

Prevalence of Silicosis in Stone Carving Workers Being Exposed to Inorganic Dust at Sikhui District Nakhonratchasima Province, Thailand; Preliminary Results

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Objective: The present research aimed: 1) to find out the prevalence of silicosis in the workers who were exposed to inorganic dust presumably silica among sand stone workers, 2) to test the sensitivity and specificity of the questionnaire related to respiratory symptoms and 3) to calculate a weighted kappa analysis between the two radiograph readers.

Material and Method: This was a cross-sectional descriptive study. The studied samples were a total of 315 workers in Sikhui District, Nakhonratchasima province, Thailand. The interviewed questionnaire and chest x-ray were used to identify silicosis. The ILO classification by B-reader was applied and the grading equal or more than 1/1 is regarded as silicosis. In addition, sensitivity and specificity of the existing questionnaire were calculated and weight Kappa was used to interpret the correlation between Air-pneumo and NIOSH B readers.

Results: Among the 315 workers, 55.9% were male and the average age was 46 years old (range 17-75). Most of them (53.2%) work in the job described as cutting the stone in the mountain. The symptoms of the respiratory system showed that 53 persons (16.8%) had wheezing, 41 persons (13.0%) had dyspnea, 29 cases (9.2%) had cough for more than two weeks. The prevalence of silicosis was 36.1% (80/315) and the majority of them worked in the stone cutting (33/80). Sensitivity of questionnaire was 21.2-27.5%. Specificity was 85.5-97.9 percent. Weighted Kappa was 0.6.

Conclusion: The prevalence of silicosis among workers was 36.1 percent. Weighted Kappa between film readers was 0.6. Criteria for diagnosis of silicosis are history of being exposed to silica dust more than 2 years and abnormal chest x-ray reported as ILO profusion category equal or more than 1/1 by an NIOSH B reader. Criteria of silica dust exposure is: 1) cutting sand stone in the mountain or 2) cutting sandstone at home or 3) cracking stone at home or 4) living in sandstone cutting area; each must last for 8 hours per day.

Keywords: Silicosis, Stone Carving Workers, Air pneumo reader, B reader

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Silicosis is an incurable disease but preventable. Although the ILO/WHO program had tried to eradicate silicosis since 1995 with the goal to reduce in 2015 and eradicate in 2030, but the study and review of the literature in Thailand and the other countries showed the number of population at risk worldwide was about 1.7 million people⁽¹⁾. Most cases of silicosis are often found in the informal sector⁽²⁾. Thailand has participated in the ILO / WHO program to eradicate silicosis and set up prevention programs to control silicosis since 2001. At present, cumulative cases of 215 persons have been reported in Thailand

during 2007-2012⁽³⁾. According to the national silicosis elimination program, the implementation of each activity was declined⁽⁴⁾. However, figures of prevalence of silicosis have not been known. The present study aimed to find out the prevalence of silicosis amongst the sand stone workers and it was part of research and development of a disease surveillance system for silicosis and respiratory disorders in stone carving workers.

Material and Method

This research employed a cross-sectional descriptive study.

Study population and samples

The study population was 5000 and the sample determination was calculated using Winpepi.

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Taking the prevalence rate of silicosis derived from the literature review, a proportion of 0.19 was used ($p = 0.19$). Acceptable difference was 10% of proportion, $d = 0.019^{(7)}$ was applied. Therefore the sample size was at least 1,229.

Tools: Questionnaire was developed from reviewing relevant documents about silicosis. The content of the questionnaire was divided into three main sections: 1. General information 2. Job characterization 3. Respiratory signs and symptoms. Questionnaire was tested for content validity by experts. The questionnaire was performed by interviewing prior to performing the chest x-ray. Reading and interpreting chest films were done by NIOSH B reader according to the International Labour Organization standard (ILO) film⁽⁵⁾.

Data were collected from the studied samples only with permission and informed consent. Then they were interviewed by the trained and validated research assistants. Following that, they had chest x-ray performed. NIOSH B reader performed the chest x-ray reading in order to diagnose silicosis. However, air-pneumo reader also read the same chest x ray in order to investigate the correlation between those two types of radiograph readers.

Data Analysis

SPSS program for Windows Version 19 was used for analyzing data as follows:

- 1) Descriptive statistics was used in case of frequency distribution to describe the results in percentage and mean. Median and interquartile range.
- 2) Weighted kappa analysis was used to compare the differences between the two types of readers.
- 3) Sensitivity and specificity were used to evaluate the questionnaire used in the present study.

This research study was approved by the Ethics Committee of Khon Kaen University on Research in Human Subjects as of document number HE541346.

