An Analytical Study Carried Out to Identify Symptoms of Occupational Lung Diseases and Preventive Measures among Workers Involved in Marble Industries in Rajsamand District of Rajasthan

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ABSTRACT

BACKGROUND

Occupational lung diseases are diseases affecting the respiratory system, including occupational asthma, black lung disease and many more. Workers exposed to marble dust stand an increased risk of suffering from asthma symptoms, chronic bronchitis, nasal inflammation and impairment of lung functions. The recognition of occupational causes can be made difficult by years of latency between exposure in the workplace and the occurrence of disease. Through this study, authors have established the importance of early identification of symptoms of occupational lung diseases and the importance of preventive measures that can be applied to reduce incidence of such diseases.

METHODS

This was a cross sectional community-based study conducted on 340 marble mining or cutting workers of Rajnagar [Morwar], Rajsamand district of Rajasthan, for a duration of three months. Workers were clinically examined and asked about environmental conditions and use of preventive measures through a questionnaire designed by the investigators and with the help of pamphlets and videos, educational interventions were provided.

RESULTS

Almost 90 % of the workers didn't use protective measure like mask or shield. Among the 10 % workers who were using safety measures, 60 % were using face mask and 20 % were using apron at the work place. After the educational intervention given by investigators, around 63 % had started using various safety measures.

CONCLUSIONS

Early interventions after development of symptoms are important as they can decrease chances of further worsening of the condition. Health education, periodic health check-ups and use of protective measures are the essence in preventing occupational lung diseases.

KEYWORDS

Occupational Lung Disease, Cough, Marble Workers, Silicosis

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DOI: 10.18410/jebmh/2021/11

How to Cite This Article:
Gupta K, Parmar M, Bhavsar P, et al. An analytical study carried out to identify symptoms of occupational lung diseases and preventive measures among workers involved in marble industries in Rajsamand district of Rajasthan. J Evid Based Med Healthc 2021;8(02):53-57. DOI: 10.18410/jebmh/2021/11

Submission 04-09-2020,
Peer Review 10-09-2020,
Acceptance 23-11-2020,
Published 11-01-2021.

BACKGROUND

Exposure to dust because of one's occupation is a common phenomenon, especially in a developing country like India.[1] Major contributors to air pollution include refineries, power plants, petro chemical industries and cement factories. Quarrying sites are also considered among sources of high emission of particulates.[2] Occupational lung diseases are occupational diseases affecting the respiratory system, including occupational asthma, black lung disease (coal worker's pneumoconiosis), chronic obstructive pulmonary disease (COPD), mesothelioma and silicosis.[3] The association between respiratory disorders and quarrying has been supported by numerous analytical studies. Exposure to substances like flock and silica can cause fibrosing lung disease, whereas exposure to carcinogens like asbestos and beryllium can cause lung cancer.[4] Fortunately, severe consequences of chronic obstructive pulmonary disease [COPD] can be prevented through early recognition and effective interventions directed at controlling known risk factors. Current knowledge of the pathogenesis of COPD indicates that chronic inhalation of toxic particles and gases can lead to progressive tissue injury via a cascade of inflammatory processes in the lung.[5] Tobacco smoking is recognized as the most important risk factor for COPD. Among blue-collar workers, however, occupational exposures contribute to an increased risk of the disease.[6] In developed countries, an estimated 15 % of all COPD is attributable to occupational exposure.[7] In some occupations, the effect of occupational exposure can be as damaging as that of smoking. A study of autopsied U.S. coal miners found that the amount of emphysema associated with coal mine dust can be equivalent to that associated with tobacco smoking.[8]

Many Indian authors have stated that around 3 million workers in India are exposed to silica dust. Estimated 8.5 million more workers who work in construction and building activities are exposed to quartz. Many factors of the mineral dust like size, shape, solubility, reactivity, etc. determine the reaction of the lung to it. Particles that are 1 to 5 μm in diameter are the most dangerous, because they get lodged at the bifurcation of the distal airways.[9] Epidemiological studies indicate that workers exposed to marble dust stand at an increased risk of suffering from asthma symptoms, chronic bronchitis, nasal inflammation and impairment of lung functions.[10]

