

## RESEARCH ARTICLE

### Study of lung function in granite workers based on duration of exposure

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#### ABSTRACT


**Background:** Stone quarry workers form a unorganized sector of industry scattered all over India. Due to these workers employed at the granite factory are exposed to different components of dust in which silica is the major one. Longer the duration of exposure to silica dust the respiratory impairment increases. High degree of respiratory morbidity is associated with this industry as people lack the knowledge about the harmful effects of the dust on their health and also negligence from the management side who fail to do periodic health checkup of the employees. **Aims and Objectives:** The present study was designed to evaluate the pulmonary function tests in the granite factory workers based on the duration of exposure. **Materials and Methods:** The study population consists of 100 asymptomatic granite workers aged between 18 and 40 years working in granite rock factory for more than 5 years' duration. Workers were divided into two groups based on the duration of exposure. Workers who were exposed for >5 years but <10 years belong to Group 1, and those workers who were exposed for more than 10 years belong to Group 2. Pulmonary function testing was done using Medspiror, which is a PC-based spirometer with flow transducer in all the subjects. **Results:** Data analyzed among these two group of workers reported a significant decrease forced expiratory volume in the 1<sup>st</sup> s (FEV1), forced vital capacity (FVC), FEV1/FVC, peak expiratory flow rate, and mean forced expiratory flow 25–75% in Group 2 workers than Group 1. **Conclusion:** Thus, the present study shows that as the number of years of the working period increases among granite workers the impairment of pulmonary functions increases.

**KEY WORDS:** Granite Workers; Pulmonary Function Tests; Spirometer

#### INTRODUCTION

India is one among the leading countries in mining and exporting granite and is rich in granite reserves. Granite is very hard crystalline, igneous or metamorphic rock primarily composed of feldspar, quartz, and dark minerals. There are many people working in these industries which involve different kinds of work such as cutting, polishing, and loading the stones. These

workers are exposed to minute dust particles (mainly silica) and chemicals which are harmful to the health of workers as they can cause allergies and cancers. Quartz which is one of the components present in the granite stone is nothing but free silica, inhalation of which can cause various respiratory diseases such as pneumoconiosis and silicosis. Silicosis is one of the oldest and most prevalent, chronic occupational lung diseases. It kills thousands of people every year in the world. Particles are <0.5  $\mu$  mts in diameter, which may pass beyond the mucociliary clearance system and enter the terminal airways and alveoli.<sup>[1]</sup> It is characterized by granulomatous and fibrotic changes and emphysema in the lungs, and is believed to be caused by chronic stimulation of phagocytic cells such as macrophages and the subsequent release of inflammatory mediators.<sup>[2]</sup> As most of the workers are uneducated and lack the knowledge about the respiratory impairment caused by

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these dust and chemicals and also lack of funds and resources by the management people these workers become vulnerable to respiratory impairment and diseases. When these workers work for longer duration, high degree of respiratory impairment has been reported.<sup>[3,4]</sup> Since silica is associated with deterioration of lung function, the present study is an attempt to know the degree of lung dysfunction caused by exposure to silica.

### Objectives

The objective of the study is to assess the lung function among granite workers by computerized spirometry based on the duration of exposure.

### MATERIALS AND METHODS

One hundred asymptomatic granite workers aged between 18 and 40 years working in granite rock factory for more than 5 years' duration were taken as subjects after applying inclusion and exclusion criteria, and they were brought to PESIMSR for assessing lung functions by spirometry. Subjects were categorized into two groups (Group 1 – workers having more than 5 years and <10 years of exposure and Group 2 – workers having more than 10 years of exposure).

#### Inclusion Criteria

- Workers having more than 5 years of exposure.
- Age group of workers between 18 and 45 years.
- Nonsmokers.
- Workers without any previous history of lung disease and other respiratory impairment.

#### Exclusion Criteria

- Workers having <5 years of exposure to silica dust.
- Workers below 18 years and above 40 years.
- Smokers.
- Workers who had the previous history of chronic lung disease.

Subjects were made to undergo clinical examination and details about past and present history were taken. All the workers were brought to PESIMSR for lung function testing. After taking Ethical Committee Clearance and subjects consent Pulmonary function testing was done using computerized spirometry (medspiror) in all the subjects. Flow transducer is bidirectional for both exhale and inhale maneuver. Mouth piece is pushed into the transducer assemble. while removing, it should be pulled out without rotating it. Hand/fingers were avoided in backside mesh while doing the maneuver. It is plug and go computer-based spirometry. PFT recording was taken in sitting posture. The procedure was explained to the subjects and demonstrated. They were allowed to practice following which minimum of 3 acceptable readings were taken and the best one was accepted and selected. Forced vital capacity

(FVC) reading was taken when the subject forcefully expires maximum into the mouthpiece after maximum inspiration. Subjects were asked to avoid coughing and they were advised complete exhalation, not to stop during the procedure. Once the procedure was done, values for FVC, forced expiratory volume in the 1<sup>st</sup> s (FEV1), FEV1/FVC, peak expiratory flow rate (PEFR), and forced expiratory flow (FEF 25%–75%) were obtained after analyzing flow volume and time volume curve.

