An analysis of pulmonary function tests in construction workers.

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Abstract: In construction workers, repeated and constant exposure to noxious materials generated at construction sites often increases the risk of respiratory illness. Pulmonary function test (PFT) is an important tool utilized for both diagnosis the cause of unknown or unexplained respiratory symptoms and monitoring prognosis of patients with known respiratory pathology. In the present study, PFT of construction workers was assessed using spirometry. A total of 100 male construction workers (working for >1 year) belonging age group 21 to 60 years were included in the study. Additionally, equal number of age matched healthy individuals without any exposure to construction work was recruited as controls. Indices of pulmonary functions included forced vital capacity (FVC), peak expiratory flow rate (PEFR), forced expiratory volume (FEV1), FEV1/FVC and maximal voluntary ventilation (MVV). Maximum workers belonged to age group 21 to 40 years. A total of 37 had habit of smoking. Construction workers also suffered from respiratory ailments like cough, dyspnea, sorethroat etc. All indices of PFT were significantly decreased in construction workers compared to controls. Construction workers are at high risk of developing respiratory ailments due to continuous long term exposure to noxious material used in construction. Habit of smoking and consumption of alcohol also adds on to risk of developing respiratory disorders. Spirometry can be recommended as an effective tool for screening of construction workers for respiratory ailments. The present study highlights the importance of regular health camps, use of proper protective wears and initiation of awareness program to prevent respiratory ailments in construction workers.

Keywords: Construction workers, respiratory ailments, pulmonary function tests, spirometry.

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1.Introduction

Being healthy is not just the absence of disease or illness but is a complex combination of an individual's physical, psychological and social factors that influences the overall wellbeing. The definition and meaning of health has evolved overtime. The definition of health has evolved overtime and multitude definitions of health have been used to serve different purposes. As per the World Health Organization (WHO), health is defined as "a state of complete physical, mental and social well-being and not merely the absence of disease and infirmity".[1]

In general, individual's health is determined by multiple factors that encase the social, physical (living and working condition) and economic environment and the characteristics and behavior of a person.[2] Approximately 75% of global non-communicable diseases (NCDs) are attributed to exposures to adverse living and working environment.[2] According to the WHO, exposures to hazardous conditions in the living and working environment are among the top risk factors for chronic disease mortality.[3]

Across the world, among various industries, construction industry is one of the most stable growing. Nearly, 7.5% of the world labor force is related to construction industry. In India, construction industry is the largest economic activity second to agriculture.[4,5] However, construction workers to various noxious substances at their work place.

Among various health hazards like injuries, dermatitis, musculo-skeletal disorders and gastro-intestinal diseases, respiratory ailments are most common due to repeated and continuous exposure to high level of dust typically constituting of concrete, silica, asbestos, cement, wood, stone, sand etc.[6] Lung function impairment, chronic obstructive lung disease (COPD), restrictive lung disease, pneumoconiosis, chronic bronchitis, emphysema, acute and chronic silicosis, lung cancer etc. are common adverse respiratory maladies. [6]

Pulmonary function test (PFT) is an important diagnostic modality for both unexplained respiratory symptoms and monitoring prognosis of patients with known respiratory pathology.[7] The present study was conducted with an aim to evaluate PFT in construction workers.

2.Material and methods

The cross sectional study was conducted in Department of physiology. The study included a total of 100 male construction workers (working for >1 year) belonging to various age groups (21 to 60 years) and willing to participate in the study. Individuals having chronic illness (diabetes and hypertension), pulmonary tuberculosis, previous history of surgery and musculoskeletal abnormalities were excluded. Equal number of age matched healthy individuals without any exposure to construction work was recruited as controls.

Indices of pulmonary functions included forced vital capacity (FVC), peak expiratory flow rate (PEFR), forced expiratory volume (FEV1), FEV1/FVC and maximal voluntary ventilation (MVV). PFT was studied using spirometer (RMS-HELIOS 702).

Participants from both the groups were explained about the purpose of the study. They were made aware of the procedure by demonstrating the technique. The demographic features and duration of work in construction workers were recorded and analyzed.

Individuals having FVC below 80% of predicted value were interpreted to have restrictive pulmonary disorder whereas obstructive impairment was diagnosed when PEFR was below 75% of predicted value. Individual was labeled to have combined pulmonary impairment

when FVC was below 80% of predicted value and PEFR was below 75% of predicted value.
The data was entered in Microsoft Excel and analyzed using SPSS version 19.0 statistical software. The *P* value of < 0.05 was considered as significant.

