
Cement dust exposure and Pulmonary function tests in construction site workers

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ABSTRACT

Background: Construction site workers are frequently exposed to and inhale dust and cement particles that cause a variety of respiratory disorders and impaired lung function tests. These particles once inhaled, lodge in the respiratory tract and even gain entry into the lung tissue depending on the size of the particle. These particles produce a series of inflammatory reactions in the mucus membrane causing severe symptoms. Lung function tests are performed to detect any change in the parameters. **Objective:** The present study was undertaken to see the degree of decline of lung function tests among workers at construction sites and compare with those working in cleaner environments. **Materials and Methods:** 160 individuals were inducted into the study of which 60 were construction site workers and 100 were normal healthy individuals working in cleaner environments. Lung function tests using Spiro Win Spirometer were formed to detect any change in lung function parameters. Forced vital capacity, Forced expiratory volume in one sec and maximum voluntary ventilation were assessed using spirometer. Results: The BMI of construction site workers was less when compared to the subjects working in cleaner environments. Performance on Pulmonary function tests was poor in construction site workers compared to healthy controls. When age, sex and BMI were adjusted for the 2 groups, workers group shows a decrease in lung function tests though not statistically significant ($p > 0.05$). **Conclusion:** Inhaled dust particles cause reactions in mucus membrane, blocking the respiratory tracts leading to poor performance on lung function tests. Conclusion: Construction site workers should undergo pulmonary function tests from time to time to detect any changes so as to provide early treatment interventions.

Key words: Cement dust, Construction site, Lung function tests

Introduction

Individuals working in construction sites are exposed to dusty environment and are at risk of inhaling particulate matter which has adverse effects on respiratory system. [1] Workers at construction sites are exposed to airborne dust generated from silica, concrete, asbestos, cement, wood, stone and sand. [2] Exposure to cement dust at construction site leads to a

variety of respiratory diseases with impaired lung functions. The diameter of cement dust particles is within respirable limit. Dust particles of $< 10\mu\text{m}$ pose a health hazard to such workers as it easily gains entry into the lower respiratory tract leading to disability among worker. Lung function tests are performed to detect any such lung function derangement. Measurements with spirometry are of vital importance in diagnosing lung disorders. It is evident that lung functions are affected by certain factors like occupation or profession and environment apart from several other anthropometric variables. Continued exposure to dust particles at such sites accelerates the decline in lung functions. Studies have shown that there is a relation between exposure to cement dust and changes in lung functions. [3,4] The present study was undertaken to see the degree of decline of lung function tests among

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workers at construction sites and compare with those working in cleaner environments.

Material and Methods

A total of 160 subjects were selected for the study and were divided into two groups, group I with 60 individuals who were construction site workers and group II consisted of 100 individuals who were working in cleaner environments and both groups were between the ages of 25-75 years. Since working environment was considered the primary criteria for selection of individuals for the study, subjects were not separated based on gender to see the difference. Hence, all subjects, both male and female were grouped together. Subjects with history of smoking, respiratory infections, bronchial asthma, chest deformities, those

using bronchodilators, those with previous diagnosis of lung disease and those on anti tuberculosis therapy presently or in the recent past were excluded from the study. Anthropometric variables like height (using a Stadiometer) and weight (weighing scale) of the individuals were measured. Lung function tests were performed using Spiro Win computerised spirometer. The subjects were made to sit quietly and readings were taken in sitting posture. The test was conducted and repeated with rest in between. The parameters measured were FEV1, FEV1/FVC%, forced expiratory flow (FEF 25%-75%) and maximum voluntary ventilation (MVV). The results were expressed as mean and SD and percentages. The data was analysed for p value to know the significance. An informed consent was taken from all the subjects and the institute ethics committee permission was obtained.

Results

Mean age of construction site workers was 36 years +/- 8.6 and that of controls is 39.4 +/- 12.9 years.

Table 1: Anthropometric parameters of controls and cases (Male and Female subjects)

Groups	N	Age (years)	Height (cm)	Weight (kg)	BMI
Controls	100	39.38 ± 12.45	162.15 ± 8.92	59.43 ± 12.11	22.67 ± 24.8
Construction site workers	60	36.47 ± 8.63	157.4 ± 7.04	53.23 ± 9.19	21.54 ± 22.45

The mean height and weight of controls was higher than cases. The BMI of both cases and controls was within normal healthy range and the BMI of controls was higher than.

