

The prevalence of silicosis among granite quarry workers, of the government sector, in Peninsular Malaysia

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Introduction:

SILICOSIS is widespread throughout the world and has been known for many years, to be caused by exposure to silicon dioxide (Si O₂) or free silica dust³. In Malaysia, the special problem of silicosis among quarry workers has been strongly suspected to exist². However, the extent of this problem has not been known.

The present study was carried out in 1976, with the objective of trying to determine the prevalence of silicosis among granite quarry workers. These data could then be used to generate codes of practice and legislation, for the control of dust in quarries. It could also form the base-line for future comparative studies and for establishing trends.

Methodology:

A questionnaire was designed to acquire preliminary information from the quarry workers such as their working history, chest symptoms and smoking habits. These questionnaires were completed through interviews, conducted by the author and his assistant. The information received was used to classify workers into two major categories: a low risk and a high risk group.

The high risk group was further examined radiologically. Each of the workers in the group had a large P.A. chest film taken, which was read with a special view to diagnose silicosis.

Material:

After a brief pilot investigation, it was decided that it would be more practical to only study the

Government quarries. The Public Works Department has centralised quarries in most of the states of Peninsular Malaysia. Only 2 states, Perlis and Malacca, did not have central quarries. 2 more states, Kedah and Selangor, have central quarries which deal with limestone. All the other 7 States have granite central quarries. These have stable populations with longstanding service. Their managements are well organised and being government employees it was easier to arrange for x-rays.

Some constraints were faced with the x-rays as they were taken by different radiographers, in different hospitals and hence the lack of consistency in terms of exposure. However, to narrow down the limits of variability, readings of all x-rays were centralised in Kuala Lumpur. Some quarries are occasionally motivated to x-ray their employees but the films taken usually are the mass miniature radiographs. These, for all practical purposes, are not appropriate for diagnosing silicosis.

All films were read by 3 doctors, of whom one was a Radiologist and one a W.H.O. Consultant. The classification of the radiographs was based on the short classification of the I.L.O. international classification of radiographs, of pneumoconioses, 1971. It has four categories of 0, 1, 2, and 3 referring to small opacities below 10 mm in size. The cases of increased interstitial fibrosis in this study are included under the category 0 (no nodules); the suspected silicosis cases under the categories 0 and 1; the positive or definite cases of silicosis under the categories 2 and 3.

As opposed to the government quarry population, the private quarries are generally employing small numbers of workers with a rapid turnover. Accordingly, the majority of the workers have had short exposures. Furthermore, the co-operation with regard to information, examination etc. is less forthcoming from the private sector. Hence, the restriction to the government sector for this study.

The population under study is divided up into two main groups (Table I). There are a total of 707 workers on the payroll of the 7 central granite quarries. Of these 481 belong to group I, the low risk category. Group I includes a number of sub-categories. As an example there is the "spreading gang", spreading pre-mix on road surfaces throughout the state. They only come to the quarry occasionally to collect their wages. Similarly there are lorry drivers who shunt the pre-mix between the quarry and the roads, under repair. Exposure to dust here is virtually nil. These two sub-categories may consist of up to 1/3 or more of the workers, on the quarry payroll. Inter-transfers of any employees from the above, to the quarry or vice versa, are rare. The remaining bulk of the employees in Group I, forming almost another 1/3 of the workers, work within the quarry premises. Here again there are those not actively engaged in production e.g. the office staff, the workshop section, watchmen and general labourers for compound or office cleaning. Hence, their exposure to dust is minimal. Also included in Group I are workers in the quarries with less than 5 years exposure, as based on previous experience from elsewhere¹ these workers would generally have not developed signs of silicosis.

Table I
Total population studied

Group	No. of workers	Percent
I	481	68
II	226	32
Total	707	100

The remaining group of workers form group II, the high risk category. They have been exposed, to free silica dust, for more than 5 years. They are engaged in the direct quarrying or the productive sections, which are very dusty. These include, drilling, blasting, earth moving; the primary, secondary and tertiary crushers; the grading bunker and premix plants. Two of the quarries had their own drillers and blasters. The rest of them engaged private labour to do this job and it was a problem to persuade many of them to participate in this study.

