

Type of Article – Original Research Article

## **A Cross-Sectional Analytical Study of Spirometry Findings & Respiratory Morbidities Among Marble Stone Cutting Workers in Jabalpur M.P**

**Dr. Asha Ram Tyagi<sup>1</sup>, Dr. Rahul Kewal Kumar<sup>2\*</sup>, Mr. Abhinav Tyagi<sup>3</sup>,  
Dr. Aditi Mishra<sup>4</sup>, Dr. Sneha Gupta<sup>5</sup>, Dr. P.K Kasar<sup>6</sup>**

<sup>1</sup>Associate Professor, Department of Community Medicine, Chirayu Medical College Hospital, Bhopal (M.P) 462030

<sup>2</sup> MBBS, MD, Associate Professor, Department of Community Medicine, Raipur Institute of Medical Sciences, Raipur (C.G)

<sup>3</sup> Mr. Abhinav Tyagi, PhD Scholar

<sup>4</sup> MBBS, MD

<sup>5</sup> MBBS, MD

<sup>6</sup> Professor, Department of Community Medicine, Jabalpur (M.P)

\*Corresponding Author :

Dr. Rahul Kewal Kumar

Associate Professor, Department of Community Medicine, Raipur Institute of Medical Sciences, Off NH-6, Bhansoj Road, Godhi, Raipur, CG, India -492101

Phone No. 9907761677

Email – [drrahulkg@gmail.com](mailto:drrahulkg@gmail.com)

### ABSTRACT:

**Introduction :** . Respiratory problem are fairly common among Marble stone cutting workers, many of them work without any preventive gears / PPEs & lack of awareness about the harmful effects results in poor quality of life and also financial burden to their families. Purpose of study was to to determine the magnitude of respiratory morbidities and impairment of lung function in marble stone cutting workers and to promote occupational health safety among them.

**Methods:** : This was an analytical cross sectional study done in stone cutting workers in Bhedaghat, Jabalpur for 3 months. Data related to socio demographic characteristics, occupational history, work environment, respiratory symptoms and spirometry findings were collected and analysed. The inclusion criteria included individuals working as stone cutting workers for more than 5 years at the time of study For all numerical variables, Pearson's correlation test was used. For all categorical variables, the Chi-square test and Fisher's exact test were used. A P less 0.05 was considered statistically significant.

Results: The most common respiratory symptom reported was Chronic cough (19%). Spirometry revealed that 64% of participants had abnormal (impaired) lung function test. Duration of work (in years), working hours per day, and use of PPE were significantly associated with abnormal pulmonary function test ( $p < 0.05$ )

Conclusions : Data from our study suggest that duration of the years of work as stone cutting worker had a significant association with the pulmonary function, so periodic screening and effective use of PPE is recommended.

Keywords: Pulmonary function tests, Respiratory morbidities, Marble Stone cutting workers , Spirometry

## INTRODUCTION

Occupational lung diseases are a major public health problem in developing countries like India. Occupations such as mining, stone quarrying, stone sculpting etc. are especially at risk.<sup>1</sup> Of occupational lung diseases, pneumoconiosis form the major burden of morbidity and mortality due to exposure to dust particles in the work environment.<sup>2</sup> Coal, silica, and asbestos are the common substances which produce respirable dust particles (0.5–5 micron). When workers are exposed to these particles over a long time, they get settled in the lungs and develop into full-blown disease.<sup>3,4</sup> Marble is a metamorphic limestone that is widely used in the sculpturing of statues and the construction of buildings and monuments. Most people are engaged in carving statues from marble stones & are exposed to the dust, which contains particles of calcium carbonate and silica.<sup>3,4</sup> As silica is major constituent of marble rocks, these workers are more prone to silicosis which is major cause of permanent disability and mortality .It is caused by inhalation of dust containing free silica or SiO<sub>2</sub>. The longer the duration of exposure, the greater is the risk of developing silicosis.<sup>2,3,4</sup> Being insidious in nature, silicosis presents with the early manifestations of irritant cough, dyspnoea on exertion and pain in chest .With more advanced disease the impairment of total lung capacity is common. Silicotics are also more prone to tuberculosis. There is no effective treatment for silicosis.<sup>3,4</sup> Fibrotic changes that have already taken place cannot be reversed. The only way to control silicosis is by rigorous control measures. The other diseases associated with silica dust are chronic obstructive pulmonary diseases and emphysema, Lung fibrosis and chronic bronchitis, Lung cancer, Immune system related diseases-RA, SLE, Scleroderma.<sup>4</sup> Most of the occupational lung diseases are easily preventable but due to lack of resources and also lack of awareness about personal protective equipments to counter the inhalation of dust particles, there is increased risk of respiratory morbidities and poor quality of life.<sup>3,4</sup>

