SILICOSIS AMONG STONE MORTAR WORKERS IN NORTHERN THAILAND, 1986

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BACKGROUND

The high rate of premature death (death at age of 30–40 years old) was found in a group of villages in Payao Province, Thailand. These villages had been named as the village of widows. The main occupation in these villages is the production of stone mortar and pestles. This doubtful situation led to at least three field investigations to find the cause of premature death in such villages. There were no definite reports of silicosis among these mortar workers in the villages, except a lot of tuberculosis cases could be reviewed from the routine tuberculosis registration at the local health authority. From working conditions with stone containing a high percentage of quartz and increasing prevalence of tuberculosis among these mortar workers, we carried out a cross-sectional epidemiology study of silicosis and a risk factor study on silicosis to confirm the silicosis cases existing in the village, explain silicosis distribution among the stone mortar workers and to identify risk factors on silicosis.

The effects of silicosis, the chronic fibrosis of the lungs produced by prolonged and extensive exposure to free crystalline silica, have been recognized for centuries. Pulmonary disease produced by dust is mentioned by Agricola in his Treatise on Mining and is described in stonecutters by Van Diemerbroeck Ramazzini.[1] Clinical evidences of previous exposure to free silica in old mines, abandoned quarries, and ancient flint tools and weapons were demonstrated.[2] Silicosis is caused by the inhalation and retention of dust containing silica in occupations such as mining, tunnelling, quarrying, stone dressing, sandblasting, fettling, boiler scaling, and in pottery, ceramics and brick manufacture.[3] Symptoms of silicosis cases are increasing dyspnea, non productive cough and chest pain, progressing to compensatory emphysema and cor pulmonaly.[4] There was a report of silicosis among miners with the prevalence of 19.48% (5,366/27,553) together with pulmonary tuberculosis of 13.83% (742/5,366).

In Thailand, there were no epidemiological reports of silicosis prevalence among particular occupations, but we did have the first case report of silicosis who was a worker in a wulfraum mine.[6]

METHODS

A cross-sectional morbidity study of stone mortar workers in three villages at the Northern Part of Thailand was carried out in January 1986. Detailed occupational, smoking, and respiratory histories were obtained on questionnaires by trained interviewers. 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 function 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.[7] The predicted values was corrected with 0.85 for non-caucasian people.

For chest radiography, posteroanterior and lateral 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 radiographers 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 control.

RESULTS

Fifty six cases met the silicosis case definition from 266 stone mortar workers which provided the prevalence rate of 21.1%. Mean age among cases was 40.7 years with median and mode of 35 and 38 years respectively. The age range was 15–59 years. The highest prevalence rate of 43.3% (13/30) was among the workers of 50–59 years age groups, together with 32.1% and 30.8% among the 40–49 and 30–49 years age groups respectively. The specific prevalence rate by duration of work was highest among the workers aged between 21-25 years with the rate of 66.6% (6/9). The sex specific prevalence rates were 29.1% (46/158) among male and 9.3% (10/108) among female. The prevalence rate by job was 28.7% (39/136) among the workers making stone mortars which was higher than the ones making stone pestles. To work inside building had the higher rate of 31.5% (23/73) than to work outside the building of the rate 17.1% (33/193). The workers who used clothes covering their noses and mouths during work had 24% (36/150) of silicosis prevalence rate, and the ones who did not use the clothes had silicosis prevalence rate of 17.2% (12/116). The smokers had 18.8% (39/208) of silicosis prevalence rate and non-smokers had 29.3% (17/58). Clinical symptoms were 75% chest pain, 71% dyspnea, 53% chest tightness, and 50% weight loss. The cases had abnormal physical examinations of 55% cyanosis, 53% clubbing fingers, 53% decrease chest expansion less than 3 centimeters, 50% decrease breath sound. All cases had abnormal ventilatory defect, with 92.8% (52/56) of restrictive ventilatory defect.

Chest radiograpbs were with shapes and sizes of p and q with the most profusion of 2/3 (28.6% by Table I). There were 7 cases from 56 cases that had large opacities, and 57% (4/7) was 'B' type. There were some other abnormalities consistent with pneumoconiosis including tuberculosis at 25% (13/52), cavity at 15.4%, definite emphysema at 13.6%, ill-defined diaphragm at 9.6%, enlargement of hilar or mediastinal lymphnodes at 9.6%, calcification in small pneumoconiotic opacities at 7.7%, abnormality of cardiac size or shape at 5.8%, pleural thickening in interlobar fissure or mediastineum 3.8%, eggshell calcification of hilar or mediastinal lymphnodes at 3.8%, bullae at 1.9%, ill defined heart outline at 1.9% and honeycomb lung at 1.9% (Table II).

