Original Research Article

A Study on Pulmonary Function Test among construction Workers

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Abstract

Introduction: The lungs are the only vital organ in direct contact with the external environment. Its function is to provide oxygen to the blood and remove carbon dioxide. The air passes through the trachea, bronchi and bronchioles and then finally reaches the alveoli. The occupation related lung diseases are more likely due to the deposition of dust in lungs and period of exposure, concentration and size of the airborne dust particles in the breathing zone. **Methodology:** This cross-sectional study was done among 120 construction workers compared with 60 controls to assess the respiratory illness, lung functions.This cross-sectional study was done at Construction sites in and around the area of Tertiary care teaching College and Hospital, and approved by institutional ethical committee. The present study was done in 120 participants (study group n = 60, Control group n = 60) selected by simple random technique.**Results:** The present study was done in 120 participants (study group-n=60, Control group n= 65). In our study, the most of workers age group is 18-30 years i.e., 37 out of 60 and in control group 18-30 years i.e., 39 out of 60. In study group out of 60, 42 subjects were male and 18 were female subjects. In control group 43 were male and 17 were female subjects. The Mean age of participants of study group is 33.7±7.14 and that of control group 36.23±5.2. The Mean weight of participants of study group is 57.2±08 and their mean height is 154±6.2. The Mean weight participants of control group is 59±8.1 and their mean height is 159.4±4.6. All the parameters of Pulmonary Function Test were significantly decreased ($p < 0.0001$) in study group as compare to control group. The prevalence of various respiratory symptoms in study and control group. Respiratory symptoms were more common among the study group as compare to control group. Overall prevalence of respiratory symptoms among study group more which is statistically significant when compared with control group.**Conclusion:** The present study adds evidence that cement dust adversely affects the respiratory functions and this impairment is association with duration of exposure to cement dust. Thus, this study showed existing changes in pulmonary function related to dust exposure, and generated evidence to integrate primary prevention methods towards dust- related morbidity and mortality.

Keywords: PEFR, FEV1/FVC, MVV, construction Workers.

Introduction

The lungs are the only vital organ in direct contact with the external environment. Its function is to provide oxygen to the blood and remove carbon dioxide. The air passes through the trachea, bronchi and bronchioles and then finally reaches the alveoli. The most important function of the respiratory passageways is to keep them patent to allow easy passage of the air, to and from the alveoli. [1] The entire surface of the respiratory passage from nose to terminal bronchiole is lined with ciliated epithelium. These cilia beat continuously at a rate of 10 - 20 times per second, the power stroke is always upwards, but in nose it beats downwards. [2]

The occupation related dust particles are either swallowed or coughed to the exterior, but the smaller particles between 1 - 5 μm settle down in the smaller bronchioles as a result of gravitational precipitation. Smaller dust particles than 1 μm in diameter diffuses in the wall of the alveoli and adhere to alveolar fluid. Many of these particles that become entrapped in the alveoli are removed by alveolar macrophages, and others are carried away by lymphatic drainage. [3] Dust particles which are inhaled and lodged in the lung irritate and set up an inflammatory reaction. Healing of this inflammation causes fibrosis leading to defective oxygen diffusion and impaired lung function. Exposure to ambient particulate, air pollution is associated with increase in morbidity and mortality from respiratory and cardiovascular diseases. [4]The occupation related lung diseases are more likely due to the deposition of dust in lungs and period of exposure, concentration and size of the airborne dust particles in the breathing zone. [5] Respiratory diseases caused by exposure to mineral dust persist in both developed and developing countries despite substantial knowledge about means of their prevention. Workers subjected to exposure may be engaged in mineral extraction refinery, quarry tunneling or construction. Decrease in pulmonary function has been reported in construction workers. [6] Cement dust initially causes mucus hyper secretion followed by lung function impairment, chronic obstructive lung disease, restrictive lung disease, pneumoconiosis etc. [10]

In occupational respiratory diseases, spirometer is one of the most important diagnostic tools which plays a significant role in the diagnosis and prognosis of these diseases and describes the effect of restriction or obstruction on lung function. [11] Pulmonary function is influenced by many factors like sex, age, height, weight, environment and ethnicity. The severity of the impairment of pulmonary function has been shown to depend on years of exposure. [12] The aim of study was to assess the effect of construction site dust exposure on lung function of workers in construction field with

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comparison to their age matched persons and also to see the effects of long duration exposure of dust on pulmonary function test.