Rationale : Bhedaghat, Jabalpur is well known for its magnificent art of stone carving giving livelihood to many people with low socioeconomic status. Respiratory problem are fairly common among the stone cutting workers, many of them work without any preventive gears / PPEs [Image No. 1a & b] & lack of awareness about the harmful effects ,which result in poor quality of life and also financial burden to their families. Therefore, by identifying such cases and providing them with health education and also motivating them to use personal protective equipments especially mask during working hours can substantially reduce the cases of respiratory morbidities. The output of this research will be an approach to improve our knowledge about occupational health and will have implications for developing and implementing health and safety interventions and policies

within stone industry and for developing new guidelines for health and safety of stone industry workers.



Image -1(a)



Image -1 (b)

**Aims & Objectives :** To determine the magnitude of respiratory morbidities and impairment of lung function in marble stone cutting workers and to promote occupational health among them.

#### **METHODOLOGY**

This was an analytical cross sectional study done in stone cutting workers in Bhedaghat, Jabalpur for 3 months. After obtaining approval the study was started. The study was carried out on 100 individuals selected by convenient sampling. The workers have many different tasks; some are directly work inside with the main cutting machine, others involved in manual stone hand polishing and pilling, and many of them are involved in many stages of production process. The inclusion criteria included individuals working as stone cutting workers for more than 5 years at the time of study and the exclusion criteria included individuals who were not able to do forced expiratory maneuver, already diagnosed with advanced diseases and who did not consent to participate. Informed consent was obtained from each participant and then they were asked to fill a preformed semi

structured questionnaire with the help students / coresearchers which collected information about socio demographic characteristics, occupational history, work environment and respiratory symptoms. The workers were given a short oral introduction in Hindi about the research and its objective. They were informed that their data is confidential and it won't affect their work performance. Medical examination of workers including chest clinical examination was done [Image 2]



Image -2

Spirometry was performed by trained researcher using a spirometer made by Medical International Research ( SN A23-05310935).[Image 3]. The test procedure was explained to the subjects and a demonstration of the test procedure was given. The subjects were allowed to sit quietly for 10 minutes to become mentally and physically relaxed prior to testing.[Image 4&5] The best forced expiratory volume in one second (FEV<sub>1</sub>) and forced vital capacity (FVC) were recorded and the FEV<sub>1</sub> /FVC ratio was calculated. Results were automatically printed according to Diagnostic criteria: By spirometry results: A- Normal (free), B- Impairment of lung function: 1- Restrictive, 2- Obstructive, 3- Combined. The ratio FEV<sub>1</sub>/FVC (FEV<sub>1</sub>= Forced Expiratory Volume in first second, FVC =Forced Vital Capacity)was calculated. The normal values for the ratio FEV<sub>1</sub>/FVC according to WHO was 70-85 % and reference range for this spirometer used for the study was 70-105% as per its specifications

*Statistical Analysis* : Data were entered into a Microsoft Excel sheet and analyzed using 'IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, N.Y., USA). The statistical methods followed were descriptive statistics and inferential statistics. For all numerical variables, Pearson's correlation test was used. For all categorical variables, the Chi- square test and Fisher's exact test were used. A  $P < 0.05$  was considered statistically significant.



