Original Research Article

Study of effect of cement dust on lung function in cement factory workers

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Abstract

Background: Normal function of lungs is an important aspect of healthy life which is neglected by many peoples. Chronic exposure to cement dust has long been associated with the prevalence of respiratory problems and airway obstruction in workers. The present study was carried out to investigate the effect of cement dust exposure on lung functions of cement factory workers in North Maharashtra region. The aim of the study was to study the lung functions in factory workers and to increase the awareness about occupational hazards of cement dust. **Method and Materials:** After obtaining Ethical committee clearance this cross-sectional study was done among 120 workers of cement factory compared with 90 controls and their respiratory functions were assessed with help of spirometry. **Results:** Overall prevalence of respiratory symptoms and abnormal spirometry parameters among study group was statistically significant when compared with control group. Spirometry tests of 120 workers of cement factory compared with control group of 90 subjects. Exposure to high concentration of Portland cement dust in a cement factory is an occupational hazard with decreased ventilatory lung function of the workers.
Key Word: Cement dust, Occupational hazard, Lung function test

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INTRODUCTION

In today's era we are living in cement jungle. In developing countries like India a lot of construction is going on continuously. For that purpose there are huge numbers of cement factories started in our country. Cement industry is one of the largest manufacturing industries and its workers are exposed to dust at various manufacturing and production processes.[1] Several clinical and epidemiological studies have shown an increased incidence of impairment of respiratory and the prevalence of respiratory symptoms among cement production workers.[2, 3, 4] Occupational exposure includes Portland cement whose constituents are calcium oxide, silicon oxide, aluminum oxide, ferric oxide, magnesium oxide and other impurities.[5] Portland cement is produced on large scale which will come in contact with the workers continuously through breathing. The aerodynamic diameter of cement particle ranges from 0.05 to 5 µm which is within the respirable extent.[6] Cement Particles are very small particles which are inhaled and are trapped in lungs. It causes respiratory tree irritation, mucus hyper secretion initially followed by impairment in lung function, lung inflammation and chronic obstructive lung disease. Also the increased lung dysfunction is reported in several studies of various Cement factory workers of different countries. In developed countries preventive measures are followed but in developing countries scenarios are different. As cement factory workers are considered larger workforce in unorganized sector of our country, our aim is to study risk assessment of respiratory functions among cement factory workers occupationally exposed to dusty environment.

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MATERIALS AND METHODS

Data collection in this cross-sectional study was conducted from one of the local cement factory. The study sample including 120 male workers exposed to Portland cement dust were selected. Similarly, 90 males were selected as controls from the area at least 5 kms from the factory and those who were not exposed to cement dust in the past. They were matched with the exposed population for age, socio economic status and were nonsmokers. Both groups were volunteer subjects. All of the participants were signed an informed consent form prior to the commencement of the study. The study was reviewed and approved by Ethics Committee of our institute.

Inclusion criteria- cement factory workers
(Exposed subjects) include:
1. Male workers with age group of 18–50 yrs.
2. Male workers working for at least three years at cement factory

Exclusion criteria of workers (exposed subjects) include:
1. Subjects less than 18 yrs of age and greater than 50 yrs.
2. Workers with less than 3 years work experience.
3. Those suffering from chronic lung diseases or musculoskeletal disease.
4. Workers who are exposed to smoke while at home.
5. Smokers.

Procedure and Instruments:

All the participants had undergone routine general examination (pulse, BP, respiratory rate, pallor, cyanosis, clubbing), anthropometric measurements which includes height, weight, chest circumference, inform consent was taken from all the participants.

