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Prevalence of Silicosis among Workers in Stone-Cutter and Silica Powder Production Factories

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ABSTRACT

***Background**: Use of industry and technology must be based on protection of health as well as the environment. In other words, constant development of technology should fulfil human needs and not pose a health hazard.*

Silicosis is one of the oldest industry-induced occupational pulmonary diseases which is caused through exposure to particles of crystalline silica in respirable sizes and still is a major health hazard in workers exposed to silica all over the world. Since there is no cure for silicosis and in affected patients the disease may continue to progress even after leaving the workforce, dust control in the working environment is the only way to overcome this disease.

***Materials and Methods**: An analytical cross-sectional study was performed on workers of the 27 stone-cutter factories in Malayer- Azandarian during 2001-2002. Sampling method was un-randomized and considering the type of study, all factory workers who were about 100 individuals entered the study. The study was done via clinical examination, questionnaire, spirometry, and chest x-ray.*

***Results**: Study results demonstrated that lung examination was abnormal in 21 workers accompanied by respiratory symptoms as follows:*

Twelve cases had irritative coughs. Four cases had coughs and dyspnea and 5 complained of exertional dyspnea. In 10 of them a significant change was seen in their chest x-ray. Fourteen cases had an abnormal spirogram curve in evaluation of their respiratory status and only in 4 patients spirometry was abnormal.

*Most patients with silicosis were under the age of 44 and had almost 5 years of working experience. Six patients were smokers. In conclusion, 10 workers had silicosis (10%) (6 cases of simple silicosis and 4 cases of the complicated type) and the diagnosis was confirmed by chest radiography. **(Tanaffos 2006; 5(3): 31-36)***

***Key words:** Silicosis, Silica, Stone- Cutter Factory, Spirometry*

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INTRODUCTION

Technology and productive industries are among the great achievements of mankind.

At present, technological advancement programs should be based on the principles of constant development, health protection policies, and environmental protection.

Silicosis is one of civilization's oldest known occupational diseases. This industry-induced disease occurs in workers exposed to 0.2 to 10 micron inhalable (1) crystalline silica particles in mines and various industries (especially silica powder). Its history is as old as mankind, and is traced back to antiquity probably Egypt and ancient Greece (2, 3). The highest prevalence of silicosis was reported in the late nineteenth and early twentieth century which was concomitant with the beginning of mechanization of industries and mines. As estimated, 2 million US workers and more than 10 million Chinese workers have potential silica exposure (4). In China, the first case of silicosis was reported in early 1950. The number of cases increased rapidly due to the industrial growth and absence of dust control methods before 1960 (5).

In 1992, 5779 new cases were recorded. This number increased to 9871 cases till 1995 (6). At the same time, in developed countries such as the USA, Sweden and Japan the incidence of silicosis diminished as the result of introducing preventive and management control measures in work environments containing silica particles (7).

MATERIALS AND METHODS

An analytical cross-sectional study was performed on workers of the 27 stone-cutter factories in Malayer-Azandarian (Hamedan province). In this study, sampling was non-randomized and since the risk of silicosis is higher in stone-cutter factories, all related workers in that district entered the study. There were a total number of 100 workers and in average, 3 to 7 people were working in each factory.

Data were collected through clinical examination forms (approved by the Ministry of Health) and a questionnaire regarding the respiratory status designed and scored by occupational medicine specialists, statisticians and epidemiologists. Researchers filled out the questionnaires containing the required data by interviewing the workers. Also, spirometry was done for all cases at the same time for assessment of lung volumes and capacities. Considering the type of work in stone-cutter factories, all workers were referred to a radiologist in Malayer city hospital to obtain a chest radiograph. Afterwards, the health status especially their respiratory status along with other data obtained through the questionnaires. Spirometry and chest radiography were also clinically evaluated by the research manager and the results were recorded.