Many authors have stressed that chest pain, dyspnoea and non-productive cough are the major respiratory symptoms among miners.[11] Considerable pulmonary function impairment have been reported in quarry workers. The physician should consider the possibilities of occupational exposure when a working or retired adult presents with unexplained respiratory illness. Identifying a workplace-related cause of disease is important because it can lead to cure and prevention. The recognition of occupational cause is difficult due to delayed responses that occur at home after work and due to years of latency between exposure in the workplace and the occurrence of disease.

Rajsamand district of Rajasthan is very well known for its marble production as it is the largest marble producing district in the whole country.[12] This district has many villages where residents are mostly workers employed in marble mining and cutting. These people have lower education and belong to a lower socio-economic class. Marble is a metamorphic rock composed of recrystallized carbonate minerals, most commonly calcite or dolomite.[13] It has been widely used in the sculpturing of statues and in the construction of buildings and monuments since ancient times. Workers who quarry, grind, polish and install marbles are exposed to the dust, which contains particles of calcium carbonate and silica. Prolonged exposure to respirable crystalline silica has long been known to cause diseases like silicosis,[14] autoimmune disease[15], non-malignant renal disease,[16,17] chronic obstructive pulmonary disease (COPD) and lung cancer.[18]

Complaints like chest pain, chronic obstructive pulmonary disease, chest tightness and abnormal breathing are common among these workers. Like any other lung pathologies, occupational lung disorders also require initial chest X-ray or computed tomography (CT) for early detection of disease.[19] Workers employed in a marble industry are greatly deployed of personal protective equipment, leading to an exponential increase in the risk of acquiring chronic lung diseases. There is dire need to identify occupational health and safety risks associated at such quarrying working place and provide appropriate safety measures. Through this study, authors have established the importance of early identification of symptoms of occupational lung diseases and the importance of preventive measures that can be applied to reduce incidence of such diseases.

Objectives

1. To study the socio-demographic profile of workers involved in a marble mining industry.
2. Find the prevalence of symptoms of occupational lung diseases among workers.
3. To educate and motivate workers for preventive safety measures.

METHODS

This is a cross sectional community-based study conducted on marble mining or cutting workers of Rajnagar [Morwar], Rajsamand district of Rajasthan, over a period of 3 months from February 2019 to April 2019.

Study Methodology

During mid-February 2019, a questionnaire was developed, subjects were selected and first assessment of study subjects was carried out. During March and April, follow up visits were done and a repeated assessment was done on subjects.

Sample Size

The prevalence of symptoms of occupational lung disease is 0.26.[20] Using this prevalence with absolute error of 5 percent, at 95 percent confidence limit, the sample size came out to be 306. Using attrition rate of 10 percent, 340 subjects were included in the study.

Sampling

Selection of the study subjects was done by using simple random sampling. First, all the workers in the Rajnagar area who were involved in marble quarrying work were enumerated and numbered. Then by using random number table, 340 subjects were finally selected and included in the study.

Educational intervention for the workers, using audio-visual aids, was carried out in each visit. Workers were clinically examined and asked about environmental conditions and the use of preventive measures through a questionnaire by the investigators. We provided educational interventions with the booklets and the videos. They were given safety masks and educated about local preventive measures like use of clothing to cover nose and mouth while working and using water to settle down marble dust.

Inclusion Criteria

Both men and women who were residents of Rajnagar [Morwar] and employed in marble mining or cutting for at least ten years were included in the study.

Exclusion Criteria

If any subject has any long standing pre-existing respiratory illness like tuberculosis, emphysema, pneumonia, asthma, etc were excluded. Also, those who didn't give consent were excluded.