3.Results.

Out of a total of 100 construction workers included in the study, 68 workers were from the Maharashtra state whereas 32 were from other states. A total of 84 workers were staying near the construction site whereas 16 travelled to work.
The construction workers were divided into 4 groups as per the age. Maximum workers belonged to age group 21 to 40 years. As shown in table 1, there was no significant difference observed between age and anthropometric measurements like weight and height of construction workers and controls (Unpaired T test, P>0.05). Therefore the anthropometric measurements of construction workers matched with their controls belonging to same age groups.

Table 1: Anthropometric measurements of construction workers and controls.

Age group in years	Participants (N)	Mean age (± SD) in years	Unpaired T test, *P* value	Mean height (± SD) in cm	Unpaired T test, *P* value	Weight (± SD) in Kg	Unpaired T test, *P* value
21-30	Construction workers (31)	24.6 (3.2)	> 0.05	160.2 (1.2)	> 0.05	58.6 (3.3)	> 0.05
	Controls (31)	25.8 (2.8)		162.8 (2.2)		56.7 (4.2)	
31-40	Construction workers (32)	34.6 (2.1)	> 0.05	164.3 (2.4)	> 0.05	61.5 (2.8)	> 0.05
	Controls (32)	36.2 (1.8)		162.6 (1.8)		59. 9 (3.6)	
41-50	Construction workers (22)	46.4 (3.6)	> 0.05	159. 8 (3.4)	> 0.05	62.4 (4.1)	> 0.05
	Controls (22)	45.2 (2.5)		160.4 (4.1)		60.5 (3.8)	
51-60	Construction workers (15)	54.6 (4.2)	> 0.05	158.8 (2.8)	> 0.05	58.6 (4.1)	> 0.05
	Controls (15)	55.2 (3.8)		159.3 (1.6)		60.2 (3.1)	

Out of 100 construction workers, a total of 37 had habit of smoking, 58 chewed tobacco and tobacco products and 72 had habit of consuming alcohol. A total of 33 construction workers reported to have habit of all three substance abuse. Construction workers also suffered from respiratory ailments. A total of 14 construction workers had cough (dry/productive). Dyspnea was noted in 8 construction workers whereas wheeze was seen in 9 construction workers. A total of 18 workers had complaint of sore throat and 2 reported to have hemoptysis.

The parameters of PFT of construction workers and controls are shown in table 2. All indices of PFT were significantly decreased in construction workers compared to controls.

Table 2: Parameters of pulmonary function test in construction workers and control.

Parameter	Group		Unpaired T test *P* value
	Construction worker Mean (± SD)	Control (± SD)	
FVC (Liter)	2.01 (0.12)	3.28 (0.32)	<0.0001*
FEV1 (Liter)	2.08 (0.16)	3.1 (0.23)	<0.0001*
FEV1/FVC	73.4 (3.1)	61.2 (2.5)	<0.0001*
PEFR	5.2 (0.4)	7.8 (0.8)	<0.0001*
MVC	63.4 (3.9)	103.7 (2.7)	<0.0001*

***statistically significant**

Various indices of PFT in construction workers as per duration of work are shown in table 3. Based on the duration of exposure the parameters of PFT were decreased. However, the statistical difference was observed only for MVC.

Table 3: Comparison of pulmonary function tests in construction workers based on duration of work.

Parameter	Years of exposure			One way Annova test *P* value
	1-5 Y (N=28) Mean (± SD)	5-10 Y (N=48) Mean (± SD)	>10 Y (N=27) Mean (± SD)	
FVC (Liter)	2.5 (0.7)	2.2 (0.5)	2.3 (0.3)	>0.05
FEV1 (Liter)	2.1 (0.9)	2 (0.4)	1.8 (0.6)	>0.05
FEV1/FVC	75.2 (4.9)	71.2 (4.3)	69.2 (6.7)	>0.05
PEFR	5.4 (1.2)	5.2 (1.1)	5.2 (1.4)	>0.05
MVV	78.2 (14.9)	75.2 (13.7)	64.2 (6.2)	<0.05*

***statistically significant**

The result of spirometry is summarized in figure 1. A total of 78 construction workers had normal PFT. Restrictive pulmonary impairment was seen in 11 construction workers. Obstructive type of pulmonary disorder was seen in 6 construction workers whereas a total of 5 construction workers had combined type of pulmonary impairments.

