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Frequency of Respiratory Symptoms among Marble Workers in Cutting and Grinding sections of Marble Factories, Lahore

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ABSTRACT

Occupational exposure to dust particles was a public health problem in developing countries. One of the main dust which is responsible for higher prevalence of obstructive lung diseases is silica dust present in marble factories. **Objective:** To compare the frequency of respiratory symptoms among individuals working in cutting and grinding sections of marble factories, Lahore. **Methods:** A cross sectional study was conducted in marble factories situated in Ichra market, Ferozepur Road Lahore, during April to September 2022. Forty-one marble employees each from wet cutting and dry grinding sections were selected after obtaining written consent from the respondents. Data were collected in a pretested standardized questionnaire regarding socio demographic and respiratory symptoms. The data were analyzed by SPSS version 24.0. **Results:** The mean age of workers was 29.93 ± 6.18 years while mean years of work experience was11.19 ± 5.66 years. 20 (48.78%) workers of dry cutting had cough as compared to 14 (34.14%) workers of wet cutting section. Similarly, 11 (26.8%) workers of grinding section had experienced phlegm whereas 6 (14.63%) from wet cutting workers complained of this symptom. Similarly, breathlessness and chest tightness were more prevalent among grinding workers as compared to marble cutting workers showing statistically significant association (p-value < 0.005). Greater than 15 years of work exposure, respiratory symptoms were significantly (p-value < 0.001) more common in grinding workers than in cutting workers. **Conclusion:** Respiratory symptoms were more marked among grinding workers than among wet cuttings workers.

INTRODUCTION

Occupational lung diseases have been a serious threat to global health since the beginning of civilization [1]. Because of growing urbanization, over 90% of the world's population is susceptible to the negative impacts of air pollution [2]. According to estimates from the World Health Organization (WHO), the 13th leading cause of mortality worldwide is due to the presence of the deadliest Particulate Matter (PM), specifically airborne particles with a diameter of 2.5 micrometers. These particles are thought to cause approximately 800,000 premature deaths annually [3]. By 2060, it is predicted that 6.9 million people will die from air pollution-related causes annually, if severe control measures are not put in place [4]. One of the most common air pollutants is dust. The marble sector is one of them which produces such type of dust containing silica, a hazardous material. The term "silica" is a generic term for minerals with the chemical formula SiO2, or Silicon Oxide [3, 4]. The most common mineral on earth is thought to be silica. Free silica has been labelled a group 1 carcinogen by the International Agency for Research on Cancer (IARC), which causes lung cancer in people with underlying silicosis [5, 6]. Nowadays, it is estimated that 23 million employees in China, 11.5 million in India, 3.2 million in the European Union, and 2.3 million in the US are exposed to

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quartz or Respirable Crystalline Silica (RCS) on the workplace [6, 7]. In many different industries, workers are exposed to the dust that is produced by crystalline silica [2, 7]. Grinding, cutting, polishing, and cleaning are the main types of activities performed by the marble workers in the marble factories. One of the most chronic work-related illnesses in human history is silicosis. Long-term inhalation of silica compounds results in this chronic, nodular, fibrotic, and granuloma formation [7, 8]. There has been a noticeable increase in silica exposure due to the growing usage of artificial marble, which is made up of 85–93% RCS and responsible for a sharp rise in the number of silicosis cases, which are primarily recorded in Spain, Australia, and Israel [4, 7]. Due to the increasing demand for work involving silica exposure and the absence of adequate protection, the incidence of silicosis is rising globally [8]. In addition to silicosis, silica exposure can result in a number of other illnesses. Prior studies have shown a link between increasing silica exposure and the development of pulmonary tuberculosis, lung cancer, Chronic Obstructive Pulmonary Disease (COPD), renal problem rheumatoid arthritis, radioactive disease, autoimmune disorder and benign respiratory diseases [9-13]. A lot of research has been done on this topic globally, however limited literature is available in Pakistan [14]. There is a scarcity of scientific research in Pakistan regarding respiratory issues brought on by occupational dust exposure. Moreover, there is a lack of understanding among the workforce regarding workplace safety.

The study objective was to investigate the occupational health of marble workers exposed to silica dust, and to compare the occupational health impacts between two exposure categories within the marble industry i.e. grinding (dry cutting) and wet cutting sections.

