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Assessment of Pulmonary Functions in Stone Crusher Workers in Western Maharashtra

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Abstract

The Spiro metric pulmonary function tests (PFT) were studied in stone crusher workers (n = 120) and normal healthy controls (n =120) from the Karad taluka Western region in Maharashtra state. Anthropometric measurements were taken of both groups before the assessment of pulmonary function. The Spirometric PFT parameters studied were FVC (Forced Vital Capacity), FEV1 (Forced Expiratory Volume in first second), PEFR (Peak Expiratory Flow Rate), and MVV (Maximum Voluntary Ventilation).

An examination of the percent of predicted values of all the parameters studied indicated that the values of all PFT parameters were significantly reduced in the stone crusher workers as compared with normal control group. We conclude from these findings of the present study that Stone crushers of Karad region exposed to stone dust are prone to develop lung disorders as indicated by abnormal pulmonary function. We promoted the stone crusher workers to initiate the protective & preventive measures to minimize the hazards of direct exposure to stone dust.

Keywords- Stone Crusher Workers, Spirometry, Pulmonary Function Test.

INTRODUCTION

Silica dust exposure is inherent in many industrial operations worldwide [1]. Silica is present in many materials used at construction sites, including soil, sand, concrete, rock, granite, etc. Stones are rich in free silica and the stone crushing process releases a high level of fine silica dust in the working environment [2]. In India, due to lack of resources and awareness at stone-crushing sites, the preventive measures against inhalation of dust particle are generally poor. Therefore, workers exposed to silica dust over a long time can develop a considerable lung function impairment that cannot be reversed [3, 4]. Deposition of silica dust in the lung is one of the key events involved in occupationally related lung diseases. Many factors like dust type, exposure duration, concentration and the size of the dust particles in the breathing zone influence silica deposition in airways [5].

Stone crushing work is widely carried out in different parts of Maharashtra, particularly in adjoining villages of major cities having hilly regions. The main aim of the present study was to analyze the pulmonary function tests finding in stone crusher workers in Western Maharashtra taking Karad region as a prototype. In Karad taluka the various stone crushing units are found bordering the Karad city. There are fairly large numbers of small units located in different parts of Karad taluka. It was believed and observed by us that the stones crushed in Karad region had an undetectable range of free silica. The workers exposed to the stone dust at the stone crushing factories at Jakhinwadi and Nandlapur villages near Karad city are shown in figure 1 to represent the occupational hazardous environment in which the workers are working for long durations. The workers usually inhale a large amount of dust generated by the crushing units and this dust contains silicon dioxide or free silica. Free silica is responsible for causing the oldest and most dreaded of occupational disease such as silicosis [6]. Many studies have been taken in India to observe the changes in pulmonary function tests (PFT) in different industries like cotton mill, grain dusts, granite dust, sand dusts, flour mill dust, etc [6-12]. The PFT helps to provide an assessment of function respiratory system [6-12]. The application of these tests in public health & occupational medicine provide biological indices that are of value in assessing the effect of exposure of hazards. In a comprehensive study by Sheikh et. al., a non-significant effect of smoking on lung function of silica-exposed workers after controlling for various factors that could affect it was reported. Also in literature there are contrasting results about the effect of smoking on lung function of silica-exposed workers so we decided not to include the smokers in the present study [6,7,9,10].

METHODOLOGY

The present study was carried out in department of Physiology Krishna Institute of Medical Sciences Karad. All male workers chosen (n = 120, age limit 20-50 years) for the study were from the stone crushing factories at Jakhinwadi & Nandlapur near Karad city. The participants were divided into two groups direct exposure group (stone crusher male workers n=120, directly exposed for more than 5 years to dust and ready to participate in the present study) and control group (n = 120) which consisted of healthy individuals of similar age but not exposed directly or indirectly to stone dust. This approach guaranteed that there were no differences in socioeconomic status and work intensity. The institutional ethical committee approved the experimental protocol. An initial screening was carried out to exclude gross pulmonary and heart diseases not related to occupational hazards (like congenital heart disease, tuberculosis, and hypertension), diabetes mellitus, and nervous system disorders and so on. Each worker was interviewed**.** Stone crusher factory workers having a history of smoking were not included in study.

General physical and systemic examinations were conducted. Anthropometric measurements (height in cm, weight in kg) were also carried out. Lung functions were measured using a computerized "MEDSPIROR" (RMS Chandigarh, India) instrument. Before recording lung functions, the subjects were shown a demonstration of the test. Consequently, a minimum three readings were recorded of each test for each subject and the best of the three was selected for having reproducibility and validity of the recorded parameters. The lung function parameters included were FVC (Forced Vital Capacity), FEV1 (Forced Expiratory Volume in one second), PEFR (Peak Expiratory Flow Rate) and MVV (Maximum Voluntary Ventilation). The values of all tests were recorded as per previously reported procedure.

