Pak. J. Chest Med. 2024;30(01)

Original Article

journal homepage: https:/www.pjcm.net/

Pakistan Journal of Chest Medicine

Official journal of Pakistan Chest Society

Comparison of Pulmonary Function tests in workers of different working units at Marble factories in Peshawar

Hina Benish Khan[1], Shahid Salam[2] ✉, Saadia Ashraf[3], Zafar Iqbal[4], Dur e Shahwar Ali[1], Asma Inam[1]

[1]Department of Physiology, Khyber Medical College, Peshawar – Pakistan [2]Provincial TB Control Program, Khyber Pakhtunkhwa - Pakistan [3]Department of Pulmonology, Medical Teaching Institute, Khyber Teaching Hospital, Peshawar - Pakistan [4]Department of Pulmonology, Medical Teaching Institute, Lady Reading Hospital, Peshawar - Pakistan

Corresponding Author:
Shahid Salam
Provincial TB Control Program,
Khyber Pakhtunkhwa - Pakistan
Email: shahidsalam1985@gmail.com

Article History:

Received:	Oct 11, 2023
Revised:	Jan 28, 2024
Accepted:	Feb 15, 2024
Available Online:	Mar 02, 2024

Author Contributions:
HBK conceived idea, SS HBK drafted the study, HBK AI DSA collected data, ZI SA did statistical analysis and interpretation of data, SS ZI critical reviewed manuscript. All approved final version to be published.

Declaration of conflicting interests:
The authors declare that there is no conflict of interest.

How to cite this article:
Khan HB, Salam S, Ashraf S, Iqbal Z, Ali DS, Inam A. Comparison of Pulmonary Function tests in workers of different working units at Marble factories in Peshawar. Pak J Chest Med. 2024; 30(01):46-50

A B S T R A C T

Background: Occupational lung diseases are some of the more important yet underdiagnosed pulmonary diseases. The more important reason for this is the lack of knowledge in the general public as well as general practitioners. Marble factories are a very common source of occupational dust exposure leading to derangements in lung functions and lung disorders. Pulmonary function tests are an important step in evaluation of lung functions for the sake of diagnosing various lung disorders1.

Objective: To determine the relationship between marble factory workers and lung derangements with respect to their place of job.

Methodology: This study was conducted in marble factories located on Warsak road, Hayatabad, and suburbs of Peshawar. 2-step randomization was used to initially select factories and then workers in each factory. A total of 45 factories were selected, followed by selection of 357 workers, 8 in each factory with 4 workers from each of the 2 units (polishing and grinding units). Spirometry was then performed on these workers and the obtained data was analyzed using SPSSv22.

Results: All the participants were male with mean age of 33. The workers were divided into 2 groups according to work place as grinding unit and polishing unit, 183 workers were from grinding units while 174 workers were from polishing unit. Out of the 183 workers from grinding unit, 137 had normal spirometric findings, 46 workers had abnormal findings on spirometry.
In the polishing unit, out of 174 workers, 151 workers had normal spirometric findings, 23 workers had abnormal spirometric findings. ANOVA test was applied. Workers in grinding unit shows more deranged pulmonary functions as compared to workers in polishing unit.

Conclusion: Workers in the grinding unit were at greater risk of developing deranged pulmonary functions as compared to workers in polishing unit.

Keywords: Occupational Lung Diseases, Spirometry, Silicosis, Marble factory workers

