SILICOSIS AMONG WORKERS IN REFRACTORY BRICK FACTORY, THAILAND

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BACKGROUND

Silicosis is a pulmonary fibrotic lung disease caused by inhalation of high concentrations of very fine free silica dust particles. The main industries and occupations at risk are mining, quarrying, manufactures of ceramics, sand blasting, and brick manufacturing.[1]

A case of more than ten years of diagnosis as pulmonary tuberculosis from refractory brick factory, had no improvement of tuberculosis treatment, went to the National Chest Disease Hospital and received transbronchial biopsy revealed silica particles in the tissue under polarized light microscope. His job was to weigh the ground raw material used in production of refractory brick. This case was reported to the Division of Occupational Health. To study the magnitude of silicosis among the workers in that factory was neccessary to be performed to identify the risk factors on silicosis developing, thus the epidemiological study of silicosis was conducted through this factory.

Despite the fact that silicosis has been a common, occupationally related disease for many years, only a few studies have been directed toward its epidemiologic aspects.[2] The study by Renes et al.involving iron foundries found 9% of silicosis prevalence rate among 2,000 workers and 25.8% of prevalence rate among those who had worked for 20 or more years.

Among workers in the brick plants, one of the studies was in an Ontario brick plant in which it was claimed that there were no cases of silicosis.[3] A study done earlier by Keatinge and Potter revealed similar results among workers in British brick work.[4] The study in a Pennsylvania brick works came up with different results.[5] The material used to make brick was significantly different from that in Ontario; it contained more quartz and less aluminum. The prevalence rate of silicosis was very high in this population. Silicosis was found at all levels of exposure, except below 2 mppcf. It was found to be more prevalent in workers involved with burned brick than "green" brick.The silica content of both was high.

The refractory brick plant in this study is the one established in Thailand, started operating in 1953. It served initially to produce fireclay refractory bricks for cement kiln linings, heating furnace walls runner bricks for steel ingot casting. There were two tunnel kilns and highly equipped machinery.

This factory produced fireclay brick, refractory castables, plastic refractory, mortars ramming mixes, gunning mixes, and insulating firebrick.

The process used in this refractory brick production was crude crushing, impact crushing, ball milling, clay grinding, size screening, vibrating milling, weighing by car, mixing, process of tamping or pressing or ramming or hand moulding, burning and packing.

Silica contents in the products were 31.2–58.7% in fireclay brick, 7.3–46.2% in high alumina brick, 51.9% in fireclay base castable, 59.6% in heat setting mortar, 46.5 in air setting mortar, 9.0–14.9% in plastic refractory, and 51.8–68.2% in the insulating firebrick.

Thus, this refractory brick plant used the material of rather high content of silica when it was compared to other brickworks. This study had the golden aim in prevention and control of such a disease.

METHODS

A cross-sectional descriptive study was designed and self-administered to collect the essential data concerning age, sex, race, job, duration of work, smoking habit, mask wearing and respiratory history, from all of the workers in the refractory brick plants. Physical examinations, pulmonary function tests and chest radiographs were also performed. A case-control study was also conducted by randomly selecting non-case workers in the same plant at ratio case : control of 1:3.

For physical examinations, the respiratory signs concerned were basal crepitation which dry end-inspiratory crackles were heard and did not clear with cough, chest expansion, cyanosis, and clubbing fingers. The pulmonary functoin tests were obtained using the spirometer. Test results derived included forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC). Three efforts were obtained. The maximal FEV_1, and FVC were selected. The FEV_1 and FVC maneuvers were considered reproducible if the 2 best values for each agreed within 5% of the larger value or 100 ml, whichever was greater. Predicted values based on age, sex and height for FVC, FEV_1 and FEV_1/FVC were obtained from the prediction equation of Crapo and coworkers.[6] The predicted values were corrected with 0.85 for non-caucasian people.