Lung function test

Spirometry was performed by using an electronic spirometer (Compact Vitalograph, UK). All respiratory function tests were carried out at a fixed time of the day to minimize the diurnal variation.[4] Spirometry were performed with the worker in standing position using a portable calibrated Vitalogrph spirometer (Compact Vitalograph, UK) according to the American Thoracic Society recommendation for acceptability and reproducibility.[7] The apparatus was calibrated daily and operated within the ambient temperature range of 20–25°C. Three reproducible tracings were obtained after adequate rest of 5 minutes to avoid the exertion. The best of the three spirogram reading was selected. The mean percentage of predicted values was based on age, weight, standing height and sex. Lung function tests were performed with the assistance of a trained, skilled technician under supervision. In this study the ventilatory function tests including Forced Vital Capacity (FVC), Forced Expiratory Volume in First Second (FEV1), Peak Expiratory Flow Rate (PEF), Forced Expiratory Flow (FEF25–75%) and Maximum Voluntary Ventilation (MVV) were measured. Results were interpreted with the predicted values of lung function parameters calculated by reference equation for Indian population.

RESULTS

The present study was done in 210 participants of which 120 were in study group and 90 were control. (Study group- n=120, Control group n=90).For the parameters to be studied the mean value and standard deviation (SD) were calculated in study group. 'Unpaired t test' was applied to test whether the differences in means were statistically significant or not. P-value less than 0.05 ($P < 0.05$) was considered to be statistically significant. P-value of less than 0.001 ($P < 0.001$) was considered to be statistically highly significant. The results of the present study are as follows. The Mean age of participants of study group is 36.2+5.4 and that of control group 35.8+6.4. The Mean weight of participants of study group is 58.53+4.4 and their mean height is 163.6+ 3.5.The Mean weight participants of control group is 60.25+2.18 and their mean height is 164.5 + 4.31. Table A: It shows the prevalence of various respiratory symptoms in study and control group. Respiratory symptoms were more common among the study group as compared to control group. Overall prevalence of respiratory symptoms among study group was more. It was statistically significant when compared with control group. Table B: All the parameters of Pulmonary Function Test such as FVC, FEV1, PEF, FEF25–75% and MVV showed highly significant reduction as compared to control groups. The values of PFT in study and control group were FVC: 3.11 ± 0.23; 4.28 ± 0.11 FEV1: 2.61 ± 0.26; 3.24 ± 0.12 PEF: 290.7 ± 34.11; 353.8 ± 33.42 FEF25–75%: 2.72 ± 0.35; 3.21 ± 0.32 and MVV: 98.10 ± 8.57; 121.60 ± 4.56 respectively. Statistically they were significant ($p < 0.05$).

Table 1: prevalence of respiratory symptoms in study and control group

Respiratory symptoms	Study Group (n=120)	Control Group (n=90)
Breathlessness	41 (34.17%)	03 (2.5%)
Cough	35 (29.17%)	06 (5 %)
Sore throat	18 (15%)	04 (3.33%)
Wheeze	23 (19.17%)	00
Haemoptosis	03 (2.5%)	00

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Table 2: Anthropometric and Lung Function Data for Cement Mill Workers with Exposure to Dust Compared with Their Matched Controls.

Parameters	Cement mill Workers(Mean ± SD) [n120]	Control subjects(Mean ± SD) [n=90]	t value	p Value	Significance
Age (years)	36.2±5.4	35.8 ± 6.4	0.15	0.880	Not Significant
Height (cm)	163.6± 3.5	164.5 ± 4.31	0.51	0.609	Not Significant
Weight (kg)	58.53 ± 4.4	60.25 ± 2.18	1.11	0.269	Not Significant
FVC (litres)	3.11 ± 0.23	4.28 ± 0.11	14.51	0.000**	Highly Significant
FEV1 (litres)	2.61 ± 0.26	3.24 ± 0.12	6.96	0.000**	Highly Significant
PEF (litres/min)	290.7 ± 34.11	353.8 ± 33.42	4.18	0.001*	Significant
FEF25–75% (litres/s)	2.72 ± 0.35	3.21 ± 0.32	3.27	0.001*	Significant
MVV (litres/min)	98.10 ± 8.57	121.60 ± 4.56	7.66	0.000**	Highly Significant

Values are presented as Mean ± Standard Deviation; NS = non-significant. S= Significant; HS= Highly Significant. P < 0.05*:- Statistically significant. P< 0.001**– Statistically highly significant.