RESULTS

One-hundred stone-cutter workers participated in this study. They were in the age range of 15 to 80 yrs. According to the study results, 70% of workers were in 20 to 40 years of age and 5% were in 15 to 20. Also, 76% had working experience up to 3 yrs. and 5% mentioned a working experience less than one month. Thirty-four workers were smokers and out of 21 cases with abnormal respiratory status, 10 cases were diagnosed as having silicosis according to their chest radiography (8). According to the radiological findings of 10 silicosis patients, 6 cases had simple silicosis while 4 had complicated silicosis or progressive massive fibrosis. Radiologic findings are demonstrated in table 1.

Table 1. Radiologic manifestations of stone-cutter factory workers with silicosis in Malayer- Azandarian.

Patients	Radiologic findings	Type of silicosis
1	Increased mild interstitial pattern throughout the lungs as increased reticulonodular pattern	Simple silicosis
2	Increased interstitial pattern throughout the parenchyma as reticulonodular pattern with nodular (under 1 cm) pattern predominance. Ground glass opacity in superior part of the right lung	Simple silicosis
3	Mild increase in interstitial pattern as reticulonodular in superior and middle lobes of the lungs	Simple silicosis
4	Increased reticulonodular pattern with reticular predominance in middle lobe of both lungs	Simple silicosis
5	Nodular lesions scattered throughout both lungs especially in superior and middle lobes	Simple silicosis
6	Increased reticulonodular pattern throughout both lungs	Simple silicosis
7	Increased interstitial pattern as nodular lesions (2cm and larger) especially in superior and middle lobes of both lungs	Progressive massive fibrosis (PMF)
8	Increased interstitial pattern in superior and middle parts of both lungs as reticulonodular pattern with nodules larger than 2 cm, hilar lymphadenopathy with calcification	Progressive massive fibrosis (PMF)
9	Increased interstitial pattern throughout both lungs as reticular and nodules larger than 2 cm in superior and middle lobes and hilar lymphadenopathy	Progressive massive fibrosis (PMF)
10	Reticulonodular patterns with nodules larger than 1 cm in superior and middle lobes and hilar lymphadenopathy	Progressive massive fibrosis (PMF)

Furthermore, 14 cases had abnormal spirometric findings and only in 4 patients with silicosis the spirogram pattern was abnormal. Three patients had an obstructive pattern and 1 had restrictive one. Twenty-one understudy workers had abnormality in their lung examination as well as the respiratory symptoms, out of which 12 cases complained of irritative cough, 4 cases complained of cough and dyspnea and 5 cases only complained of exertional dyspnea. In this study, 6 patients with silicosis were smokers and mentioned a mean of 10.5 yrs smoking history. Overall, 10 workers had silicosis (6 cases of simple type and 4 cases of complicated type) (Fig 1-3).

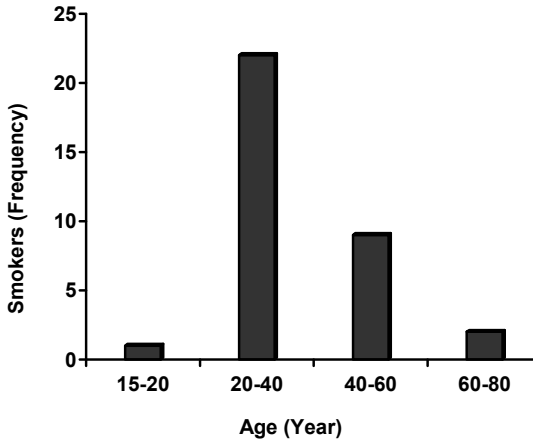

Figure1. Relative frequency distribution of smokers at stone-cutter factories in Malayer-Azandarian.

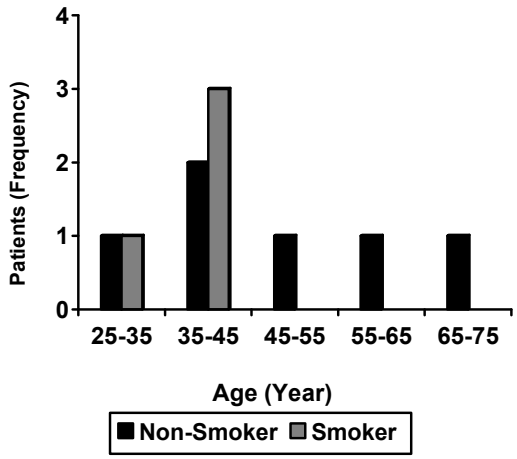

Figure 2. Relative frequency distribution of smoker workers with silicosis in Malayer-Azandardian stone-cutter factories.