METHODS

This cross-sectional study took place in Ichra Market on Ferozepur Road, Lahore, a heavily urbanized industrial area where marble factories were located. The focus was on marble workers from the grinding (dry cutting) and wet cutting sections. The data were collected over a six-month period from April to September 2022, after getting approval from UHS (No; UHS/Education/126-19/1001). The study group included male marble workers aged 18 to 40 who worked 30 hours or more per week and had been exposed to marble dust for over a year. Workers with chronic respiratory conditions were excluded from the study. In this study, the cough was defined as the rapid, harsh sound produced when air was expelled from the lungs, persisted for longer than eight weeks, while a wheeze was characterized by a persistent, high-pitched, whistling, or rattling sound that comes from the chest during expiration for more than 12 weeks [15, 16]. To determine the sample size, the WHO sample size calculator was utilized, with assumptions made on 5% significance level, 90% study power, population variance ($\sigma 2$) = 0.5329, and anticipated percentages of respiratory problems of study groups I and II ($\mu 1$) = 35.5% and ($\mu 2$) 16.2%, respectively. A total of 82 subjects were the study sample size, forty-one subjects were from each marble section working in the grinding and cutting section respectively [17]. The study population was selected through a simple random sampling method, with 41 individuals chosen for both the marble wet cutting and the marble dry cutting (grinding) group. Each participant was informed about the study, and written informed consent was obtained from those who agreed to participate. All participants were personally interviewed using a functional proforma developed by the American Thoracic Society [18]. All the collected data were entered and analyzed by SPSS version 25.0 Frequency tables were created for categorical variables, whereas mean and standard deviations were computed for continuous variables. Chi square test was used for the comparison among marble workers with years of work exposure. For all analyses, a p-value of ≤ 0.05 was considered statistically significant.

RESULTS

The sociodemographic characteristics between the marble wet cutting and grinding (dry cutting) group were compared and no association ($p > 0.05$) was noted (Table 1).

Table 1: Demographic Characteristics of Marble Workshop Workers Wet Cutting and Grinding (Dry Cutting) Group

Study Variables	Marble Workers (Wet Cutting) Group N (%)/(Mean ± SD)	Marble Workers Grinding (Dry Cutting) Group N (%)/(Mean ± SD)	p-Value
Age (Years)			
21-25	08 (19.51%)	14 (34.15%)	0.068
26-30	12 (29.27%)	13 (31.71%)	
31-35	06 (14.63%)	08 (19.51%)	
36-40	15 (36.59%)	06 (14.63%)	
Mean ± SD	31.17 ± 6.70	28.68 ± 5.42	
Marital Status			
Single	21 (51.22%)	22 (53.66%)	0.822
Married	20 (48.79%)	19 (46.34%)	
Educational Status			
Middle	31 (75.60%)	32 (78.04%)	1.000
Matric	05 (12.20%)	05 (12.20%)	
Intermediate	05 (12.20%)	02 (04.88%)	
Graduation	00 (00.00%)	02 (04.88%)	
Height (cm)	172.59 ± 10.82	173.10 ± 9.66	0.822
Weight (Kg)	75.66 ± 15.60	73.12 ± 11.71	0.408
Experience (Years)	11.03 ± 06.19	11.35 ± 05.16	0.802

Marble workers of the grinding section experienced more coughs (48.78%) cough as compared to 14 (34.14%) wet cutting workers, which was statistically insignificant (p=0.262). Grinding workers also had a higher rate of breathlessness, 10 (24.39%) and chest tightness 8 (19.51%), than wet cutting workers 4 (9.76%) and 1 (2.44%) respectively. Statistically significant result (p=0.015) was noted in chest tightness, while on the other hand no

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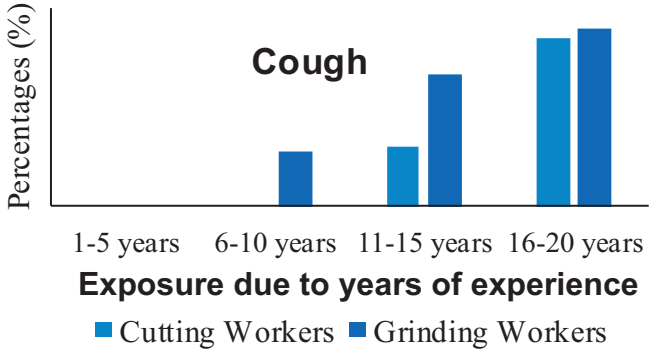
difference (p=0.140) was observed in breathlessness.