Image 3 – Spirometer



Image - 4



Image 5

Ethical considerations: No harmful interventions and the tests were done . The workers were given a short oral introduction in Hindi /Local Language about the research and its objective. They were informed that their data is confidential and it won't affect their work performance.

## RESULT

The present study shows that 71% of the studied participants were older than 25 years, and 29 % were aged 25 years and less. The mean age was  $36.59 \pm 9.1$  years. 82% of the participants were males, and 18 % were females. 89% of the participants were married. About 51.4% were urban residents and 48.6% were rural residents. Only a few workers had college education (14%). About 63% of the participants were currently cigarette smokers. With regard to respiratory complaints, 19%, 9% and 5% of workers reported chronic cough, dysnoea and wheezes respectively.(Figure 1) Spirometry revealed that 64% of participants had abnormal (impaired) lung function test. The vast majority of cases with impaired lung function were restrictive (59%), and only 5% of workers were



obstructive.(Table 1).

Table.1 : Description of Socio-demographic and medical characteristic of the participants.

Socio-demographic characteristics	Number (n)	Percent (%)
<b>Age group (in years):</b>		
Less than 25	29	29
25-34	19	19
35-44	20	20
45-54	24	24
55+	8	8
Age (mean $\pm$ SD)	36.59 $\pm$ 9.2 years	
<b>Marital status:</b>		
Single	5	5
Married	89	89
Divorced	6	6
<b>Education:</b>		
School level	86	86
University level	14	14
<b>Smoking status:</b>		
Current smoker	63	63
Current non-smoker	37	37
<b>Lung functions:</b>		
Normal spirometry	36	36
Abnormal spirometry	64	64
<b>Detailed lung functions:</b>		
Normal spirometry	36	36
Restrictive	59	59
Obstructive	5	5

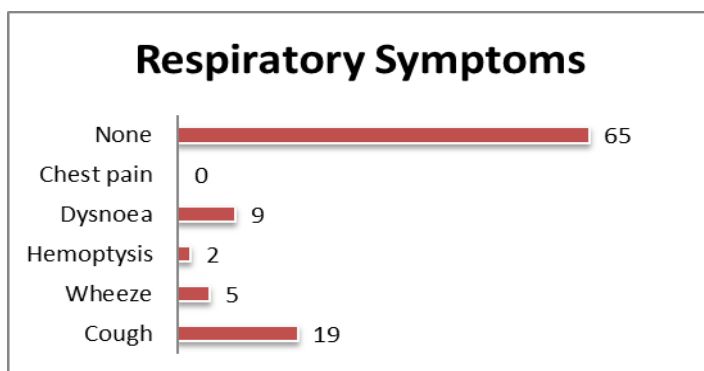


Figure 1 : Proportion of Stone cutting workers with respiratory symptoms

Table 2 shows that 19% of the workers were working in closed and poorly ventilated areas, while 81% were working in open and well ventilated areas. 32% participants had work experience of 5-10 years, 42% had 11-20 years experience and 26% had >21 years work experience. About half (51%) of participants were involved in working more than 8 hours daily. Only 23% of the participants reported that they used Personal Protective Equipments (PPE) most of the time, while 77% reported that they sometimes used PPE.

working conditions	Number (n)	Percent (%)
<i>Duration of work:</i>		
5-10yrs	32	32
11-20yrs	42	42
>21yrs	26	26
<i>Work more than 8 hours daily:</i>		
Yes	51	51
No	49	49
<i>Using PPE:</i>		
Most of the time	23	23
Sometimes	77	77
<i>Type of Workplace:</i>		
close and poorly ventilated	19	19
open and well ventilated	81	81

Table 3 illustrates the relation between different risk factors and abnormal pulmonary function test among workers. The results showed that duration of work (in years), working hours per day, and use of PPE were significantly associated with abnormal pulmonary function test ( $p < 0.05$ ). Associations with other factors were not found to be statistically significant.

Table .3 : Association of abnormal PFT with the personal and work characteristics of the participants.