### RESULTS

Workers were divided into two groups: Group 1 – Workers who were exposed <10 years and Group 2 – workers who were exposed for >10 years. The data profile of subjects which include age, height, weight, body mass index (BMI), lung function test values are entered in tables. Student *t*-test was done to compare means of lung function parameters between the two groups. *P* value <0.05 was considered as statistically significant. The values of each lung parameters are entered as mean and standard deviation.

Table 1 shows totally 100 granite workers. 32% were exposed to granite dust for <10 years and 68% had exposure >10 years. The mean age of all 100 workers is 35.18±3.88, their mean height 162.28 ± 8.63, and BMI of workers being 23.46 ± 3.46 [Table 2]. Table 3 shows the relation of mean lung function values of granite workers of both Group 1 and Group 2. It is very clear according to the results that workers exposed for >10 years had a significant decrease in FEV1, FVC, FEV1/FVC%, PEFR, and MEAN FEF 25–75%. Values compared to workers exposed <10 years. This shows that more the duration of exposure to the granite industry (silica dust) more the impairment of lung functions.

### DISCUSSION

Employees of granite factory are exposed to different components of dust in which silica is a major one. As workers

**Table 1:** Distribution of subjects according to the duration of exposure

Groups	Number of workers (%)
Group 1	32 (32.0)
Group 2	68 (68.0)
Total	100 (v)

**Table 2:** Descriptive statistics of age, height, weight, and BMI

Characteristics	Min-Max	Mean±SD
Age (years)	25.0–40.0	35.18±3.88
Height (cm)	121.0–180.0	162.28±8.63
Weight in kg	42.0–85.0	61.61±8.22
BMI (kg/m <sup>2</sup> )	15.94–36.88	23.46±3.46

SD: Standard deviation, BMI: Body mass index

**Table 3:** Comparison of lung function test among granite workers exposed <10 years and >10 years

Parameters	Group 1	Group 2	P value
FEV1(Lt)	2.86±1.24	2.06±0.69	<0.001**
FVC (Lt)	3.15±1.48	2.36±0.88	0.001**
FEV1/FVC%	94.15±5.42	89.16±11.98	0.027*
PEFR (L/S)	6.85±2.99	5.30±2.17	0.004**
Mean FEF25-75(L/S)	3.89±1.58	2.78±1.30	<0.001**

P value: 0.01 < P ≤ 0.05 is considered \*Moderately significant;

P value: P ≤ 0.01 is considered \*\*strongly significant.

FVC: Forced vital capacity, FEV1: Forced expiratory volume in the 1<sup>st</sup> s, PEFR: Peak expiratory flow rate, FEF25-75: Forced expiratory flow

are employed for a longer duration, exposure to dust is more and at the same time lung functions are also highly impaired. As the duration of exposure increases the impairment of lung increases. Ignorance and lack of knowledge from workers, negligence from the management of granite factory leads to various kinds of occupational respiratory diseases.

This study assessed the lung functions in the employees of granite factory having different duration of exposure. There was a significant decrease FEV1, FVC, FEV1/FVC, PEFR, and mean FEF 25–75% in Group 2 workers than Group 1.

This is probably because of the silica dust, which causes inflammation in the bronchi and the peripheral airways by causing the release of inflammatory mediators such as cytokines, chemokines leading to obstruction of airways.

A study done by Mohammad Golshan *et al.* have reported that decrease in FEV1 and FEF 25–75% is the important sign of starting lung diseases such as bronchitis and obstructive lung disease.<sup>[5]</sup>

PEFR value also showed significant decrease among Group 2 workers and its value indicates the function of large airways. The decrease is probably because of obstruction of the larger airways due to inflammation brought about by the toxic silica particles.<sup>[6]</sup>

FEF 25–75% which is measured in middle half of the FVC has been proposed as a sensitive indicator of early obstruction in small airways. In the present study, the cause for the significant decrease in Group 2 workers than Group 1 is probably due to silica dust which can penetrate the small airways and result in fibrosis.<sup>[6]</sup>

Similar study was done by Ghotkar *et al.* who reported that the lung function parameters are reduced when the stone quarry workers are exposed to dust for more than 20 years.<sup>[4]</sup>

Similar findings were found in studies done by Urom *et al.* and Liou *et al.*, who have reported that as the duration of exposure to the dust particles in employees working in granite factory increased, respiratory impairment increased.<sup>[3,7]</sup>

## Strength of the Study

Our study concentrated on workers who belong to lower socio economic status, who are hardly educated and do not have knowledge about occupational health hazards. The early detection of respiratory impairment in these people will prevent further damage and educating them regarding the protective care to be taken while working in such places where there is exposure to minute dust particles will avoid further damage to the respiratory system.

## Limitations of the Study

Only few lung function parameters were assessed.

## CONCLUSION

The present study shows that as the number of years of working period increases among granite workers, exposure to silica dust increases, and thereby impairment of pulmonary functions increases.

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