Methodology: This cross-sectional study was done among 120 construction workers compared with 60 controls to assess the respiratory illness, lung functions.

This cross-sectional study was done at Construction sites in and around the area of Tertiary care teaching College and Hospital, and approved by institutional ethical committee. The present study was done in 120 participants (study group n = 60, Control group n = 60) selected by simple random technique.

Data collection - Subjects were selected on the basis of the results of a preliminary questionnaire specifically designed for this study. Subject from the control group were selected from the general population not directly exposed to the dusty environment.

Selection criteria - Construction workers occupationally exposed to the polluted environment were randomly selected on the basis of inclusion and exclusion criteria.

Inclusion criteria - Construction workers (exposed subjects) include:

1. Male or female workers with age group of 18–60 yrs.
2. Male or female workers working for at least one year at construction site.

Exclusion criteria of workers (exposed subjects) include:

1. Subjects less than 18 yrs of age and greater than 60 yrs.
2. Workers with less than six months work experience.
3. Those suffering from chronic lung diseases.
4. 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.

Questionnaire: The participants were interviewed using the "Respiratory surveillance questionnaire by OHF (March 2013)". Clinical examination for respiratory health was done and the symptoms for respiratory illness were recorded in the questionnaire for every individual who participates in this study.

Lung function tests FEV1 (Forced Expiratory Volume in 1 second), PEFR (Peak Expiratory Flow Rate) and FVC (Forced Vital Capacity) for pulmonary impairment of each subject (study group and control group) was performed using a Spiro meter (RMS-HELIOS 702) by following standard protocols.

Results

The present study was done in 120 participants (study group-n=60, Control group n= 65). In our study, the most of workers age group is 18-30 years i.e., 37 out of 60, followed by 31-40 years, i.e., 21 out of 60 in study group and in control group 18-30 years i.e., 39 out of 60, followed by 31-40 years, i.e., 20 out of 60.

Table 1: Distribution of different age groups of patients

Age in years	Study Group	Control Group
18-30	37	39
31-40	21	20
41-60	2	1
Total	60	60

Table 2: Distribution of gender

Gender	Study Group	Control Group
Male	42	43
Female	18	17
Total	60	60

In table 2, in study group out of 60, 42 subjects were male and 18 were female subjects. In control group 43 were male and 17 were female subjects

Table 3: Anthropometric measurements of Construction workers

Variables	Study group	Control group
Age (years)	33.7±7.14	36.23±5.2
Height	154±6.2	159.4±4.6
Weight (kg)	57.2±08	59±8.1
Working hours	8.10±0.37	

The Mean age of participants of study group is 33.7±7.14 and that of control group 36.23±5.2. The Mean weight of participants of study group is 57.2±08 and their mean height is 154±6.2. The Mean weight participants of control group is 59±8.1 and their mean height is 159.4±4.6 in Table 3.

Table 4: PFT Data of Construction workers and Healthy individuals

Variables	Study group	Control group	P values
FVC(lit)	2.07±0.29	3.17±0.37	0.001**
FEV1(lit)	2.13±0.23	2.93±0.33	0.001**
FEV1/FVC	71.42±2.41	62.26±3.1	0.03*
PEFR	5.6±0.11	7.10±0.12	0.001**
MVV	68.18±2.7	104±1.7	0.001**

(*suggested significant p<0.05 ** suggested highly significant p<0.001)

In table 4 showed that all the parameters of Pulmonary Function Test were significantly decreased ($p < 0.0001$) in study group as compare to control group.