The total number of workers in group II was 226, all of whom were examined radiologically. All the workers were males. Speaking of race, in the East Coast States of Kelantan and Trengganu, they are all Malays. In the other States there is a mixture of all 3 races i.e. Malays, Indians and Chinese. Certain occupations, like the contract drilling and blasting and repair jobs in workshops, are predominantly carried out by the Chinese. The workers working in the crusher or premix houses, as labourers or machine operators, are mainly Indians and to a lesser extent Malays.

The Environment:

The main hygienic problem, in the environment of the quarry, is the fine rock dust. The Department of Chemistry carried out an analysis of a sample of quarry dust, to size the particles. In the different crusher houses, the screening and premix areas, an average of 98 percent (range 96.5 - 100) of the particles were respirable dust (0.5 - 10 microns).

The Geology Department analysed granite quarry rocks from 2 different parts of the country and found that the silica content, was approximately 76 percent. As opposed to this, the limestone rock had a silica content of less than one percent.

The other big problem is the occurrence of accidents. In most of the quarries the workers, climbing the quarry face, and drilling and blasting were ignoring basic safety precautions like the use of harnesses or safety belts, safety goggles, boots, helmets, and hearing protection. Machinery safeguarding also was unsatisfactory. In general, the safety aspects showed a great need to be reinforced and improved.

Results:

Table II shows the findings, of the radiological study, on the 226 workers in the high risk category. The workers are divided into categories according to the duration of exposures. 57 cases (25 percent) were diagnosed as positive or having silicosis. Another 17 (8 percent) were found to have suspected silicosis. The rest, 152 x-rays (67 percent), were negative or normal.

Table III shows the cases of silicosis in relation to the duration of exposure and the age, of the workers. The cases of silicosis and suspected silicosis are combined, which gives a prevalence of 32.7 percent (74 cases). Only 4 cases of silicosis occurred in the 5 - 9 years group (11 percent). In the 10 - 14 years exposure group there were 26 cases of silicosis (27 percent). In the group with 15 - 19

years exposure, 17 had silicosis (46 percent). In the group with more than 20 years exposure, 27 workers had silicosis (48 percent).

There were no workers below the age of 20 years. Only 5 workers belonged to the 20-29 years age-group, and they did not have silicosis. In the 30-39 years group, there were 10 cases (17 percent). In the 40-49 years age-group there were 34 cases of silicosis (37 percent). Among the workers older than 50 years, 30 (46 percent) had silicosis.

Table IV shows cases of other radiological findings, besides silicosis. These include 13 cases (6 percent) with shadows suggestive of pulmonary tuberculosis, most of them being old sequelae. Another 12 cases (5 percent) had signs of combined silico-tuberculosis. 18 cases (8 percent) had increased interstitial fibrosis, suggestive of damage to the normal lung tissue, most likely due to deposition of silica dust. There was also evidence of emphysematous changes.

Table II
Cases of silicosis among group II workers; Radiological diagnosis by period of exposure

Duration of exposure in years	No. of workers exposed	Diagnosis of silicosis					
		Negative		Suspected		Positive	
		No.	Percent	No.	Percent	No.	Percent
5 - 9	35	31	88	1	3	3	9
10 - 14	98	72	73	1	1	25	26
15 - 19	36	19	53	6	17	11	30
20 +	57	30	52	9	16	18	32
Total	226	152	67	17	8	57	25

Table III
Prevalence of silicosis (confirmed + suspected) in relation to duration of exposure and age:
W = workers; S = silicosis

