OCCUPATIONAL SILICOSIS AMONG WORKERS IN AN ORE MILL, THAILAND

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BACKGROUND

In July, 1986, the chest disease hospital in Nonthaburi reported a death to the divisions of occupational health and epidimiology of the ministry of public health. The death occurred in a 27 year-old female worker with a diagnosis of silicosis. The patient had a long history of dyspnea treated at numerous clinics. Two weeks prior to her death she was admitted to the Nakorn patom provincial hospital with fever, dyspnea, cough, and crepitation in both lungs. Her chest X-ray was abnormal with marked reticulo-nodular infiltration. The index case worked in a mill in Nakorn patom province, located 60 kilometers southwest of Bangkok.

The factory ground minerals such as quartz, feldspar, flint, talcum, clay, dolomite, and phosphate, as seen here before the crushing process. The process of grinding very fine granules 300 mesh of these ores.

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 which the prevalence of 19.48% (5,366/27,553) together with pulmonary tuberculosis of 13.83% (742/5,366).

In order to carry out the investigation of this fatal case, and to search for other possible cases, meetings were held with officials from various other goverment agencies, including the ministry of interior and ministry of industry.

The objectives of our investigation were (1) to establish whether or not there was an epidemic of silicosis among the workers in the factory; (2) to find the epidemiological distribution of silicosis; (3) to identify risk factors for silicosis disease; and (4) to develop appropriate preventive and control measures.

METHODS

The methods included (1) describing the epidemiology of the problem; (2) a case-control study for risk factors for disease; and (3) studying the environment of the factory.

To describe the problem, we interviewed all 80 workers in the plant with questionnaires about work histories and history of illness, and performed physical examinations included chest auscultation, chest percussion, and measurement of chest expansion. All 80 workers received posteroanterior chest radiographs. All 80 workers underwent pulmonary function testing. Capro's prediction equation was used to find predicted values.[5] The predicted values were corrected with 0.85 for non-caucasian people.

A case of silicosis was defined as any worker in plant whose chest radiograph change by ILO-1980 international classification of pneumoconiosis at 1/1 profusion of lung parenchyma.[6] Four controls for each case in the case-control study were selected by simple random sampling from non-case workers in the mill.

The environmental survey included a walk-through of the plant. We measured dust concentrations at various sites in the plant. We also observed the workers performing their jobs, and we attached portable dust concentration measuring devices top selected workers.

RESULTS

The mill was divided into three plants. Plant number one ground feldspar and phosphate. Plant number two usually ground quartz and flint, and on occasion would grind feldspar and phosphate. Plant number three ground clay, only. Of the total of 80 workers in the plant, we found 10 workers or 12.5% with silicosis,including the fatal index case. This index case was the only worker to have died in the previous year, for a mortallity rate of 1.2 percent, and a case-fatality rate of 10 percent.

Chest radiographs revealed the small opacities of parenchymal profusion of 1/1 at 20%, 2/1 at 30%, 3/3 at 50%. Most of the sizes and shapes of such abnormalities were p and q. One case had large capacity catagorized as "B".

Pulmonary function tests were normal in five, or half of the cases. The five cases with abnormal pulmonary function generally had a restrictive ventilatory defect. Clinical symptoms and sign in the case included dyspnea, chest pain,

chronic cough, restriction of lung expansion, and decreasing breath sounds.

The mean age of the 10 cases was 34.9 years with a range from 34 to 49 years. The duration of working in the plant averaged 8 years before our study,with a range of 1 to 14 years of exposure.

The attack rates for silicosis by job category were highest in two housekeepers whose job was to sweep up the dust which accumulated in the working areas. The second highest attack rate was in ore-grinders at rate of 33% (7/21).

Attack rate by job location were highest in plant number two, where quartz and flint were ground. The attack rate was 3.5%. This is the plant where the fatal case worked. The attack rate was 10.7% in plant number one, where feldspar and phosphate were ground. There were no cases in plant number three, where clay was ground. There were no cases in office workers, but there were two cases among foremen, who were exposed to dust in all the plant areas.