Table 5: Prevalence of respiratory symptoms in study and control group.

Respiratory symptoms	Study group(n=60)	Control group(n=60)	P values
Cough-Dry	16	2	0.001**
Dyspnoea	17	1	0.001**
Cough-Productive	9	0	0.001**
Wheeze	11	0	0.001**
Sore throat	12	1	0.001**
Haemoptosis	1	0	0.001**

In table 5, showed the prevalence of various respiratory symptoms in study and control group. Respiratory symptoms were more common among the study group as compare to control group. Overall prevalence of respiratory symptoms among study group more which is statistically significant when compared with control group.

Discussion

Although, smoking is considered the most important predisposing factor in development of emphysema; environmental exposures also play an important role. There have been several studies on work related respiratory symptoms and ventilator disorders among employees of cement industry. The present study is done among the construction workers. In the present Study the Pulmonary Function tests FEV1, FVC, PEFR and MVV has shown significant decrement. Occupational and environmental exposure to hazardous particulate matter (PM) had lead to respiratory health care problems. Other Studies has shown that cement dust may enter into Systemic circulation and thereby reaching all the organs of body and different tissues including heart, liver, spleen, Bone, hair, skin and ultimately affecting their microstructures and physiological performance as it creates the breeding ground for vector. [15] Also while conducting such kind of studies little consideration has to be given to promising factors which affect the lung function such as age, height, weight, and smoking. Therefore, the study was designed to investigate the effects of airborne dusts on the lung function of construction workers matched for age, height and weight.In present study of PFT in workers suggest working in construction sectors have greater risk of decreased lung functions and more chance develop restrictive lung disease (high FEV1/FVC). Proper protection and ventilation advised to such workers and regular health check up with spirometry also advisable in such workers.Ulvestad et al 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 in agreement with the observations made by these authors. 15]Milanowski J gora *et al.,* found significant lower FEV1/FVC ratio in their study in workers which also comparable with our study showing significant lower FEV1/FVC (71.42±2.41 study group Versus 62.26±3.1healthy group) ratio [16].

Kamat SR found significantly lower PEFR values in their study as compare to healthy individuals in their study which is comparable PEFR (5.6±0.11 study group Versus 7.10±0.12 healthy group) in our study [17].

Pranav s studied MVV significantly lower among construction site same interpretation was carried by our study with significant lower MVV (75.02±3.6) as compare to healthy individuals (68.18±2.7 study group Versus 104±1.7 healthy group) [18].

In the present study, FEV1, FVC, PEFR, MVV values showed highly significant reduction as compare to control groups. The significant decrease in these values is indicative 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 construction site, as majority of the subjects in study group were occupationally exposed to PMs for 5 to 10 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 hexavalent chromium content of cement has been implicated as the etiology of allergic occupational pulmonary impairment. [19] Sultan AyoubMeo et al carried out a study which showed that cement dust adversely affects the respiratory function and this impairment is associated with duration of exposure to cement dust. [20]

Similarly, to our findings, Zeleke ZK investigated the effect of cement dust exposure on 127 cement factory workers with a mean of 10 years exposure to cement dust on lung function. [21]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.Also, Mwaiselage et al investigated ventilator function in cement factory workers and reported that exposed workers had significantly lower FVC, FEV1, and PEF than controls. [22]

Conclusion

The present study adds evidence that cement dust adversely affects the respiratory functions and this impairment is association with duration of exposure to cement dust. The Findings are of Importance in that it highlights the need to overcome the effect of long term exposure. It also suggests that the workers must undergo pre-employment and periodic medical examination including lung function test. Thus, this study showed existing changes in pulmonary function related to dust exposure, and generated evidence to integrate primary prevention methods towards dust- related morbidity and mortality.

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