Duration of exposure in years	Age in years											
	20		20 - 29		30 - 39		40 - 49		50		Total	
	W	S	W	S	W	S	W	S	W	S	W	S
5 - 9	Nil	Nil	4	Nil	16	1	12	2	4	1	36	4 (11%)
10 - 14	Nil	Nil	1	Nil	34	6	36	9	26	11	97	26 (27%)
15 - 19	Nil	Nil	Nil	Nil	8	2	22	9	7	6	37	17 (46%)
20+	Nil	Nil	Nil	Nil	3	1	25	14	28	12	56	27 (48%)
Total	Nil	Nil	5	Nil	61	10 (17%)	95	34 (37%)	65	30 (46%)	226	74 (33%)

Table IV
Other radiological findings

Total No. of workers X-Rayed	Evidence of Pulmonary Tuberculosis		Silico-Tuberculosis		Increased Interstitial Fibrosis	
	No.	Percent	No.	Percent	No.	Percent
226	13	6%	12	5%	18	8%

Discussion:

A very high prevalence of silicosis (32.7 percent), was found among the quarry workers, who had been exposed to free silica dust for more than 5 years. It should be pointed out that additional cases of silicosis in the low risk group cannot be completely ruled out. The present rates therefore are minimum figures.

The prevalence of silicosis is seen to increase, with the duration of exposure, being the highest in those exposed the longest. 70 out of 74 cases of silicosis (96 percent) occurred among workers with more than 10 years exposure.

97 percent of the workers belonged to the over 30 years' age-groups. The prevalence of silicosis cases was noted to increase among the older age groups.

The prevalence of tuberculosis, among the quarry workers, was increased as compared to the general population. When the 13 cases of silico-tuberculosis are combined, an overall prevalence of 11 percent is obtained, for tuberculosis. The National Prevalence Survey of 1970⁵ indicated a prevalence of 5.02 percent, for radiological shadows suggestive of tuberculosis, in the general population above an age of 15 years. Though this study was carried out in 1970, according to the authorities concerned, the picture is unchanged. Hence, the present study shows the rate of pulmonary tuberculosis among granite quarry workers to be more than twice as high as that of the general population. In the study on silico - tuberculosis in Singapore⁴, it is stated that silicosis is particularly liable to be complicated by tuberculosis infection. Cases diagnosed as pure tuberculosis on clinical and radiological grounds, with a history of high dust exposure, were proved to be tuberculo - silicosis on necropsy in 50 percent of the cases.

Cases with radiological lesions, suggestive of tuberculosis activity were referred to the respective states for further investigation. Also, one case of a nodular shadow and another of hilar enlargement were referred to the Physicians, for further investigation of the aetiology.

Conclusion:

A cross-sectional survey, on silicosis was done on all 7 central, government granite quarries in Peninsular Malaysia. 226 workers were in the high risk group and all were males. 57 (25 percent) were diagnosed, radiologically, as silicosis cases and 17 (8 percent) as suspected silicosis. The overall prevalence rate was 32.7 percent. Cases of tuberculosis and silico-tuberculosis combined showed a prevalence of 11 percent. This is more than twice the national prevalence rate (5.02 percent). 96 percent of the silicosis cases have occurred among workers, with more than 10 years exposure. 97 percent of the workers, were over 30 years of age. The prevalence figures show a clear trend of silicosis increasing with the duration of exposure and the age. It is not possible to establish time trends but a future survey may be able to contribute to this.

Silicosis among quarry workers is evidently a serious and frequent hazard. A formation of the codes of practice, and continuous surveillance of workers is clearly indicated, for the quarrying industries.

Acknowledgements:

I am grateful to Dr. Raja Ahmad Nordin, Director of Health Malaysia, for his advice and permission to publish this article. I would like to thank Dr. H. Jorgensen, W.H.O. advisor on occupational health for the consultation and review of the manuscript; Dr. K. Ragupathy, radiologist, and Mr. H.S. Tara for their advice; all the medical and health staff who assisted in this study, especially Mr. S. Thilaganathan and Mrs. Lee Boon Chit for typing this manuscript.

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