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EFFECTS OF CEMENT DUST ON PULMONARY FUNCTION TEST PARAMETERS

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ABSTRACT

Cement is one of the most important building materials in the world Cement mill workers are exposed to dust during various manufacturing and production processes, such as quarrying and handling of raw materials, during grinding the clinker, blending, packing and shipping of the finished products. The aerodynamic diameter of cement particles range from 0.05 to 5.0 μm. These particles are respirable in size, hence Portland cement is important as a potential cause of occupational lung disease .The present study concentrated on pulmonary function test parameters of worker working in cement factories of south India. present study conducted in cement factory workers in south India cement factories who exposed to cement dust and normal individuals who are not exposed to cement dust. The pulmonary function test parameters were performed in individuals. In present study we measured the pulmonary function test parameters in 200 workers occupationally exposed to cement dust and 200 matched unexposed controls. The FCV, FEV_1, $FEV_{25-75\%}$, FEV_1/FVC and PEF are shown significance different between exposed and non-exposed individuals to cement dust. The present results confirmed that pulmonary function values changed significantly between exposed and non-exposed individuals to cement dust.

INTRODUCTION

Cement production is invariably a dusty operation resulting in the exposure of factory workers to cement dust. Although protective gears should be worn, reports from third world countries indicate that industries rarely provide precautionary measures [1]. The resulting exposure to cement dust has led to impairment of respiration and a prevalence of respiratory symptoms amongst workers culminating in what has been described as a "Cement factory lung disease" [2]. The severity of the impairment of respiratory function has been shown to depend on years of exposure [3].

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These reports suggest that cement dust exposure may neither increase the morbidity of respiratory diseases nor be associated with the prevalence of respiratory symptoms among workers [4]. In the present study, parameters used to assess respiratory function in these studies include vital capacity, FEV1 (Forced expiratory volume in 1 second) FEV1% (Forced expiratory volume in 1 second as a percentage of forced vital capacity), and PEFR (Peak expiratory flow rate).

Work-related disorders are the major cause for complaints and disability in worker populations. The main problem encountered in the environment is the respirable dust (<10 μm). When fine dust enters the respiratory system, the human body considers it to be foreign material which should be defended against. Exposure to ambient particulate air pollution is associated with increase in

morbidity and mortality from respiratory and cardiovascular diseases. Individuals working in dusty environment face the risk of inhaling particulate materials that may lead to adverse respiratory effects. All construction sites generate high level of dust typically from concrete, silica, asbestos, cement, wood, stone, sand and the workers are exposed to this airborne dust. Dust and cement particles which are inhaled are lodged in the lung and causes lung irritation, mucus hypersecretion initially, followed by lung function impairment, lung inflammation chronic obstructive lung disease, restrictive lung disease and pneumoconiosis and so on[5,6,7,8].

Cement industry is one of the largest manufacturing industries and its workers are exposed to dust at various manufacturing and production processes. Portland cement dust is a mixture of calcium oxide, silicon oxide, aluminum tri oxide, ferric oxide, magnesium oxide, sand and other impurities. The aerodynamic diameter of cement dust particles is within the respirable extent, consequently occupational exposure to cement dust can cause numerous health hazards including the onset of acute or chronic respiratory diseases and respiratory function deficits [9, 10].

Workers who work in the dusty production operation such as ore crushing and raw milling have high occupational exposure to total dust (59-95 mg/m3) and respirable dust (20- 23 mg/m3) [11]. In a previous study reported that in the cement production process the aerodynamic diameter range is 0.05- 5.0 μm, which is produced by hearing ground cement rock or other limestone-bearing materials into a fused clinker that, is then ground into a fine powder [12]. Several clinical and epidemiological studies have shown an increased incidence of impairment of respiratory and a prevalence of respiratory symptoms among cement production workers [13]. Regarding potential adverse effects on the respiratory system also Portland cement dust is considered to have little potential to induce adverse effects on the lung such as pneumoconiosis or fibrosis [14].

However, in study of Mwaiselage et al. showed a significant relationship between cumulative cement dust exposure and reduction of FVC and FEV1, in the same study explained that association between developing chronic obstructive pulmonary disease and exposure to cement dust for more than 10 years at 10 mg/m3 is well documented [15]. In some previous studies stated that the main hazard in Portland cement production is dust, and respiratory tract disorders are the most important group of occupational diseases in this industry, evidence for associations between exposure to cement dust and either respiratory symptoms or functional impairment has not been conclusive[16, 17,18].The present study is concentrated on the effect of pulmonary function tests in cement dust exposed worker in cement factories in south Indian region.