All the participants were invited by the department of Physiology, KIMS Karad to carry out lung function test. The entire PFT tests were carried in early morning sessions such as between 10.00 am to 12.00 noon.

Statistical analysis

Data was summarized by computing mean and standard deviation (SD) of each studied variable. The significance of difference of each variable among Direct and Control groups was studied by applying ANOVA. A Post-Hoc test was used to detect the pairs showing a significant difference. The difference was said to be significant if the probability ($p<0.05$).

RESULTS

One hundred twenty male stone crushing workers were the main subjects of the present study whose PFT was compared with the 120 healthy male subjects, which were considered as normal controls. Most of the crusher workers were affected with persistent cough, weight loss, fever, chest pain, which are considered as the most common symptoms of decreased pulmonary functioning. Also breathlessness was reported by most of the stone crusher workers during PFT studies. It was also noted that a large number of subjects also consume alcohol.

The results of the various anthropometric tests are presented in figures 2, 3 and 4. It was observed that there were no significant difference seen in the age, weight and height of the exposed subjects and controls. The results of the lung function tests are presented are presented in Figure 5. The statistical difference in lung function tests between two groups can be visualized through bar diagrams. Additionally a comparison of percent decrease in PFT between the direct exposure group and normal control was evaluated which is presented in figure 6. When the values of FVC, FEV, PEFR and MVV of the control group were compared with the direct exposure group it was observed that all the values were significantly reduced.

DISCUSSION

Duration of exposure to silica is the most strong and well-documented predictor of reduced lung function in workers exposed to silica dust. Workers involved in directly handling of silica material and working in close proximity to dust generating sites, such as manual workers are at high risk of lung function deterioration due to exposure to high dust concentrations for a prolonged time period.

Figure 1 The stone crushing sites at A. Nandlapur and B. Jakhinwadi representing the hazardous environment in which the workers are exposed.

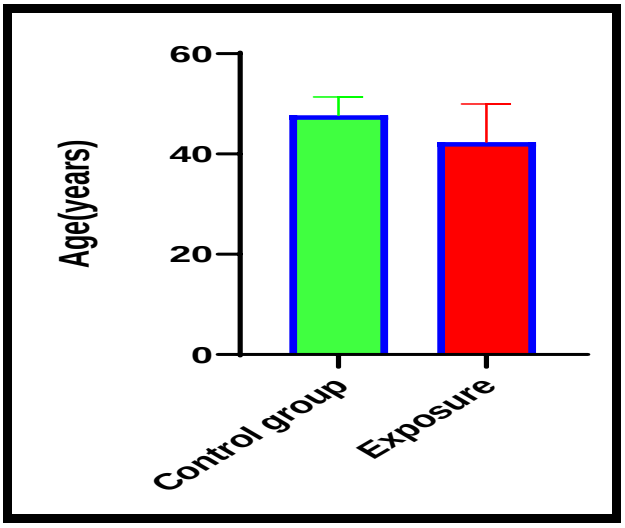

Figure 2 Age variables of stone crusher workers (direct exposure group) and control group. Values are represented as Mean ± SD

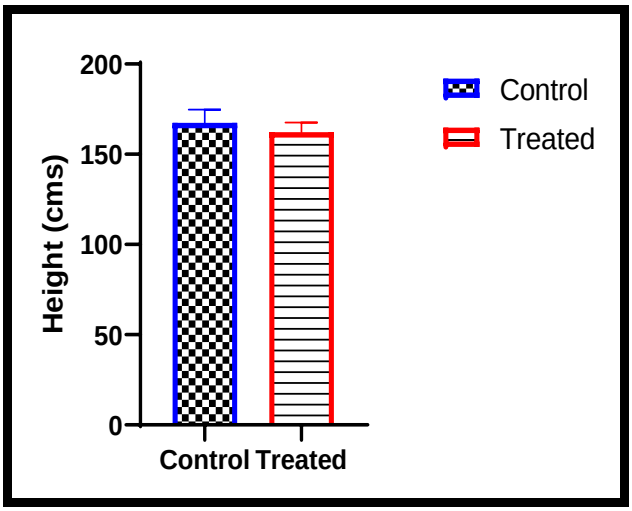

Figure 3 Height variables of stone crusher workers (direct exposure group) and control group.
Values are represented as Mean ± SD