Results

Personal characteristics

The sample was 315 workers exposed to silica from stone carving in Sikhiu District, Nakhon ratchasima. They were consisted of 186 males (55.9%) and 139 females (44.1%), aged between 17-75 years old or an average age of 46 years old. The majority of the workers (78.7%) were under universal coverage program. Most of them (93.6%)

lived in Northeastern region. An average monthly income was 7,500 (600-10,500) baht. Two hundred and thirty five workers (74.6%) had elementary education. There were 237 workers (75.2%) who were non-smoker while 78 workers (29.5 %) still smoked and 38 workers (12.1%) quitted smoking already. They had underlying diseases as follows: asthma 16 (5.1%), pulmonary tuberculosis 8 (2.5%), allergic rhinitis 8 (2.5%), heart disease 2 (0.6%) . Sixty-two persons (19.7%) worked as cutting stone in their house, 61 (19.4%) worked as cutting stone in the mountain, and 86 (27.3%) worked as cracking stones. One-hundred persons (31.4%) lived in the carving areas but did not work.

The use of personal safety protection equipment

One hundred and seventy four workers persons (55.2%) used personal protective equipment. There were 120 persons (39.7%) used their clothes, while there were 71 persons used protective mask (23.5%). There were 12 persons used N95 mask (3.8%). The workers who used personal protection equipment at all working time were 117 persons (37.1%). The reasons for not using personal protection equipment were suffocated 89 persons (28.3%), thinking silica was harmless 13 persons (4.3%) and had no personal protection equipment 3 persons (1.0%).

Prevalence of silicosis

Criteria for diagnosing silicosis was parenchymal abnormality by NIOSH B reader and ILO profusion categories equal or more than 1/1. Silicosis was found in cutting stone worker (in the mountain) 33 persons (53.2%), cutting stone at home 19 persons (31.1%), cracking stone at home worker 15 persons (17.4%). In general, working as a cutting stone workers caused a more severe silicosis than other jobs. In addition, people who lived around the sand stone processes area showed less severity of silicosis (Table 1).

The symptoms of the respiratory system showed that 53 persons (16.8%) had wheezing, 41 persons (13.0%) had dyspnea, 29 cases (9.2%) had cough for more than two weeks. In addition, the workers who had severe grade of ILO classification (from grade 2/1) showed more respiratory symptoms as compared to the less severe grade (Table 2).

The results of sensitivity of questionnaire were 27.5% for dyspnea, 23.7% for wheezing, and 21.2% for chronic cough. In general, respiration questionnaire seemed to be not appropriated to use for screening silicosis (Table 3).

Table 1. ILO-classification categories separated by job characterization

ILO classification	cutting stone worker (in the mountain) n = 62	cutting stone worker (home worker) n = 61	cracking stone (home worker) n = 86	stay near area of stone cutter n = 100	others n = 6	sum n = 315
(Grade equal or more than 1/1)	33 (53.2)	19 (31.1)	15 (17.4)	13 (13.0)	0	80 (25.4)
Grade equal 1/0	9 (18.0)	11 (22.0)	18 (36.0)	10 (20.0)	2 (4.0)	50 (15.8)
Grade equal 00/01	20 (10.8)	31 (16.8)	53 (28.6)	77 (41.6)	4 (2.2)	185 (58.7)

Table 2. ILO classification of chest radiographs compared with the respiratory symptoms

Grading	0/0,0/1 n = 185	1/0 n = 50	1/1-1/2 n = 37	2/1-2/3 n = 42	3/1-3/3 n = 1
Wheezing (n = 53)	25 (13.5%)	9 (18.0%)	7 (18.9%)	11 (26.2%)	1 (100%)
Dyspnea (n = 41)	11 (5.9%)	8 (16.0%)	7 (18.9%)	14 (33.3%)	1 (100%)
Cough (n = 22)	2 (1.1%)	3 (6.0%)	2 (1.1%)	14 (33.3%)	1 (100%)

Table 3. Sensitivity and specificity of questionnaire

	sensitivity	specificity
wheezing	23.7% (14.9%-34.6%)	85.5% (80.4%-89.8%)
dyspnea	27.5% (18.6%-38.6%)	91.9% (87.7%-95.1%)
Chronic cough	21.2% (14.9%-34.6%)	97.9% (95.1%-99.3%)

Table 4. Parenchymal abnormality by reader and ILO profusion categories (n = 315)

ILO category	n	%	n	%
0	117	37.1	82	26.0
0/1	102	32.4	103	32.7
1/0	43	13.7	50	15.9
1/1-1/2	21	6.7	37	11.8
2/1-2/3	31	9.8	42	13.3
3/1-3/3	1	0.3	1	0.3

Air - pneumo reader diagnosed silicosis in 53 persons (16.8 percent), B reader diagnosed 80 persons (25.4 percent) when considering Kappa values by reading the radiograph. Abnormal chest radiograph reading by the ILO classification for the criteria diagnosis of Silicosis greater than or equal to 1/1 showed some correlation between Air-pneumo reader and NIOSH B reader (Weighted Kappa was 0.60) (Table 4).