For chest radiography, posteroanterior chest radiographs of 16*17 inches films at a standard distance of 72 inches at 11 kvp. Interpretation was carried out by a radiologist and an occupational health physician by using the ILO-1980 international classification of radiographs of the pneumoconiosis.[8] The case definition of silicosis used was a mortar worker with chest radiograph of fibro-nodular profusion at 1/1 and above.

For statistical analysis, the prevalence rate of silicosis was calculated by age specific groups, job, duration of work, worksite, smoking habit and cloth using instead of approved masks. In case-control study, Chi-square and Student's t-tests were used to calculate the significance of factors between cases and controls.

RESULTS

There were eighteen cases of silicosis that met the definition from 190 workers in the plant. The whole plant prevalence rate was 9.5% (18/190). Mean age of cases and mean duration of work were 49.6 (range = 42–56) and 23.9 (10–32) years. Female prevalence rate was 27.8% (5/18), while male rate was 7.6% (13/172). When prevalence rate was classified by position, it is found that prevalence rate among workers was 9.8% (17/173) and rate among foremen was 5.9% (1/17). The prevalence by section was highest among workers in production section 'B' of 13.3% (2/15) followed by 11.5% (13/113) in production section 'A', 6.1% (2/33) in maintenance section, and 4.5% (1/22) in quality control and technical section. When it was considered by job description, the highest prevalence rate was 15.7% (8/51) among those who prepared raw material, followed by the prevalence rate of 12.8% (5/39) in "green" brick production job and 10% in repairing brick model job description.

Seven cases or 38.8% (7/18) had clinical symptoms included weakness, dyspnea, low fever and chest pain. Eleven percent (2/18) of cases had abnormal physical signs of cyanosis and clubbing fingers. The pulmonary function test among cases was abnormal at proportion of 44.4% (8/18) which 75% (6/8) was restrictive ventilatory defect.

Two of cases were silicotuberculosis. The chest radiographs revealed mostly p and q of shapes and sizes with the parenchymal profusion of 2/2 at 38.9% (7/18).

In the case-control study, the case had worked for 25 years or more at 20.8 times of controls and this was significantly different ($p<0.05$, OR = 20.8). This was not adjusted for age. The cases and controls were not significantly different in terms of smoking habits ($p<0.05$, OR = 0.8).

DISCUSSIONS AND RECOMMENDATIONS

Even two from three studies concerned the occurrence of silicosis among brick workers did not show any cases of silicosis.[3,4] This study confirmed the existing prevalence of silicosis among brick workers of 9.4% which was rather high. Since the development of silicosis depended upon the material used in the process, thus this study, different from other two, identified silicosis cases among refractory brick along with rather high silica content. As the highest prevalence rate was found among workers preparing raw materials to produce bricks, so the main concentration in providing prevention and control measures should be set for this group of workers first if there is limited budget. The primary prevention for those workers who did not develop the disease should be urgently set up by using engineering control, especially the local hood ventilation.

For two cases of silicotuberculosis were referred for further management in the chest disease hospital.

Cases of definite silicosis (ILO-1980), classification of "p 1/1" and above aged below 50 years and who are symptomatic should preferably not continue in work with silica exposure. All definite silicosis cases must be folowed up annually to exclude complications.

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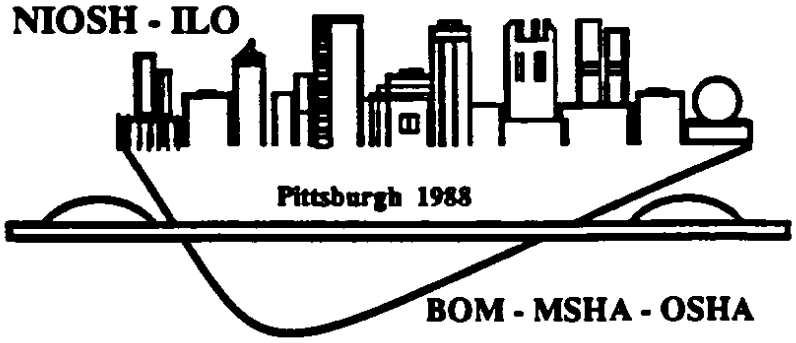

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