MATERIAL AND METHODS

200 normal individuals are served as controls in same region who they have not exposed to cement dust, 200 subjects are selected from who they are working in different cement factories located in south Indian region . The parameters such as age, weight, height and years of exposer, the pulmonary function test parameters included like FCV, FEV_1, $FEV_{25-75\%}$, FEV_1/FVC and PEF.

Statistical Analysis

Statistical analysis was done by using SPSS software. Comparison of demographic data among exposed and non exposed groups calculated using Student's t-test, one-way variance analysis for continuous variables. $p< 0.05$ was considered statistically significant.

RESULTS

The average age of normal individuals was 37.1±0.8 and exposed were 35.6±2.2, the mean weight was 63.4±2.7 kg and in exposed subjects it was 67.5±3.3kg, the mean height of controls was 171.6±1.7cm and 171.2±1.2cm in exposed subjects and average years of exposer in cement factory workers to cement dust was 12.2±2.6 years. The FVC of unexposed to cement dust was 78.12±12.43 and exposed to cement dust was 85.42±15.42 with significance difference($P<0.05$). The FEV_1 of unexposed to cement dust was 83.11±16.93 and exposed to cement dust was 87.34±17.35 with significance difference($P<0.05$). The $FEF_{25-75\%}$ of unexposed to cement dust was 103.94±41.53 and exposed to cement dust was 107.98±35.47 with significance difference($P<0.05$). The FEV_1/ FVC of unexposed to cement dust was 107.37±6.42 and exposed to cement dust was 110.37±12.09 with significance difference($P<0.05$). The PEF of unexposed to cement dust was 91.23±11.33 and exposed to cement dust was 86.46±16.62 with significance difference($P<0.05$).

DISCUSSION

In present study the pulmonary function tests FCV, FEV_1, $FEV_{25-75\%}$, FEV_1/FVC and PEF are shown significance difference. Occupational and environmental exposure to cement dust and their effects on human health is a leading respiratory health problem. Exposure to cement dust can cause various acute and chronic respiratory diseases including respiratory function impairment. In study of Sultan Ayoub Meo etal found a duration response effect and shows that long term exposure to cement dust prominently decreased the pulmonary function. Cement factory workers with duration of exposure greater than 10 years showed a significant reduction in FVC, FEV1, PEF and MVV relative to their matched controls, this results are in agreement with our study. In study of Shamssain and Thompson [20] reported that the mean values for FVC and FEV1 were not significantly decreased in cement mill workers.

They also did not show a significant relationship between the length of exposure in cement industry and lung function parameters. In study of Al-Neaimi et al. [21] demonstrated that the pulmonary function tests FVC, FEV1, PEF were significantly lower in the cement factory workers compared with unexposed subjects. In study of Meo et al. [22] show in significant reduction in parameters of FVC, FEV1, PEF and MVV in cement mill workers compared with controls. In study of Mwaiselage et al. [23] pulmonary function tests in cement factory workers and reported that exposed workers had significantly lower FVC, FEV1, and PEF than controls. in study of Zelke et al. [24] found that FVC, FEV1 were significantly reduced. In study of Merenu et al. [25] investigations found that the vital capacity and forced expiratory volume in one second were significantly lower in cement factory workers than in unexposed people. In study of El Badari and Saeed [26] reported a significant reduction in FVC, FEV1 and PEFR in cement dust exposed workers compared to control. In study of Fell et al. [27] found that the mean pulmonary function indices were similar for cement factory workers and control group. There was no duration-response-related decrease in lung function indices. In study of Alakija et al. [28] reported that cement factory workers had a consistent decline in FVC, FEV1 and PEF with prolonged years of service in the cement industry. They also reported that workers who had less than five years of occupational exposure to the cement dust had a significantly higher FVC, FEV1 and PEF than the workers who had more than 15 years of exposure, our present study results in agreement with this Alakija study. In our study pulmonary function tests were found significant reduced in cement dust exposed workers that non-exposed controls, the previous studies also confirming the same results of present study.

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CONFLICT OF INTEREST:

The authors declare that they have no conflict of interest.

STATEMENT OF HUMAN AND ANIMAL RIGHTS

All procedures performed in human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

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