Personal and work characteristics	Normal PFT	Abnormal PFT	p-value
<i>Age group:</i>			.69 (NS)
<25 years	20	09	
25-34 years	12	07	
35-44 years	14	06	
45+ years	18	14	
<i>Smoking:</i>			.77 (NS)
Smoker	41	22	
Non smoker	23	14	

<i>Type of workplace:</i> close and poorly ventilated open and well ventilated	11 53	08 28	.54 (NS)
<i>Duration of work:</i> 5-10yrs 11-20yrs >21yrs	11 32 21	21 10 05	.001***
<i>Working hours:</i> >8 hours 8 hours	40 24	11 25	.002***
<i>PPE:</i> Always/most of the time Sometimes	09 55	14 22	.005***

(\*\*\* A *p-value* < 0.05 was considered statistically significant.)

## DISCUSSION

In our study, the most common respiratory symptom was chronic cough (19%). In a study done by S.Vidya Priya *et al.*, 33 (26.4%) had dyspnea, 25 (20%) had cough, 17 (13.6%) had sputum<sup>5</sup>. Ashish Shrivastava *et al.* studied the prevalence of respiratory symptoms among the marble cutting workers and found that the most common reported respiratory problem was dyspnea 26%.<sup>6</sup> SP Yadav *et al.* in their study observed that one - third of the sandstone quarry workers complained of cough with dyspnea, similar to our study.<sup>7</sup>

In our study, 64% of participants had abnormal (impaired) lung function test. The vast majority of cases with impaired lung function were restrictive (59%), and only 5% of workers were obstructive. Saranya Rajavel *et al.* in their study among sandstone mine workers in Jodhpur, Rajasthan, observed that abnormal spirometry (abnormal pulmonary function) was found in about 89.2% of workers. Approximately, 42% of these employees had abnormal findings in chest X- rays.<sup>8</sup> Findings of V. B. Ghotkar *et al.* among the stone quarry workers found that the impairment of the lung function was associated with the increasing age, duration of dust exposure, status of smoking, and presence of chronic obstructive airway disease.<sup>9</sup> Mashaallah Aghilinejad *et al.* found that 35 workers had abnormal spirometry findings among their study population.<sup>10</sup>



The current study showed an increase in percentage of workers with abnormal PFT among workers with longer duration of exposure and long working hours (Table 3). In a study done by El-Salamoni et al., they found that 18.6%, 20.9% and 30% of workers with exposure duration <10yrs, 11-20yrs and >21 years had abnormal PFT respectively <sup>11</sup>. Similarly, Singh et al., (2006) noticed that defects in lung ventilation were significantly related to the duration of exposure more than 20 years<sup>12</sup>. This observation was also in agreement with data reported by Urom et al., (2004), who found that the lung function indices correlated negatively with duration of employment <sup>13</sup>. Moreover, Singh et al., (2007) found that exposure duration and exposure concentrations are the main factors responsible for the reduction in forced vital capacity of lungs, and damage the respiratory tract of quarry workers.<sup>14</sup> Furthermore, CH Kiran et al., (2014) reported that the % reduction of pulmonary function values was positively correlated with duration of their work.<sup>15</sup> It was found that those who wear PPE more regularly had lesser percentage of pulmonary restriction compared to those who rarely use, which emphasizes the importance of PPE in decreasing respiratory problem among quarry workers. This agree with Nigerian study that reported lack of PPE usage in the quarry industrial site as one of the causes for the high prevalence of some of the respiratory problems reported in this study <sup>16</sup>.

## CONCLUSION & RECOMMENDATIONS

Data from our study suggest that as the duration of the years of work as stone cutting worker had a significant association with the pulmonary function, periodic screening is recommended, and further exposure must be avoided when there are compromised lung functions. Effective use of PPE should be recommended and reinforced to prevent respiratory morbidities. Also provision of legislative measures by the government to mandate the owners to provide PPEs such as respirators and facemask for their workers. In addition to this, the workers should be educated about occupational health and safety.

Limitations – Study sample was not large .