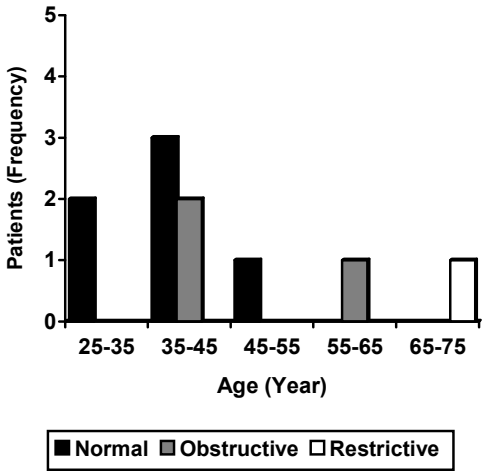

Figure 3. Frequency distribution of spirogram pattern in workers with silicosis in Malayer-Azandarian stone-cutter factories.

DISCUSSION

Comparison of our study results with similar domestic studies showed that 10 workers (10%) had silicosis; thus, this study can be used as a profile and pattern for other stone-cutter workers because there was no similar study in the country.

Our results are comparable with those of a study conducted in north Nigeria demonstrating that in 126 grindstone cutters, 49 cases had abnormal radiologic findings confirming the diagnosis of silicosis and 17 cases had progressive massive fibrosis (9).

Out of 21 cases, 12 patients of ours had irritative cough, 4 cases had cough and dyspnea and only 5 complained of exertional dyspnea. In the Nigeria study, the most common symptom in silicosis patients was dyspnea and only 42% complained of cough. But in our study patients, the most common symptom was irritative cough (75%) which seems logical considering the workers' exposure to active silica dust.

Our study results demonstrated that 6 silicosis patients were smokers (a mean of 20 cigarettes a day and 10.5 yrs of smoking history in average) and 4 of these patients had complicated silicosis (progressive massive fibrosis) and also 2 cases mentioned a 5-year smoking history while 2 others mentioned longer than a 5-year history. These are comparable with the results of a Hong Kong study of the factors effective on and accompanied by progressive fibrosis in silicosis (10). Also, the spirogram pattern was abnormal in 4 patients with silicosis. Three cases had obstructive patterns (all three were smokers) while one case had the restrictive pattern (non- smoker).

The risk of silicosis is correlated to the severity of exposure, type of silica particles, duration of exposure, and some other factors (11) in a way that the higher the concentration of dust in the inspiratory air (as mg/m^3) and the more silica particles in the respirable sizes (in this study silica powder was at this range), the higher the risk of silicosis (4, 7, 12, 13, 14).

Based on the above-mentioned facts our results are consistent with those of other studies. Evidence indicates that exposure at the rate of OSHA (Occupational Safety and Health Administration) and MSHA (Mine Safety and Health Administration)

standards (0.1 mg/m^3) for 100% inhalable silica crystalline does not eradicate the risk of silicosis (4, 15). This is also true about our study site because the concentration of silica particles was several-folds above the safe limit (16).

There were several limitations in our study. One problem was the impossible evaluation of type and size of silica particles because there was no measuring device available. Occupational health specialists in the country should undertake proper professional measures in this regard. Another limitation was the absence of a system to record and report silicosis cases regularly and also the inability for early or even late diagnosis of silicosis by physicians of that district. Therefore, the estimated cases of disease were far less than the actual rate. To overcome this problem, after completion of the study, a one- day work-shop entitled: "Occupational pulmonary diseases" with the main subject being silicosis was held for the physicians of that district.

Also, it was recommended that a system be established by the environmental and occupational health office at the Ministry of Health for protection against silicosis and reporting cases all over the country.

We are hoping to take a step forward in eliminating or decreasing the risk of silicosis by undertaking these measures.

Acknowledgement

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