For the environmental inspection, we tested the mineral content of the ores used in the plant. Silica is the mineral ingredient of greatest hazard. Quartz and sand had the highest silica content, at 45.7%.

We found no engineering dust control measures in use; no hoods and no protective dust enclosures. A few workers tried to avoid breathing the hazardous dust with cloths over their face, but this is very ineffective. Our inspection revealed very hazardous levels of dust being created by the grinding process. No occupational health services were provided for workers in the plant, as required by regulations.

The Thai ministry of interior's maximum permissible level of respirable dust in workplace air is 5 mg/cubic meter. We measured an average concentration of respirable dust in the breathing zones of ten workers of 437.7 mg/cubic meter of air, 87 times the permissible level.

In the case-control study, the workers with a duration of exposure of greater than 5 years had odds ratio of 16 times the likelihood of being a case than workers with less exposure.

The case-control study also found that workers in the grinding and packing areas of the mill had an odds ratio of 12 times the likelihood of being a case than workers in other areas of the plant.

When it was analyzed by the measured amounts of dust in various work areas, we found that workers in areas with dust exceeding permissible exposure limit had an odds ratio of 11 times the likelihood of having silicosis, compared to workers in areas with dust within regulation limits.

When we measured amounts of silica contained in the dusts, we found that workers in areas with dust containing 33% or more of silica had an odds ratio of eight times the likelihood of having silicosis than workers in areas with dust containing less than 33% silica.

DISCUSSIONS AND RECOMMENDATIONS

This investigation revealed 12.5% of silicosis prevalence rate with one dead case. It is a quite severe situation. To prevent workers from exposure to silica is among the highest priorities in protecting the health of the workers. 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. Since it is known that silica causes silicosis, but there are 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.[7]

As the epidemiological data show that the housekeepers and the ore-grinders were the highest risk group to develop silicosis. This group should be firstly provided preventive measures, if there were any constraints.

At the conclusion of the investigation, we gave essential health education lectures to all the workers about the hazards of silica and how to avoid it by using NIOSH-approved masks. We advised the owners how to make engineering changes that would make the workplace safer. The report was provided to the ministry of industry, which closed down the factory for 6 months because of the health dangers. A joint meeting of the ministries of industry, interior, and public health was held with many owners and operators of ore and stone grinding plants throughout Thailand to tell the plant operators about the dangers of silica, and how to prevent workers from developing silicosis.

This plant was reopened after making recommended changes in workplace practices, including (1) building covers and hoods over grinding machines to prevent escape of dust, (2) providing approved masks for exposed workers, (3) offering medical care for workers, and (4) tranferring those with lung problems to safer parts of the plant.

This plant was inspected about six months after the original investigation. Dust levels were found to be below permissible limits and workers were wearing approved masks.

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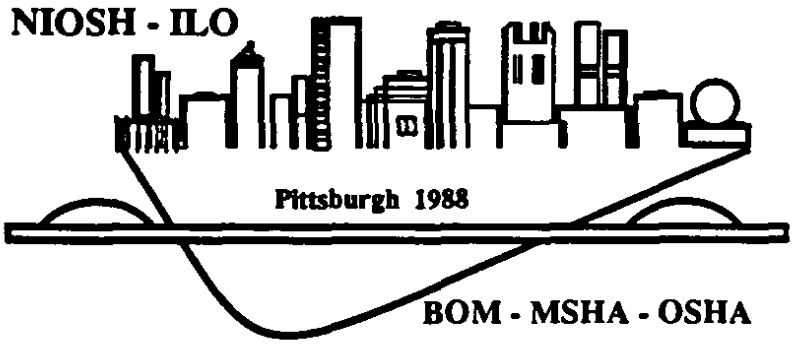

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