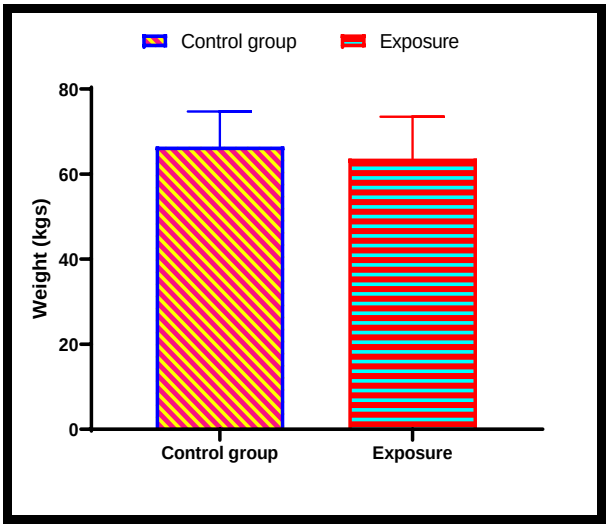

Figure 4 Weight variables of stone crusher workers (direct exposure group) and control group
Values are represented as Mean ± SD

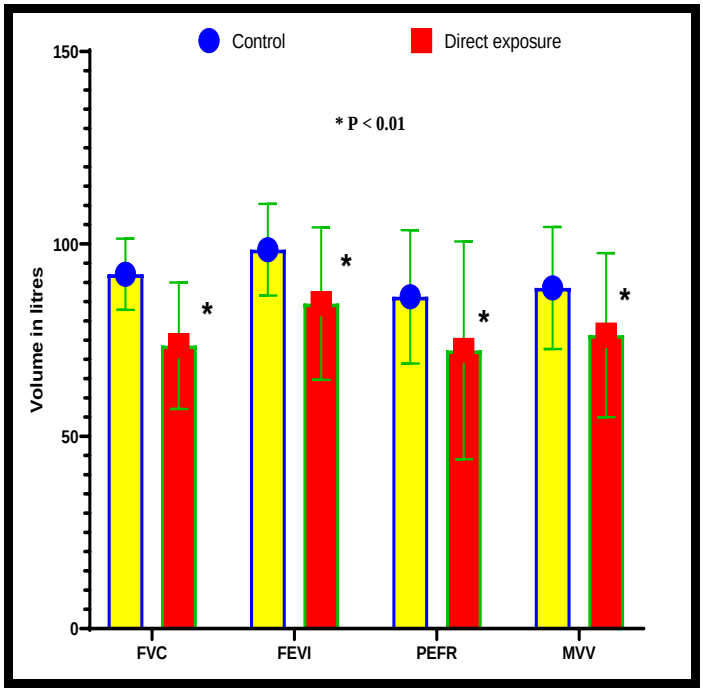

Figure 5 Pulmonary function test parameters in of stone crusher workers (direct exposure group) and control.
Values are represented as Mean ± SD. FVC- Forced Vital Capacity; FEV1- Forced Expiratory Volume in First; PEFR- Peak Expiratory Flow Rate; MVV- Maximum Voluntary Ventilation.

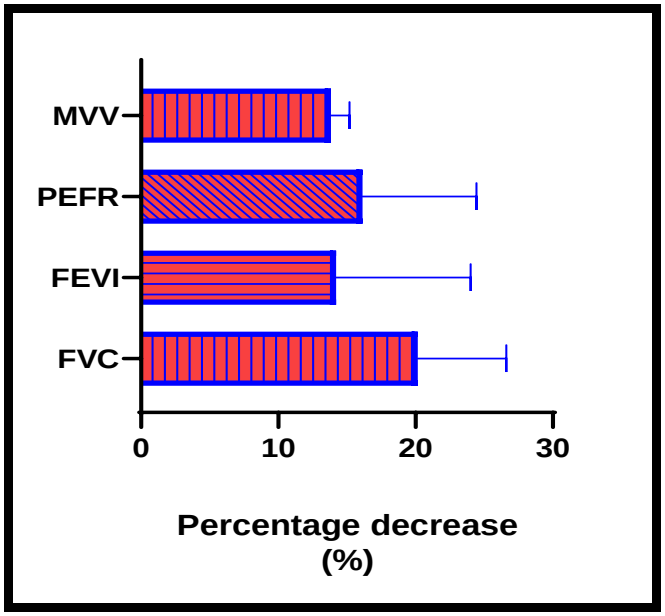

Figure 6 Percentage decrease in Pulmonary function test parameters of stone crusher workers (direct exposure group) against the control.
Values are represented as Mean ± SD

The results of the present study have shown that the exposure to stone crusher dust and other pollutants in stone crushing factory workers is associated with an impairment of lung function. The direct exposure group showed a statistically significant impairment of lung function as compared to the control. To confirm the above findings, comprehensive studies on large scale are

essential. The selection of percent of predicted values of various Spirometric test parameters excluded the effect of difference in height and weight of control and study groups on lung function tests results. Moreover, the workers from both study groups were age-matched and from the same region of the Karad district. The study excluded confounders like gross pulmonary and heart diseases not related to occupational hazards like congenital heart disease, tuberculosis, hypertension, diabetes mellitus, nervous system disorders, and smoking. The results of this investigation agree with those of earlier studies in other group workers like saw mill workers, fur-processing workers and electroplaters showing a decrease in the predicted values of pulmonary-function test parameters [6-12].