Introduction

Occupational lung diseases are a group of diseases which is caused by inhalation of dust, chemicals, or proteins.[12] Repeated and prolong exposure to certain irritants on the job location can cause a number of lung disorders that may persist after the cessation of exposure.3 It's also known that even a single and severe exposure to a strong agent can damage the lungs.4 The severity of disease is directly related to the material inhaled, intensity and the duration of inhalation.5 Indirect exposure can also cause occupational diseases.'6 With the development of modern industrialization, the number of lung diseases increases dramatically. Increased dust exposure is a very common problem especially in developing countries like Pakistan.7 As we know prolonged inhalation of crystalline silica results in occupational lung diseases. Inhalation of silica causes pulmonary reaction to it which effect the pulmonary functions.8 In initial stage the patient does not experience any symptoms so this disease is underestimated.9 Pakistan is also included because no preventive measures are applied in Pakistan. There are different factors that can cause air pollution. A very important source of dust are the marble factories especially in our city of Peshawar. Numerous marble stone factories are present in the suburbs of Peshawar, mainly in and around Warsak road and Hayatabad industrial zone. Thousands of laborers work here. Marble stone is used in many different shapes and sizes for different things namely; decorating floors and walls, buildings and crafting statues etc. Exposure to this dust cause various lung disorders, like pneumoconiosis and silicosis.10

In the light of above we decided to conduct a study targeting these factories where marble stone was being prepared. As discussed below, marble stone dust is a very important factor in causing occupational lung diseases leading to significant morbidity and mortality. One factor conducting this study was the lack of local research targeting these workers and the impact of marble stone dust on the workers especially in the context of extreme lack of occupational hazard mitigation measures. The study was also very important as it not only addresses the issue of impact of marble stone dust on lung function but also the various units of the factory where different steps of marble stone finishing was done namely the polishing and the grinding unit. The lung functions are more deranged in workers working in grinding unit as compared to polishing unit at marble factories.

This was the most important conclusion that we wanted to derive from our study and it was first of its kind study in our region with this hypothesis. It also proved a first step towards opening further dimension and avenues of research in these local marble factories as well as it will signify the importance of mitigation measures in such factories. The data might well be used as a source in improving the working conditions of these factories as we have seen in other countries where such studies were conducted leading to increased awareness and timely detection of their lung disorders.

Objectives

To evaluate the lung functions (FEV1, FVC, FEV1 /FVC) of workers at marble factories in Peshawar with respect to their unit of job.

Methodology

The present study was conducted at different Marble Factories situated on Warsak road, Hayatabad and suburbs areas of District Peshawar. It was a descriptive cross-sectional study conducted from 3rd March 2019 to 1st September 2019 (6 months duration). These factories were small to medium sized factories where large marble stone were initially cut into small pieces followed by the grinding and polishing into final product. It was mix of open plus closed environment setup.

Taking 95% Confidence level and confidence interval of 5, the sample size came out to be 357.

It was a 2 stage random sampling, in the first stage factories were selected and then 8 workers from each factory were selected. Four workers from each grinding and polishing unit were selected. All workers were nonsmoker of age 18 to 60 with at least 1 year of work duration at marble factory with no previous pulmonary disease or any other pathological condition affecting the spirometric values.

A questionnaire was given to the workers for collection of personal, epidemiological and work-related data followed assessment of lung functions by spirometry. Initially their weight and height was measured followed by evaluation of their smoking history (if any). This was followed by informing them about the test that was being conducted and also taught as to how to perform the test. Some workers were not able to perform adequate spirometry which were then properly guided again until they had performed an adequate spirometry test. Each worker was made to perform three blows and the best blow was selected automatically by the spirometry software.

Results

All of the subjects in the present study were male and non-smokers. None of them had any previous health issue that could affect spirometric findings. Age of the workers ranged from 18-60 years. More than 60% of workers had their age between 26 and 4. The mean age in workers of both units was almost same. The age was kept within similar range so that there is minimal age-related bias.

Table 1. Spirometry findings of study cases

Spirometry	Grinding (n =183)	Polishing (n =174)	P-value
FVC	89.48±9.260	92.32±7.627	0.004
FEV1	90.50±8.532	92.35±7.183	0.085
FEV1/FVC	85.07±8.860	84.16±6.934	0.662

ANOVA test was done to assess the relation of dust exposure to deranged pulmonary functions. which showed that 80.67% of workers had normal spirometric findings, 14.01% had restrictive, 3.92% had obstructive while 1.40% had mixed findings on spirometry.

Mean FVC% in the different working units is shown in Table 1. The FVC% of grinding unit workers is slightly lower than that of polishing units. The same pattern is seen when FEV1% of both unit is compared. We can see that FEV1% of grinding units are slightly lower than that of polishing units and p value is non-significant.