Table 2: Age matched anthropometric parameters among males (controls and cases)

Age groups	Age		Height		Weight		BMI	
	Controls	Cases	Controls	Cases	Controls	Cases	Controls	Cases
21- 30	28.29 ± 1.57	27.63 ± 1.82	166.53±9.15	156.69±6.03	58.29 ±7.78	49.06 ±5.82	21.12 ±26.73	19.99 ±21.74
31- 40	33.62 ± 2.36	34.89 ± 2.64	170.92±9.15	159±7.62	62.23 ±15.74	53.71 ±7.78	21.31 ±31.15	21.35 ± 22.78
41- 50	46.13 ± 2.17	45 ± 3.82	165.5±6.87	156.91±7.25	78.75 ±10.15	56.27 ±13.3	28.94 ±32.02	22.73 ±23.61
51- 60	55.83 ± 3.55	53 ± 2	166.83±9.47	152.25±3.69	58 ±5.83	52.75 ±8.42	21.08 ±21.09	22.82 ±22.68
61- 70	64 ± 1.73	67	164±1.73	157.52±7.03	58.67 ±6.35	46	21.8 ±22.35	18.66

When the parameters of sex, height, weight and BMI were matched for controls and cases, it was seen that for each age group the parameters were on the healthier side for controls when compared to cases though $p > 0.05$.

Table 3: Parameters measured by Spirometer in the 2 groups

Mean	Construction workers	Controls	P value
FVC	84.81+/-18.25	87.23+/-21.4	0.4660
FEV1	86.91+/-16.6	90.62+/-23.02	0.2776
FEV1/FVC%	109.18+/-6.94	107.47+/-8.79	0.2006
FEF 25%-75%	79.07+/-29	79.46+/-23.5	0.9261
MVV	70.64+/-22.04	72.41+/-20.8	0.6111

The lung function test parameters of controls were better than construction site workers though they were not statistically significant

Table 4: A correlation of BMI with lung function parameters

	BMI	FVC	FEV1	FEV1%	Mid flow	MVV
Controls	22.84 ± 22.63	87.23+/- 21.4	90.62+/- 23.02	107.47+/-8.79	79.46+/- 23.5	72.41+/- 20.8
Cases	21.54 ± 20.56	84.81+/- 18.25	86.91+/-16.6	109.18+/-6.94	79.07+/-29	70.64+/- 22.04

The controls having better BMI also performed better in most of lung function test.

Discussion

In the present study a comparison between the anthropometric parameters of controls living or working in clean environment and those working at construction sites was done. The mean height and weight of controls was found to be higher than cases. The BMI of both cases and controls was within normal healthy range. However, the BMI of controls was higher than cases indicating that the controls belonged to more affluent families and had better nutritious food intake. Individuals grouped under cases were manual labourers working at construction sites and belonged to low income group with probably less nutrition available in the diet that is responsible for overall decrease in the values of height, weight and hence BMI. However, some studies show that in obese subjects there is a significant negative correlation between BMI and lung function parameters though this correlation is absent in non-obese individuals.[5] In the present study, the range of BMI for both cases and controls was within normal range and controls being disease free performed better in lung function tests. Also, when the parameters were matched for age, the mean values for height, weight and also BMI were on the healthier side for controls. The present study shows a decline in lung functions in construction site workers when compared to healthy controls working in cleaner environments. Several studies have shown the association between inhalation of cement dust and

impairment of lung function tests. [6-10] Forced Vital Capacity (FVC) and Forced expiratory volume in one sec (FEV1) are the lung parameters of choice for measuring any respiratory disability. FVC is a measure of volume rather than rate. Measurements of FVC combined with FEV1 are more authentic in diagnosing respiratory insufficiencies. FVC and FEV1 declines with age as a part of normal aging process but an enhanced or accelerated decline occurs in lung disorders of which one reason is occupational exposure to dust particles. The findings in our study correlate with those of previous study where there is decline in the FEV1 on exposure to dust and cement particulate matter that leads to altered airway patency as a part of occupational exposure. [11,12] Inhaled cement and dust particles at construction sites, gain entry into lungs, get lodged and cause lung irritation, mucus hypersecretion, inflammation of lung parenchyma which lead to decreased lung function predisposing to chronic obstructive and restrictive lung diseases as well as pneumoconiosis. [7,13-16] Cement dust on deposition in the respiratory tract causes increased pH irritating the mucus membranes also. [17]

Conclusion and recommendations

The limitations of the present study are its small sample size and sample being selected from a single site of construction. Lung function tests performed on a

larger sample and from various sites of construction might give a more generalised picture of lung function parameters among this group of individuals. Construction site workers are exposed to a variety of respirable dust particles which lodge and cause inflammatory reaction in the mucus membranes of the respiratory tract and lead to poor performance on lung function tests. Hence, construction site workers may be subjected to screening tests by spirometer from time to time to detect any lung function disorders at an early stage so that interventions for effective treatment of the disease may be undertaken.

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