Statistical Analysis

The data was entered in the pre-designed Microsoft Office Excel and responses were coded and analysed by using pre-designed Microsoft Office Excel. The prevalence rates of common respiratory symptoms and use of preventive measures were found out by simple percentages.

RESULTS

	N	Percentage
Age Distribution		
11 - 20	17	5
21 - 30	112	33
31 - 40	126	37
41 - 50	68	20
> 50	17	5
Gender		
Male	306	90
Female	34	10
Educational Level		
Illiterate	105	31
Literate	235	69

Table 1. Demographic Profile of Study Subjects

The study included a total of 340 workers involved in marble mining and cutting industry. Mean age of the study population was 33.5 years (Table 1). Majority of the workers were males (90 %) (Table 1). We found 69 % of the workers to be literate (could read and write with understanding in any language and were above 7 years of age).

Majority of the workers were involved in marble mining (39 %) and cutting (34 %) work. Around 14 % workers were involved in loading the marble blocks. Rest 13 percent workers were involved in other tasks like pulling trolleys, marble finishing and cleaning work. (Table 2)

	N	Percentage
Marble cutting	116	34
Marble mining process	132	39
Loading marble	48	14
Others	44	13

Table 2. Job Designation of Workers

Most common respiratory symptom found among the workers was cough (82 %) followed by shortness of breath (65 %), chest pain in 39 %, weight loss in 30 % and loss of appetite in 25 % workers. Around 5 % workers reported having sputum mixed with blood. (Table 3)

Information on the availability of medical care at marble mining site and use of safety measures revealed total absence of a medical centre in the study area. Almost 90 % of the workers didn't use protective measure like a mask or shield while working. (Table 3)

Common Respiratory Symptoms	N	Percentages
Shortness of Breath	221	65
Chest Pain	132	39
Cough	279	82
Loss of Appetite	85	25
Weight Loss	102	30
Sputum Mixed with Blood	17	5
Protective Measures Used [mask]		
Used before Intervention	34	10
Used after Educational Intervention	306	63

Table 3. Common Respiratory Symptoms and Protective Measure Used

Among the 10 % workers who were using safety measure, 60 % were using face mask and 20 % apron. After the educational intervention given by investigators, around 63 % were reported to use the various safety measures and the difference was found to be statistically significant. ($p < 0.05$) (Table 4)

Use of Safety Measures	N [Before Intervention] [%]	N [After Intervention] [%]
Use of face mask	20 [60]	135 [44]
Use of apron	7 [20]	56 [18]
Use of other devices	7 [20]	115 [38]
Total	34	306

Table 4. Various Types of Protective Measures Used

	Safety Measure Used	Safety Measure Not Used	Total	P Value
Shortness of Breath*	4	217	221	0.001
Chest Pain*	1	131	132	0.01
Cough	9	270	279	0.04
Loss of Appetite	9	76	85	0.02
Weight Loss	10	92	102	0.001
Sputum Mixed with Blood*	1	16	17	0.03

Table 5. Association between the Use of Safety Measures and Respiratory Symptoms

[*Fischer exact test applied]

On analysis, it was found that the presence of major respiratory symptoms was statistically significantly associated with the absence of use of safety measure. (Table 5) Among the workers who had shortness of breath, 98 % were not using any safety precaution. Similarly, workers who suffered from chest pain, cough, loss of appetite and other such symptoms, majority of them were not using any safety precaution. ($P < 0.05$)

DISCUSSION

This study is the first of its kind in the marble mining industry in India. It focused on the demographic profile of workers involved in marble industry and the prevalence of symptoms of respiratory disorders.