In our study, we observed a maximum reduction in lung function volumes among stone crusher subjects with dust exposure of minimum five years. Indeed, comparison of pulmonary function tests between the stone crusher workers with exposure duration of up to 5 years and controls was statistically significant. This finding shows that significant changes in the lung function occur after chronic exposure to silica dust.

In agreement with our research, Sheik et al., also found a reduction in FVC, FEV1, FEV3 and PEFR values related to an increase in duration of exposure, particularly in subjects with chronic exposure [6].

There were few limitations of the present study such as the non-inclusion of factors such as the effect of gender, silica dust concentration in the environment at the working site were some of the limitations of our study. Moreover, radiological assessment of the workers would have helped in better understanding of the lung involvement and effect of silica and smoking on lung function. Nevertheless, our findings indicate a dysfunction of lung function tests in workers chronically exposed to stone dust. A study on larger scale could throw a more light on the observations of the present study.

The following recommendations were discussed with the workers and business owners in co ordinance with previous studies and suggestions- Regular health surveillance of manual workers exposed to silica dust is important to identify individuals with compromised lung function as they are at higher risk for lung function deterioration in case of chronic silica exposure. Health surveillance should include occupational exposure history, clinical examination, lung function testing and chest radiography, in order to detect abnormalities in the airways at early stages. However, it is essential to pursue a strict monitoring of dust control measures for collective prevention, and provision of occupational health and safety services to these workers. We suggested that workers directly exposed to stone dust may benefit from the use of protective measures like wearing masks and avoid direct exposure. The business owners assured us the implementation of policies that will necessary to be framed to control and prevent the overall lifetime duration of exposure to silica dust among silica exposed workers to reduce the morbidity and mortality among stone crusher workers.

To summarize the conclusions from the present study we suggest that the chronic duration of stone dust exposure is the most important determinant in deterioration of pulmonary function in workers and limiting or preventing direct stone dust exposure can effectively reduce damage to airways in exposed workers.

REFERENCES

1. American Thoracic Society. Adverse effects of crystalline silica exposure. Am J Respir Crit Care Med. 1997;155:761–765.
2. Tiwari RR, Sathwara NG, Saiyed HN. Serum copper levels among quartz stone crushing workers: A cross sectional study. Indian J Physio Pharmacol, 2004;48(3):337–342.
3. Theriault GP, Peters JM, Fine LJ. Pulmonary function in granite shed workers of Vermont. Arch Environ Health. 1974;28:18–22.
4. Malmberg P, Hedenstrom H, Sundblad BM. Changes in lung function of granite crushers exposed to moderately high silica concentration: a 12 year follow up. Br J Ind Med. 1993;50: 726–773.
5. Mengesha YA, Bekele A. Relative chronic effects of different occupational dusts on respiratory indices and health of workers in three Ethiopian factories. Am J Ind Med. 1998; 34(4):373–380.
6. Sheikh Junaid Aziz , Khan Zahid Ali, Khan Tazeen, Chowdhary Sumaira, Pulmonary function among stone quarry workers in India: The effect of duration of exposure, smoking status and job profile on pulmonary function tests. Journal of Health and Social Sciences 2018; 3,2:137-146.
7. Patil SN, Somade PM, Joshi AG. Pulmonary function tests in sugar factory workers of Western Maharashtra (India). J Basic Clin Physiol Pharmacol. 2008;19(2):159-66.
8. Sivacoumar R, Jayabalou R, Subrahmanyam YV, Jothikumar N, Swarnalatha S. Air pollution in stone crushing industry, and associated health effects. Indian J Environ Health. 2001; 43(4): 169-173.
9. Chattopadhyay B. P, Gangopadhyay P. K., Bandopadhyay T. S., Alam J., Comparison of Pulmonary Function Test Abnormalities between Stone Crushing Dust Exposed and Nonexposed Agricultural Workers. Environmental Health and Preventive Medicine 2006, 11, 191–198.
10. Kumarupadhyay Mahendra, Chaturvedi Surya Kant. Respiratory Ailments of Stone Crusher Workers in Bundelkhand Region of Uttar Pradesh. International Journal of Science and Research, 2016, 5(10), 163-166.
11. Gottesfeld P, Nicas M, Kephart J, Balakrishnan K, and Rinehart R. Reduction of Respirable Silica Following the Introduction of Water Spray applications in Indian Stone Crusher Mills. International Journal of Occupational and Environmental Health, Vol. 14, No. 2, 2008 pp94-103.
12. Rathod SB, Mane SB, Handergulle SS, Kekan D. Pulmonary function tests in stone crushers. Indian J Physiol Pharmacol. 2014; 58(3):302–305.