Discussion

The results showed the prevalence of silicosis

in the workers exposed to silica in the Sikhui district, Nakhon Ratchasima in 2013, was 80 persons (25.4 percent) compared to the prevalence of the disease in South Africa^(6,7) 18.3-19.9 per cent, depending on the doctor who read the chest film. However, it may be due to the present study investigated in a higher intensity of silica dust concentrations. When comparing with the report of the Bureau of Occupational and Environmental⁽⁴⁾ in 2014, the report of silicosis in the country amounted to 100 persons, which 25 persons were reported in Nakhon Ratchasima province. The number of reported cases was underreported as shown in reports silicosis of the Bureau of Occupational and Environmental Diseases. Although the prevalence of silicosis in the present study showed higher than the report from Bureau of Occupational and Environmental Diseases, this might be because the Bureau's surveillance system was passive while this study was active surveillance. The others reasons may be that this was part of the research and development of disease surveillance system for silicosis and respiratory disorders in stone carving workers therefore, the

workers who were likely to be exposed to dust participated in the study.

The questionnaire screening for silicosis showed that the three symptoms had sensitivity in the range of 21.2 to 23.7 with the specificity was 85.5 to 87.9. Therefore, if it was required to be used as a screening tool, reconstruct or revalidate is indeed required. As recommended questionnaires are needed to conduct surveillance of silicosis as a primary database. In addition, it is one-third important tool for monitoring disease silicosis in the worker exposed to silica dust^(8,9).

Use of personal protective equipment, 12 person (3.8%) used N95 mask and only one person did not develop silicosis. Personal protective equipment using was similar problem as other countries^(10,11).

The problem of silicosis in the present research showed that the actual number of silicosis was somewhat underreported and almost passive surveillance. Most of them were informal workers not covered by personal protective equipment policy and lacked of policy for silicosis screening^(11,12).

Conclusion

The prevalence of silicosis among stone carving workers was 25.4%. The highest proportion (53.2%) worked in the job described as cutting the stone in the mountain. The diagnosed cases had wheezing symptoms 16.8%. The sensitivity of the questionnaire is highest in dyspnea symptoms (27.5%). The highest specificity of the questionnaire was cough symptoms (97.5%). There are some correlation between Air-pneumo reader and NIOSH B reader.

What is already known on this topic?

Prevalence of silicosis in stone carving worker is underreported and it is not known elsewhere.

What this study adds?

This study revealed the preliminary results of prevalence of silicosis by having the standard diagnosis using NIOSH B reader and ILO profusion categories. In addition, this study showed some dose response relationship derived from job categories.

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Potential conflicts of interest

None.

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โรคซิลิโคซิสในกลุ่มคนงานแกะสลักหิน

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วัตถุประสงค์ : เพื่อศึกษาความชุกของของโรคซิลิโคซิสในกลุ่มคนงานแกะสลักหิน

วัสดุและวิธีการ : การศึกษาภาคตัดขวางในกลุ่มคนงานที่ทำงานสัมผัสฝุ่นหินในพื้นที่ อ.สีคิ้ว จ.นครราชสีมา จำนวนตัวอย่าง 315 ราย ใช้การสุ่มแบบเฉพาะเจาะจง โดยใช้แบบสอบถามคัดกรองโรคซิลิโคซิสและรถเอกซเรย์เคลื่อนที่ ใช้การวินิจฉัยจากระดับการอ่านฟิล์มตามเกณฑ์มาตรฐานองค์การแรงงานระหว่างประเทศ โดย B-reader ที่ระดับเท่ากับหรือมากกว่า 1/1

ผลการศึกษา : กลุ่มตัวอย่างจำนวน 315 คน จากเป็นเพศชาย 186 คน (ร้อยละ 41.1) และเพศหญิง 139 คน (ร้อยละ 58.6) มีอายุระหว่าง 17-75 ปี โดยมีค่ามัธยฐานเท่ากับ 46 (17-75) ปี โดยพบความชุกของโรคซิลิโคซิส จำนวน 80 ราย (ร้อยละ 36.1) พบมากในกลุ่มคนงานที่ลงบ่อหินบนภูเขาจำนวน 33 ราย (ร้อยละ 53.2) พบค่าความไวของแบบสอบถามกับอาการและอาการแสดง อยู่ที่ร้อยละ 21.2-27.5 ค่าความจำเพาะอยู่ที่ 85.5-97.9 และ พบค่าความเชื่อมั่นระหว่างผู้อ่านฟิล์ม Air-pneumo และ NIOSH B reader อยู่ที่ 0.60

สรุป : ความชุกการเกิดโรคซิลิโคซิสในกลุ่มตัวอย่าง ร้อยละ 25.4 และพบมากในกลุ่มที่ลงบ่อหิน ร้อยละ 53.2 กลุ่มเสี่ยงมีอาการหายใจมีเสียงหวีด ร้อยละ 16.8 ค่าความไวของแบบสอบถามกับอาการหายใจไม่อึดมากที่สุดเท่ากับ 27.5% (18.6%-38.6%) ค่าความจำเพาะกับอาการไอมากที่สุดเท่ากับ 97.9% (95.1%-99.3%) ทั้งนี้ผู้อ่านฟิล์มทั้ง 2 คนมีความเห็นไปในทิศทางเดียวกันระดับหนึ่ง
