Function Test in brass factory workers might have been as a result of the exposure to different metal (copper, zinc, lead, tin, iron, manganese, arsenic, cobalt etc.) dust and silica dust, which may have been inhaled through nose and dislodged into the lung. Long-term exposure to fumes, chemical substances and dust in the workplace has been mentioned as risk factors for the development of COPD. Minute particles are formed when molten metals coagulate in air due to temperature gradients outside the furnace. Without proper personal protective equipment (not readily available in developing countries) these particles are easily inhaled and enter into the lungs and reaches the alveoli and gets dislodged, causing bronchial irritation and inflammation of the lung parenchyma particularly in the terminal bronchioles, interstitium and alveoli which have permanent damaging effects on respiratory function. [(4)] This inflammation caused results in granulomas and may progress to fibrosis which in turn may lead to lung diseases after which the person's lungs are no longer able to take enough air required for the functioning of the body, additionally, many people who have a lung disease have air-sacs which are not functioning properly, so the oxygen that a person takes is not fully absorbed in the blood. Long term exposure of these pulmonary pollutants in the working environment could cause the occurrence of interstitial fibrosis and pulmonary nodules, thereby affecting the function of pulmonary ventilation and air exchange, which on investigation shows up as decreased lung function values.

In the present study we found a strong relation between the metal dust exposure and chronic respiratory dysfunction which is supported by Silvana Bala, Afrim Tabaku (2010).

According to Naba Kumar Das, Hiranmoy Mahata, Prakash Chandra Dhara (2017) reduction in the PEFR of bell metal worker might be due to a significant reduction in expiratory capacity suggests obstruction in

smaller airways which is in support of our study. [12]

According to Ege Gulec Balbay, Umran Toru et al. (2014) there was no statistically significant difference between grinding and painting worker's group in security and safety products plant, regarding the expected values of respiratory function, they also found that painting group in lock and key factory workers had more but statistically insignificant respiratory complaints. [13]

In our study we found decline in all parameters of pulmonary function as FEV_1, FVC and FEV_1/FVC ratio especially in FEV_1 in the brass factory employees suggesting pulmonary obstructive abnormalities. Reduction of $FEF_{25-75\%}$ in observational group was also found in the present study indicating small airway obstruction.

CONCLUSION

The study concluded that there is significant reduction in pulmonary Functions FVC%, FEV_1%, FEV_1/FVC, $FEF_{25-75\%}$, PEFR% value in brass ware factory workers when compare to control group.

Clinical Implication

As, there is high chance to develop occupation related chronic respiratory disease due to prolong exposure to metal and silica dust, use of preventive measures should be taught to prevent respiratory hazards

Declaration by Authors

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REFERENCES

1. Sultan A. Meo. Effect Of Exposure to Wood Dust on Peak Expiratory Flow Rate Among Workers in Small Scale Wood Industries. International Journal Of Occupational Medicine and Environmental Health. 2004; 17(4): p. 451-455.
2. Meo S. A. Abdul Azeem, M. M. F. Subhan. Lung function in Pakistani welding workers. Journal of Occupational Environmental Medicine. 2003; 45: p. 1068-73.
3. D. Rothenbacher, V.Arndt, E.Fraisse, et al. Chronic respiratory disease morbidity in construction workers: patterns and prognostic significance for permanent disability and overall mortality. European Respiratory Journal. 1997; 10: p. 1093–1099.
4. Bala Silvana, Afrim Tabaku. Chronic obstructive pulmonary disease in iron-steel and ferrochrome industry workers. Cent European Journal Public Health. 2010; 18(2) p. 18: 93-98.
5. Costello J, Robert M. Castellan, Gary S. et. al. Mortality of a cohort of US workers employed in the crushed stone industry 1940–1980. American Journal of Industrial Medicine. 1995; 27: p. 625–640.
6. P. L. Jayawardana, W. R. de Alwis, M. A. Fernando. Ventilatory function in brass workers of Gadaladeniya. occupational medicine 1997; 47(7) p. 411-416.
7. Sharada Srinivasan, S. Ranganathan, A. Giumlia-Mair Ethnoarchaeological and archaeometallurgical insights. In S. S. Bronze image casting in Tanjavur District. National Institute of Advanced Studies, Bangalore. 2015; p. 209-216.
8. Khirasariya DV. A study of practices working prblems and performance of Brass parts industries with reference to Jamnagar District. Saurashtra University. 2010 August; 3: p. 1-257.
9. Pravati Pal, John RA, Dutta TK, Pal GK. Pulmonary Function Test in Traffic Police Personnel in Pondicherry. Indian Journal Physiol Pharmacol. 2010; 54(4): p. 329-336.
10. Kumar D, Puri R, Sinha N, et.al. Peak expiratory flow rate assessment in obese and non – obese subjects in western Uttar Pradesh. IJRRMS. 2013; 3(3): p. 9-12.
11. Cohen Z. Pulmonary Function testing. In Robert M. Kacmarek JK Saj. EGAN'S Fundamentals of Respiratory care. Elsevier; 2017. p. 400-427.
12. Naba Kumar Das, H. Mahata, Prakash Chandra Dhara. Evaluation of Pulmonary Capacity and Prevalence of Pulmonary Dysfunctions of Bell Metal Workers in Relation to their work Experience and Smoking Habit. International Journal Life

Science Scientific Research 2017 July; 3(4): p. 1181-1189.

13. Ege Gulec Balbay, Umran Toru, Peri Arbak, Oner Balbay, et.al. Respiratory symptoms and pulmonary function testes in security and safety products plant workers. International Journal of Clinical Exp Med. 2014 july 30; 7(7): p. 1883-1886.

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