Table 2: Respiratory Symptoms among Marble Workers by Study Group (n=82)

Respiratory Symptoms	Grinding		2-Sided Significance
	Wet Cutting Group N (%)	Dry Cutting Group N (%)	
Cough	14 (34.14%)	20 (48.78%)	0.262
Phlegm	6 (14.63%)	11 (26.86%)	0.276
Breathlessness	4 (09.76%)	10 (24.39%)	0.140
Chest Tightness	1 (02.44%)	8 (19.51%)	0.015
Wheezing	0 (00.00%)	2 (04.88%)	0.494

Cough, phlegm, and breathlessness were the predominant respiratory symptoms among marble grinding workers which started to appear soon after 6-10 years of work exposure, while in cutting workers these appeared after 11-15 years of work exposure, and phlegm it showed up after 16-20 years of work exposure (Figure 1).

Figure 1: Comparison of Cough with Years of Exposure among Marble Workers



Chest tightness was the only respiratory symptom developed in both groups after 16-20 years of work exposure, whereas wheezing was the only symptom developed in grinding (dry cutting) workers after 16-20 years of work exposure. The Chi square was applied, which showed that with increased duration of 16-20 years of work exposure, the maximum rate of cough 9 (90%), 11 (84.61%) were noted in grinding (dry cutting) and wet cutting workers respectively, which were statistically insignificant (p > 0.05) (Figure 2).

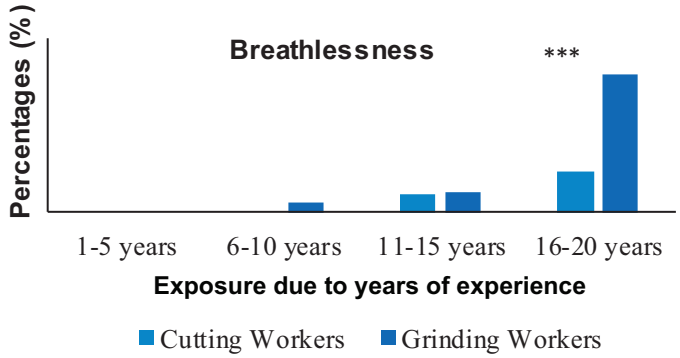


Figure 2: Comparison of Breathlessness with Years of Exposure among Marble Workers

Similarly, with same work exposure, the maximum rate of phlegm 9 (90%), 6 (46.2%) were noted in grinding (dry cutting) and wet cutting workers respectively, which were statistically significant (p < 0.05) (Figure 3).

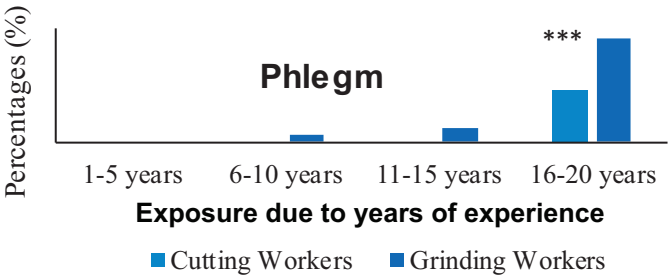


Figure 3: Comparison of Phlegm with Years of Exposure among Marble Workers

Similar to this, workers who had work exposure of 16-20 years, more incidence of breathlessness 8 (98%), 3 (23.1%) and chest tightness 7 (70%), 1 (7.7%) were observed among grinding and wet cutting workers respectively (Figure 4).