We found that majority of the workers were males as mining industry requires more of physical work. On the contrary, in a Nigerian study on stone quarry workers, both men and women were equally involved in physical work.[22] Seventy percent of the workers were in the age group 20 - 40 years. Shrivastava A et al.[20] reported 77 % workers to be in the same age group in stone quarrying industry. Literate was defined as anyone above 7 Years of age who can read and write with understanding in at least one language. In our study, 69 % of the workers were literates. AN Nwibo et al.[21] reported more than 99 % of the workers involved in stone crushing industry in Nigeria to be above primary level of education. Almost 10 % of the respondents had tertiary level education, suggesting a low level of awareness of the respondents about the health implications of the respirable quarry dust.[21]

The current study reported complaint of cough to be maximum [82 %], followed by shortness of breath in 65 %, chest pain in 39 %, weight loss in 30 % and loss of appetite in 25 %. Around 5 % workers reported episodes of sputum mixed with blood. AN Nwibo et al.[18] reported cough in 40 %, shortness of breath in 6.4 %, occasional chest pain in 47.4 % and blood mixed sputum in 0.5 % among stone crushers; Shrivastav A et al.[21] found cough among 19 % stone quarrying workers, shortness of breath in 26 %, chest pain and weight loss among 2 % each. Mashallah A et al.[22] did a study among silica powder production factory workers and reported 12 % with cough, 9 % with shortness of breath and overall, 21 % workers had one or more respiratory symptoms. In Iran[23] it was reported that irritative cough was present in 75 % of the workers while that in Rio de Janeiro[23] reported cough in 31.9 % with expectoration in 41.7 %. Hence, it is important to associate the respiratory symptoms present in the workers with the respirable mining dust. A study on similar lines reported association between chronic exposures to dust produced from crushing of rocks of granite with impaired pulmonary function and some respiratory and non-respiratory complaints. Although the process by which dust particles at such workplace reduce lung function is not clear, it may be that such particles on inhalation are lodged in the lungs causing inflammatory reactions. It has been seen that healing of this inflammatory process results in fibrosis leading to defective diffusion of oxygen and impaired pulmonary function.[24]

Data on the availability of medical care in the marble industrial site and use of safety device by the mining and cutting workers indicated that there was a near absence of medical care in the study area and infrequent use of personal protective equipment by the workers. We found that 90 % of the workers were not using any method of personal protection while working. Only 10 % of the workers who used safety measures commonly used masks and aprons. AN Nwibo et al.[22] reported 98 % of workers worked without safety measures and Shrivastav A et al.[21] stated 95 % worked without safety measure before intervention. Yadav S P et al.[26] did a study in Rajasthan among stone quarrying workers and found many problems associated with the use of personal protective equipments like breathing difficulty with use of mask, inconvenience of repeated removing and putting of mask while eating, drinking, etc. These workers were not using water-based drilling as a most appropriate method to reduce floating silica in the environment while making holes through drilling. This was a significant observation of the study by Yadav S.P. et al.[25] that the formal education of sand stone quarry workers did not play a vital role on their behavioural change. Better understanding of the situation of the workers and their working environment would go a long way in designing safety equipment for these workers. In our study, post educational intervention, procurement of safety measure was done by 64 % workers and by 56 % workers in Shrivastav A et al.[20] study.

We did cross analysis of symptoms of respiratory disorders among exposed workers with the use of personal protective measures. We found statistically significant results, indicating towards the higher prevalence of symptoms among workers who were not using any safety measure. Almost no study till now has reported such cross analysis between symptoms among workers and use of safety measures. There is dire need to have more research in the field, so that appropriate safety measures can be designed for these workers.

CONCLUSIONS

Prevention is the key in reducing the incidence of occupational lung diseases. Early interventions after development of symptoms are important as they can decrease chances of further worsening of the condition. Early diagnosis and treatment play a major role as prolonged exposure to these risk factors may cause irreversible damage. Health education, periodic health check-ups and use of protective measures are the essence in preventing occupational lung diseases. Proper education of workers about hazards of mining and cutting marble, along with awareness about personal protective measures will largely help in reducing the prevalence of occupational lung diseases. Designing of the protective equipment should be need based, suitable for the area concerned and acceptable to the target group. The study has a limitation that we didn't use higher investigations like pulmonary function test or x ray due to lack of funding.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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