Table 2 shows that total workers were 357 out of which 183 workers were from grinding unit while 174 workers from polishing units. Out of the 183 workers from grinding unit, 137 (74.8%) had normal spirometric findings, 8 (4.3%) had obstructive while 36 (19.6%) had restrictive and 2 (1.09%) had mixed findings on spirometry.

In the polishing unit, out of 174 workers, 151 (86%) had normal spirometric finding, 6 (3.44%) had obstructive changes, 14 (8%) had restrictive while 3 (1.72%) had mixed findings on spirometry.

In the Fig 1 there is comparison of various diagnosis amongst the 2 working groups, i.e. grinding and polishing. As we can see that polishing unit workers had better spirometric output when compared to grinding units.

Discussion

Occupational lung diseases are a broad term which include number of diseases caused by work area exposures. These are caused by inhaling different small particles like dust, minerals and proteins. These small particles cause lung inflammation and inflamed air sacs in lungs which is the basis of lung injury that happens in occupational lung diseases. Earth crust main component is silica. It is found in alpha, beta quartz form and it has harmful effects on respiratory system11. There are numerous occupational lung diseases that are present but some of the most common and important are silicosis, coal workers pneumoconiosis, asbestosis etc.12

Incidence of Silicosis was highest in the late nineteenth and early twentieth century.13 A study was done in Iran in which they took symptomatic patients, they selected 180 workers. Out of 180 workers 16 workers showed silicosis 11 had an abnormal radiographic pattern on their chest x ray in which 7 had obstructive pattern and 4 had restrictive pattern.14 In our study, we had to take asymptomatic workers and check their level of lung derangements as those with symptoms are already in advance stage of lung disease. The reason for this was to check how early does lung function deteriorates before the appearance of symptoms, if they do get deranged.

In another study by Ghotker, the morbidity due to respiratory problem was 32.5% in marble factory workers and this study showed a very strong relation between the severity of pulmonary function derangement to duration of exposure to dust and smoking.

In a study by Ophir et al. also found that ultrafine silica particles have strong relation with and responsible for the deterioration of pulmonary function parameters among

Table 2. Diagnosis within working units

		Diagnosis					
		Normal (%)	Obstructive (%)	P Value Restrictive (%)	Mixed (%)	Total	
Working Unit	Grinding	137 (74.9)	8 (4.4)	36 (19.7)	2 (1.1)	183 (100.0)	0.014
	Polishing	151 (86.8)	6 (3.4)	14 (8.0)	3 (1.7)	174 (100.0)	
Total		288 (80.7)	14 (3.9)	50 (14.0)	5 (1.4)	357 (100.0)	