DISCUSSION

Due to uncontrolled urbanization the air quality has drastically changed. Also the demand of construction material like cement is increased not only in urban area but also in rural areas. Occupational and environmental exposure to dust and their effects on human health is a leading respiratory health problem. Although, smoking is considered the most important predisposing factor in development of emphysema; environmental exposures also play an important role. Exposure to cement dust can cause various acute and chronic respiratory diseases including respiratory function impairment. Cement factory workers were exposed to dust at various manufacturing and production process such as quarrying, handling, grinding, shifting, packing and transportation. Physiologically, only particles less than 5µm or PM 5 (also termed Particulate Matter or fine dust) are known to be inhaled into the smaller bronchioles, thus affecting the ventilatory lung function and also responsible for the prevalence of respiratory symptoms.[8] In the current study FVC, FEV1, PEF, FEF25-75% and MVV values showed highly significant reduction as compare to control groups. The significant decrease in these values is suggestive of obstructive type of changes in lung functions. Continuous exposure to dusty environment leads to inflammatory changes in small airways as well as in lung parenchyma leading to development of obstructive type of lung dysfunction. These obstructive types of changes among study group can be correlated with the duration of exposure to dusty environment at the work site, as majority of the subjects in study group were occupationally exposed to PMs for 3 to 8 years on an average. Also the prevalence of respiratory symptoms was more among the study group than the control group which can be explained on the same basis. The present study found a duration response effect and shows that long term exposure to cement dust prominently decreased the pulmonary function. Since major determinants of lung functions, age, height and weight, showed insignificant difference with the control population (constant variables), these reductions in lung functions suggest that there is indeed an association between exposure to cement dust and the lung function of the factory workers. Ulvestad et al[9] conducted a study to find out association between dust exposure and airway inflammation and found lower airway inflammation even though they worked for only 1 year. The results of the present study also showed a decreased FEV1 which is similar with the observations made by these researchers. Similarly to our findings, Zeleke ZK[10] studied the effect of cement dust exposure on 127 cement factory workers with chronic exposure to cement dust on lung function. They found that pulmonary function test parameters were significantly lower in cement factory workers than in control subjects. Their results suggest that chronic cement dust exposure impairs lung function. Concurrently, Zelke et al found that FVC, FEV1 were significantly reduced among the cement production workers but not among the controls. The reduction in lung function was probably associated with high cement dust exposure. The FEV1 and FEV1% were also lower compared to predicted values by Singh *et al.*[11] These findings differ from a few observations elsewhere. Rasmussen *et al*[12] found no differences in the spirometric measurements of Danish workers and other blue collar workers. Abu Dhaise *et al* [13] found that inhalation of cement dust did not markedly affect the lung function in Jordan cement workers. Thus to conclude, it can be said that, as there is intense diversity regarding lung function and its correlation with occupational hazards, this study was an attempt to establish a relationship between exposure to cement dust and lung function.

SUMMARY AND CONCLUSION

Occupational exposures to airborne cement dust were generally higher in the Portland cement manufacture

process. The present study adds evidence that cement dust adversely affects the respiratory functions. It showed not only the prevalence of symptoms more in exposed workers than controls but also significant decrease in lung function. It also suggests the cement factory workers were exposed to the dust in the environment, with minimum or no protective equipments. Hence, there is an urgent need to improve the working conditions. Health education should be given regarding the personal protection measures. Keeping in view the hazards of cement dust it is advisable, workers should work in well ventilated work areas. Workers should wear appropriate apparel, mask, safety goggles, gloves, ear plugs and gum boot. It is also important that cement mill workers must undergo pre-employment and periodic medical screening test. These measures would help to identify susceptible workers in due time and improve the technical preventive measures that will decrease the risk of occupational hazards in the cement industry workers.

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