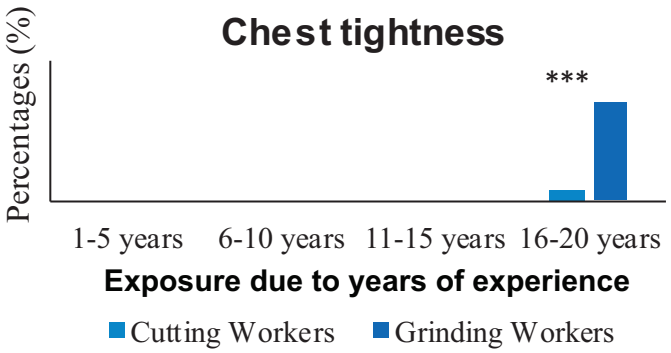


Figure 4: Comparison of Chest Tightness with Years of Exposure among Marble Workers

Similarly, the percentage of grinding workers who reported phlegm 11 (26.83%) was also higher than that of wet cutting workers 6 (14.63%), with insignificant (p=0.276) findings. The Chi square test showed that breathlessness and chest tightness were highly statistically significant among both groups (p < 0.001). The only reported respiratory symptom among grinding workers was wheezing (20%), and it was significant (p < 0.05) when the workers had been exposed to work for 16 - 20 years (Figure 5).

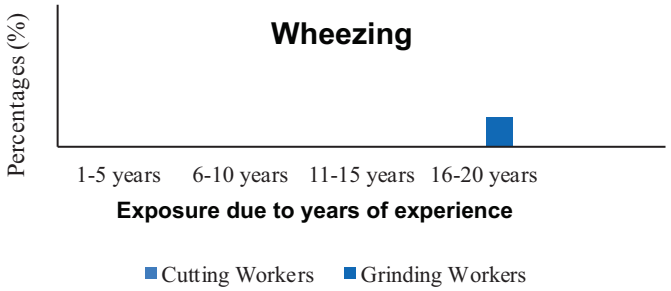


Figure 5: Comparison of Wheezing with Years of Exposure among Marble Workers

df = 1, Statistically Significant at $\alpha \leq 0.05$ (***p-value≤0.05)

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DISCUSSION

Cough, phlegm, breathlessness, and chest tightness were the most predominant reported respiratory symptoms in this study. The investigation's results were comparable to those of previous studies carried out in Bangladesh and Turkey [19, 20]. It was determined that individuals working in marble areas were more susceptible to respiratory problems due to prolonged exposure to silica dust. Additionally, they provided evidence of a high correlation between respiratory impairment and prolonged exposure to silica dust [19, 20]. The study findings indicated that cough was the most reported respiratory complaint. This finding was in consistent with earlier studies conducted by Ullah (50%), Isara (35.5%) while several authors, including Aydin (14.46%), Thongtip (17%) and Nemer (11.4%), reported a considerably lower prevalence of cough than this study's result [14, 17, 21, 22, 23]. Phlegm was the second most prevalent respiratory condition identified in the current study. Several researchers Thongtip (3%), Aydin (9.95%), found relatively low prevalence [20, 22]. Their working knowledge, routine medical examinations, understanding of personal protective equipment, high standards, and regulatory restriction were probably the main causes of the low prevalences of these symptoms. Most of the previous researchers Aydin, Ullah, had documented in their studies that all these respiratory symptoms linked to marble dust generated during marble crushing activities and with increased work exposure were significantly ($P < 0.005$) associated with worsening of respiratory ventilation which were consistent with the findings of this study [20, 14]. In contrast to current study findings, stone crushing workers in Bangladesh reported extremely high rates of cough (66.5%), chest tightness (76.00%), shortness of breath (74.5%), wheezing (45.5%), and phlegm (29.5%) [19, 23]. Study limitation includes recall errors, information bias and harmful substances in the workplace, chemical compounds present in the stone, undetectable amounts of dust particles other than silica, which were not addressed in this study. Marble workers should undergo pre-employment screening and to enhance the working environment there was a need for health education, and rationalization of working procedures (like ergonomics, protective equipment, safety method, government regulations, longitudinal or interventional studies) in marble factories. In future more longitudinal or intervention studies with larger sample sizes were recommended to determine the temporal association between pulmonary system and numerous variables for better worker knowledge and understanding of health risks based on observation.

CONCLUSIONS

Respiratory symptoms were found to be more common in grinding (dry cutting) workers soon after 1-5 years of dust exposure as compared to the wet cutting workers, who developed after 6-10 years of exposure. The present study showed that working in the marble factories constantly for more than 15 years led to the higher prevalence of respiratory symptoms, this would ultimately disrupt their state of health.

Authors Contribution

Conceptualization: IMB
Methodology: IMB, SH, AC, MJK, JI, FM
Formal analysis: IMB, FM
Writing, review and editing: IMB, SH, AC, MJK, JI

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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