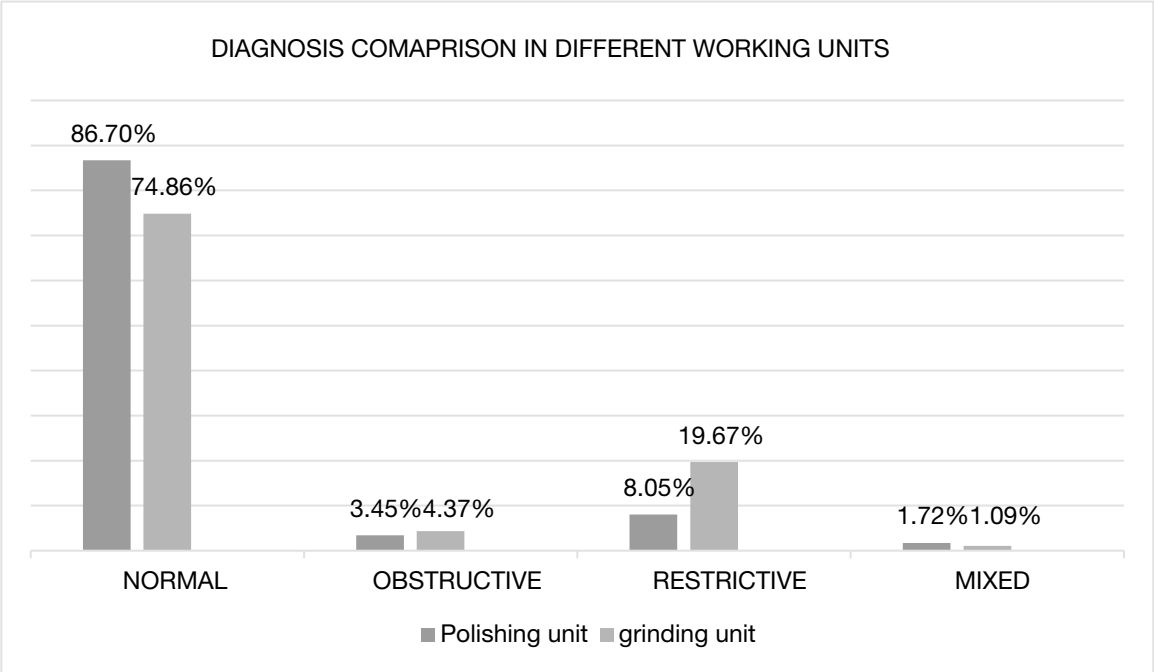

Figure 1. Diagnosis comparison in various units

stone factory workers.15

A study in Palestine was conducted on workers in stone crush plant. Total 259 workers were selected.21.6 % showed abnormal spirometric findings with 20.1% showed restrictive and 1.5% shoed obstructive pattern. Restrictive pattern was present in majority of cases.16 In the present study the restrictive pattern was more common than obstructive, as was seen in the study conducted by Hatim M. Jabar in Palestine. This study in Palestine also concluded that smoking was also an independent factor other than silica dust exposure in the derangements of lung function. This was the reason that we excluded smokers from our study so that we could only see the effect of dust on pulmonary functions.

Another study was conducted in Pakistan in stone crush plants to check silicosis and pulmonary functions test in workers. Total 204 workers were selected among which 18 were diagnosed with silicosis, 13 with simple silicosis and 4 with advanced silicosis and 1 was diagnosed as complicated silicosis7. This study shows that the chance of silicosis development is more in cases which has abnormal PFTS. Also it was found that silicosis was most common in cases having restrictive pattern in PFT7. In our study we also found more restrictive pattern on spirometry.

A study was conducted by Butt IM in Pakistan, they compared the spirometric findings of marble factory workers and control group. They concluded that about 71% of workers from the exposed group had statistically significant ($p < 0.001$) abnormal spirometry results whereas none of the healthy individuals (non-exposed) had abnormal spirometry results. which shows dust exposure cause abnormal pulmonary functions.17

Furthermore, many other studies are conducted in India, Thailand, Iran, Egypt, Nigeria and Libya reported similar findings and mean values of pulmonary function parameters were found to be remarkably deteriorated resulting in pulmonary dysfunction.

Our study was aimed at exploring the established fact that the pulmonary function tests are deranged in marble stone workers especially in grinding unit. The things which differentiate this study from all the previous ones are as follow.

It was the 1st local study to comprehensively look at the association between marble factory workers and spirometric changes. Previous study that was conducted wasn't exclusive to marble factory workers and also the number of participants were far too few.

Another strength of this study is the classification of workers according to different units, i.e. grinding and polishing units. This classification was important in order to see which workers are at greatest risk for developing occupational lung disorders. Previous studies would take factory workers as a whole and thus we cannot identify which marble factory units are at greater risk.

Conclusion

The study highlights a significant difference in pulmonary function between workers in different units of marble

factories. Specifically, workers in the grinding unit exhibited a higher prevalence of abnormal spirometric findings compared to those in the polishing unit. This suggests that the nature and extent of dust exposure in the grinding unit may be more detrimental to lung health than that in the polishing unit. Consequently, targeted interventions to reduce dust exposure and improve protective measures in grinding units are crucial to mitigate the risk of occupational lung diseases among marble factory workers.

Further research is needed to look for the reasons causing greater derangement of lung functions in grinding unit then in polishing unit.