## ACKNOWLEDGEMENTS

We would like to thank all the Participating Subjects , Our HoD that time Dr. P.K Kasar & Mr. Adil Expert Technician of Spirometry.

Compliance With Ethical Standards.

Conflict Of Interest – None.

Funding – None.

Consent - Obtained.

## REFERENCES:

1. World Health Organization. Regional Office for the Eastern Mediterranean. Occupational Health: A Manual for Primary Health Care Workers; 2002. Available from: <https://apps.who.int/iris/handle/10665/116326>.
2. Vlahovich KP, Sood A. A 2019 update on occupational lung diseases: A narrative review. *Pulm Ther* 2021;7:75-87.
3. Lippmann M, Yeates DB, Albert RE. Deposition, retention, and clearance of inhaled particles. *Br J Ind Med* 1980;37:337-62.
4. Theodore FH, Paul G. Pulmonary deposition and retention of inhaled aerosols. In: E-Book: Environmental Science. First edition: Elsevier; Cambridge, Massachusetts, United States 1964. Available from: <https://www.elsevier.com/books/pulmonary-deposition-and-retention-of-inhaled-aerosols/hatch/978-1-4832-5671-9>
5. Priya SV, Rajalingam R, Vallabhaneni V, Varghese J. A cross-sectional study of lung functions and respiratory morbidity in stone sculptors in rural areas of Kanchipuram District. *Indian Journal of Respiratory Care*. 2022 Jul 1;11(3):261.
6. Shrivastava A, Tomar SP, Patel M. Prevalence of symptoms of occupational lung diseases in marble cutting workers. *Int J Community Med Public Health* 2018;5:3368.
7. Yadav SP, Anand PK, Singh H. Awareness and practices about silicosis among the sandstone quarry workers in desert ecology of Jodhpur, Rajasthan, India. *J Hum Ecol* 2011;33:191- 6.
8. Rajavel S, Raghav P, Gupta MK, Muralidhar V. Silico- tuberculosis, silicosis and other respiratory morbidities among sandstone mine workers in Rajasthan – A cross- sectional study. *PLoS One* 2020;15:e0230574.
9. Ghotkar VB, Maldhure BR, Zodpey SP. Involvement of lung and lung function tests in stone quarry workers. *Indian J Tuberc* 1995;42:155- 60.
10. Aghilinejad M, Naserbakht A, Naserbakht M, Attari G. Silicosis among stone- cutter workers: A cross- sectional study. *Tanaffos* 2012;11:38- 41.
11. El-Salamoni Ok, Ibrahim HM, El-Din WS. Pulmonary Problems among Stone Cutting Workers in West Bank-Palestine. *Med. J. Cairo Univ*. 2015 Sep;83 (1).
12. Singh S., Chowdhary G., Purohit G.: Assessment of impact of high particulate concentration on peak expiratory flow rate of lungs of sand stone quarry workers. *Int. J. Environ. Res. Public Health*, 3 (4): 355-9, 2006.
13. Urom S., Antai A., Osim E.: Symptoms and lung function values in Nigerian men and women exposed to dust generated from crushing of granite rocks in Calabar, Nigeria. *Nigerian Journal of Physiological Sciences*, 19 (1): 41-7, 2004.

14. Singh S., Chowdhary G., Chhangani V., Purohit G.: Quantification of reduction in forced vital capacity of sand stone quarry workers. *Int. J. Environ. Res. Public Health*, 4 (4): 296-300, 2007.
15. C.H. Kiran Kumar, Mallikarjuna Reddy N., Sharan B. Singh M., Bandihari Krishna, Sasikala P., Shravyakeerthi G, Siva Kumar A. Kareem S: Deterioration of pulmonary function in stone quarry workers. *Biomedical Research*, 25 (2): 261-6, 2014.
16. Nwibo A., Ugwuja E., Nwambeke N : Pulmonary Problems among Quarry Workers of Stone Crushing Industrial Site at Umuoghara, Ebonyi State, Nigeria. *The International Journal of Occupational and Environmental Medicine*, 3: 178-85, 2012.