In case control study, there was no significant difference between 56 cases and 168 randomly selected control in terms of smoking habit and using clothes instead of approved masks. The men were ill more than female significantly ($p < 0.05$, or = 3.5). The cases were older than the controls significantly ($p < 0.05$, OR = 2.8). The ones who worked with longer period had more likelihood to be case, more than the ones who worked with shorter period significantly ($p < 0.05$, OR = 2). The workers who polished mortars had the chance to develop silicosis 8 times higher than the ones who did not polish the mortar ($p < 0.05$, OR = 8).

DISCUSSIONS AND RECOMMENDATIONS

To prevent workers from exposure to silica is among the highest priorities in protecting the health of the workers. As silicosis is not reversible. If one gets the disease, one will be affected for the rest of one's life. Thus, this epidemiological study aimed ultimately to such prevention. As one definition of epidemiology is the study of distribution and determinants of the disease. The classical process consists of examining a series of variables to ascertain causation including age, sex, socioeconomic status and other. It is known that silica causes silicosis, but there were several major difficulties involved in attempting to do this, which were difficulties in the accurate determination of exposed dose, difficulties in the accurate determination of the health effects and difficulties in dealing with competing variables such as cigarette smoking and host susceptibility.[9] This study of health effects from silica was

Table I

Small Opacities of Parenchymal Abnormalities by Profusion among Silicosis Patients in Northern Thailand, 1986

Profusion	Number	Percentage
1/1	6	10.7
1/2	4	7.1
2/1	12	21.4
2/2	8	14.3
2/3	16	28.6
3/2	9	16.1
3/3	1	1.8
3/4	0	0.0
All types	56	100.0

Table II

Other Abnormalities Consistent with Pneumoconiosis among Silicosis Patients in Northern Thailand, 1986

Type	Descriptions	Number	percentage
bu =	bulla(e)	1	1.9
cn =	calcification in small pneumoconiotic opacities	4	7.7
co =	abnormality of cardiac size or shape	3	5.8
cv =	cavity	8	15.4
em =	definite emphysema	7	13.5
es =	eggshell calcification of hilar or mediastinal lymph nodes	2	3.8
hi =	enlargment of hilar or mediastinal lymph nodes	5	9.6
ho =	honeycomb lung	1	1.9
id =	ill-defined diaphragm	5	9.6
ih =	ill-defined heart outline	1	1.9
pi =	pleural thickening in interlobar fissure or mediastinum	2	3.8
tb =	tuberculosis	13	25.0
All Abnormalities		52	100.0

performed even though there were many constraints mentioned above, because we wanted to provide useful findings used in prevention and control of silicosis. From the study, it seems that the ones who were exposed with mortar polishing need to be protected from free silica more than others. To work inside the building is more dangerous than to work outside. To wear clothes instead of approved masks is not useful and may be harmful, thus the workers should wear approved masks.

Since there were 25% of tuberculosis among silicosis workers or silicotuberculosis in this study in the high tuberculosis prevalence country, when it is compared to the study among miners,[5] we recommended all pulmonary tuberculosis to be referred for further management in the chest hospital or special clinic concerned with silicosis.

Cases of definite silicosis (ILO-1980), classification of "p 1/1" and above aged below 35 years and who are symptomatic should preferably not continue in work with silica exposure. All definite silicosis cases must be followed up annually to exclude complications (e.g. pulmonary tuberculosis, chronic bronchitis and cardiac failure).

For reduction of stone dust at worksite, we recommended wet process in appropriate way.

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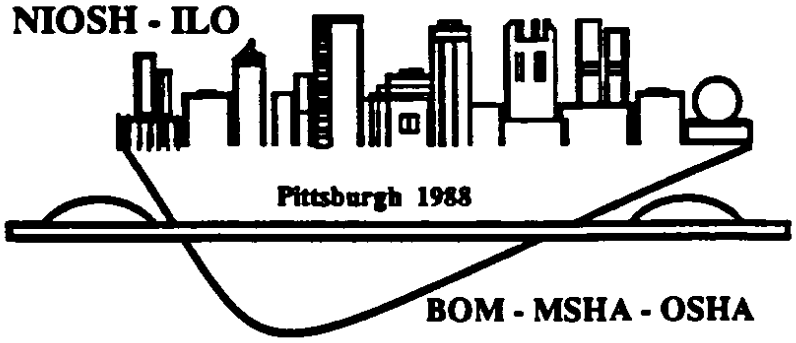

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