References

1. De Matteis S, Heederik D, Burdorf A, Blanc PD, Kromhout H, Kramer MR, et al. Current and new challenges in occupational lung diseases. Eur Respir Rev. 2017;26(146):170080. DOI:10.1183/16000617.0080-2017.
2. Cooper JH, Johnson DL, Phillips ML. Respirable silica dust suppression during artificial stone countertop cutting. Ann Occup Hyg. 2015;59(1):122-6. DOI:10.1093/annhyg/meu083.
3. Burge PS. Recent developments in occupational asthma. Swiss Med Wkly. 2010;140(9-10):128-132. DOI:10.4414/smw.2010.12883.
4. Shaik A, Afroze M K. Lung Function Test in Quarry Workers. Int J Innov Res Dev. 2015;4:50-55.
5. Jaakkola MS, Sripaiboonkij P, Jaakkola JJK. Effects of occupational exposures and smoking on lung function in tile factory workers. Int Arch Occup Environ Health. 2011;84(2):151-158. DOI:10.1007/s00420-010-0603-6.
6. Sheta S, El Laithy N. Brick Kiln Industry and Workers' Chronic Respiratory Health Problems in Mit Ghamr District, Dakahlia Governorate. Egypt J Occup Med. 2015;39(1):37-51. DOI:10.21608/ejom. 2015.809.
7. Ullah I, Sarwar G, Hamayun M, Khan MS. Frequency of silicosis and its relationship with dust and pulmonary functions tests in stone crushing industries workers in Peshawar. KJMS. 2018;11(2).
8. Joseph B. Dealing with Occupational Lung Diseases - A few challenges. Indian J Occup Environ Med. 2019;23(3):101. DOI:10.4103/ijoem.IJOEM_282_19.
9. Draid MM, Ben-Elhaj KM, Ali AM, Schmid KK, Gibbs SG. Lung function impact from working in the pre-revolution Libyan quarry industry. Int J Environ Res Public Health. 2015;12(5):5006-5012. DOI:10.3390/ijerph120505006.
10. Isara AR, Adam VY, Aigbokhaode AQ, Alenoghena IO. Respiratory symptoms and ventilatory functions among quarry workers in Edo state, Nigeria. Pan Afr Med J. 2016;23:212. DOI:10.11604/pamj.2016.23.212.7640.
11. Park R, Rice F, Stayner L, Smith R, Gilbert S, Checkoway H. Exposure to crystalline silica, silicosis, and lung disease other than cancer in diatomaceous earth industry workers: a quantitative risk assessment. Occup Environ Med. 2002;59(1):36-43. DOI:10.1136/oem.59.1.36.
12. Barnes H, Goh NSL, Leong TL, Hoy R. Silica-associated lung disease: An old-world exposure in modern industries. Respirology. 2019;24(12):1165-75. DOI:10.1111/resp.13695.
13. Kramer MR, Blanc PD, Fireman E, Amital A, Guber A, Rhahman NA, et al. Artificial stone silicosis [corrected]: disease resurgence among artificial stone workers. Chest. 2012;142(2):419-424. DOI:10.1378/chest.11-1321.
14. Aghilinejad M, Naserbakht A, Naserbakht M, Attari G. Silicosis among Stone- Cutter Workers: A Cross-Sectional Study. Tanaffos. 2012;11(2):38-41.
15. Ophir N, Bar Shai A, Korenstein R, Kramer MR, Fireman E. Functional, inflammatory and interstitial impairment due to artificial stone dust ultrafine particles exposure. Occup Environ Med. 2019;76(12):875-879. DOI:10.1136/oemed-2019-105711.
16. Mosleh H. Pulmonary Problems among Stone Cutting Workers in West Bank-Palestine. Med J Cairo Univ. 2015;83.
17. Butt IM, Mustafa T, Rauf S, Razzaq A, Anwer J. Pulmonary function parameters among marble industry workers in Lahore, Pakistan. F1000Res. 2021;10:938. DOI:10.12688/f1000research.52749.1.