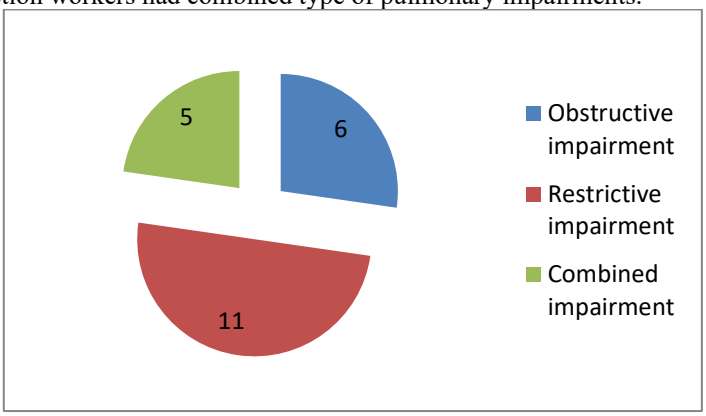

Figure 1: Respiratory impairment in construction workers.

Discussion.

Among various earthly happiness's, good health is the most important. Great scholars, thinkers, spiritual leaders, preachers and prolific authors across the globe have highlighted the importance of good health in human life. Emphasizing the importance of health, Hippocrates, the father of Medicine wrote "Health is the greatest of human blessings".
Occupational exposure to noxious material is one of the major risks affecting the health and wellbeing of an individual. Across the globe, skilled, semiskilled and unskilled workers in different types of industries like construction, agriculture, coal, petroleum etc. are exposed to environment that increases the risk of inhaling particulate materials that adversely affects the respiratory system.[6]
In this study, the effect of occupational exposure to construction materials on respiratory system was studied. In recent years, with increase in constructional work, workers are often exposed to cement, dust, sand and other material for longer period of time.[8]
Construction workers usually reside near to their site of work. In this study, a total 84 resided near to site of construction. These authors reported that in their study construction workers lived in kutcha houses near construction site. These settlements had poor sanitation and workers were exposed to cement dust and exhaust from both from kitchen and automobiles. Dusty environment in and around construction site often have adverse effects on respiratory system.
In the present study, respiratory ailments like cough (dry/productive), dyspnea, sore throat and hemoptysis were observed in construction workers. Similar finding was reported by[9] Smoking habit in the form of bidi/cigarette was reported in 37 construction workers. Majority of construction workers had habit of alcohol consumption. Tobacco smoking is identified as one of the main risk factors for development of COPD. Therefore it is very essential to initiate awareness programs to motivate construction workers to cease smoking and other habits of substance abuse.
Estimation of pulmonary function using spirometer is essential for detection of deterioration of respiratory system.[10] In the present study when PFT of construction workers was studied using spirometer and compared to that of age matched healthy controls, the indices like FVC, FEV1, PEFR and MVV were markedly decreased in construction workers. Various national and international researchers have reported the similar findings. The significant decrease in these indices of PFT in construction workers is an indicative of obstructive impairment.
The construction workers had high FEV1/FVC suggestive of high chances of developing restrictive pulmonary impairments. In this study, although not statistically significant (except for MVV), a decrease was noted in pulmonary functions of construction workers in relation to duration of work/exposure. This finding is in consistent to that of [12]
In the study pulmonary functions were decreased in construction workers but the changes were restricted to small airways. [11]
A total of 11 construction workers had restrictive pulmonary impairment while obstructive type of pulmonary disorder was seen in 6 construction workers. Combined type of pulmonary impairments was seen in a total of 5 construction workers. The rate of pulmonary impairments in the present study was comparable.

4.Conclusion

To conclude, construction workers are at high risk of developing respiratory ailments due to continuous long term exposure to noxious material used in construction. Habit of smoking and consumption of alcohol also adds on to risk of developing respiratory disorders. Spirometry can be recommended as an effective tool for screening of construction workers for respiratory ailments. The present study highlights the importance of regular health

camps, use of proper protective wears and initiation of awareness program to prevent respiratory ailments in construction workers.

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