

A STUDY ON THE USAGE OF RESPIRATORS AMONG GRANITE QUARRY WORKERS IN SINGAPORE

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ABSTRACT

The frequency and correctness of respirators were studied in 5 granite quarries in Singapore involving 201 workers. The overall prevalence of usage of correct respirators was 45.8%. 10.4% of the workers were found to be using the wrong respiratory protective devices. Age, years of exposure and types of occupations were found to affect the usage of respirators. Some common reasons given by workers for not wearing the respirators were 'breathing difficulty', 'hot & sweaty', and 'respirator smells after a while'.

KEY WORDS: Granite quarries, Respirator usage, prevalence rate.

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INTRODUCTION

Granite is mined in the open in Singapore. The mining operation involves, firstly, the drilling of holes into the granite face for planting of dynamite. The blasted rock is then transported by lorry from the quarry face to crusher plants to be crushed to smaller sizes. All these processes generate dust. The percentage of free silica in granite dust can vary from 10 to 40%.⁽¹⁾ It is well-established that occupational exposure to silica dust can cause silicosis.⁽²⁾

Control of silica dust by engineering measures is difficult because of the nature of the quarry operations. Therefore the wearing of respirators by the workers in the granite quarries is important and necessary.

The objectives of this study were to determine the frequency of use and the appropriateness of respirators among the male workers in the granite quarries and the reasons why some workers do not use respirators.

METHOD

A listing of all the granite quarries in Singapore was obtained through the Department's records. All granite quarries with more than 40 workers were included in the study. As the majority of the workers in the quarries were male, only men were included in the study. All male workers, with any exposure to silica dust and present on the day of the survey, were interviewed and examined.

In order not to bias the workers' response the objectives of the study were not revealed to them.

All the workers were interviewed, by the same interviewer, using a standard questionnaire.

Smoking history was obtained. The workers were divided into 5 categories based on the criteria used by Brinkman & Coats and Saric^(3,4). The number of cigarettes smoked per day was multiplied by the number of years during which the subject had smoked. Hence on this basis they were categorised into Ex-smoker (stopped smoking more than one year), non-smoker (0 cigarette), light-smoker (1-200 cigarettes), moderate-smoker (201-600), and heavy-smoker (> 600 cigarettes).

Respirators used by the granite quarries were checked by the author to verify if they were the correct type for protection against silica dust.

A total of 201 workers in 5 granite quarries were studied.

RESULTS

The majority of the workers were Chinese (88.1%). Malays and Indians made up the remainder, comprising 7.0% and 4.9% respectively. 63.2% (127/201) of the workers were less than 40 yrs old. The mean age was 36.2 yrs (ranging from 20-68 yrs). The mean exposure duration was 9.3 yrs (ranging from 1-39 yrs).

Of the 201 workers, 43.8% (88/201) did not use respirators in the course of their work. 10.4% (21/201) workers were found to be using the wrong protective devices eg. wrong type of respirators, dust masks, towel, etc. Only 45.8% (92/201) workers were found to be using the correct respirators.

Table 1 shows the distribution of usage of correct respirators by occupation. The prevalence of usage of respirators was highest among the crusher attendants and 'others'; whilst the usage of respirators was low among the drivers and mechanics. There was a significant difference in the prevalence of use of respirators among the drillers and crusher attendants when compared with the drivers and mechanics. ($p < 0.0001$)

Age, years of exposure to the silica dust and the types of occupations were tested as independent variables against the usage of respirators using the stepwise regression procedures. All the three factors were found to be correlated with the usage of respirators. ($r=0.28$, $p < 0.0008$) The usage of respirators was found to increase with age and exposure duration.

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Table 1
DISTRIBUTION OF USAGE OF RESPIRATORS BY OCCUPATION

Occupation	Usage of respirators		
	Yes	No	Total
Drillers	16 (57.1%)	12 (42.9%)	28
Crusher attendants	27 (73.0%)	10 (27.0%)	37
Drivers	13 (7.3%)	62 (82.7%)	75
Mechanics	14 (45.2%)	17 (54.8%)	31
Others	22 (73.3%)	8 (26.7%)	30
Total	92	109	201

Breathing difficulty was the commonest reason (25.8%) why workers did not wear respirators. Other common reasons were: respirators got 'hot and sweaty' and 'smell after using it for a while'. 14.7% of them also complained of difficulty with communication when using the respirators. (Table 2)

Table 2
REASONS FOR NOT WEARING RESPIRATORS

Reasons	No. of workers ^a	% of total (n = 109) who did not wear respirators
1 Breathing Difficulty	27	25.8%
2 Hot & Sweaty	25	22.9%
3 Respirator smells after a while	17	15.6%
4 Difficulty with communication	16	14.7%
5 Not supplied	15	13.8%
6 Did not fit well	9	8.3%
7 Wanted to smoke	8	7.3%
8 Did not know necessity to wear	8	7.3%
9 Looked ugly	3	2.8%

a: one worker can have more than one reason.

Table 3 shows the distribution of frequency of usage of respirators (all the working time) by occupation. 75.0% or more of the crusher attendants and drillers, who wore respirators, had their respirators on all the working time. Likewise, about 50.0% of the mechanics and drivers wore respirators the whole working time.

'Hot and sweaty' and 'Difficulty with communication' were the commonest reasons for workers not wearing the respirators all the working time. (Table 4). 35.7% of the workers who did not wear respirators all the working time cited 'wanting to smoke' as the reason. However, breathing difficulty was given as the reason in only 25.0% of these workers.

There was no significant difference between the types of respirators used and the reasons for not wearing them all the time. (Table 5)

Smoking habits of the workers did not appear to influence the usage of respirators either. (Table 6)

DISCUSSION

The prevalence of usage of respirators was 45.8% among the granite quarry workers in Singapore. However, this is not a reflection of the usage corresponding to risk of exposure to silica dust. As shown in Table 1, the usage of respirators was higher among the crusher attendants and drillers as compared to the drivers and mechanics.

A driller is required to operate a drilling machine which drills a shaft, using compressed air, into the granite surface. Dynamite is placed in these shafts to blast the granite slabs. Crusher attendants have to man the crushing machine which crushes the larger boulders into smaller ones. Both these operations generate high levels of silica dust. This could be the reason for the higher prevalence rate of usage of respirators in these 2 groups.

The drivers are responsible for transporting the granite from the granite face to the crusher plants. This also included tractor operators who load the granite onto the lorry. The prevalence rate of usage of respirators among the drivers was only 17.3%. The common reason cited for not wearing them was that the vehicles were air-conditioned. This Department has found that workers in these air-conditioned vehicles were exposed to 0.006 mg/m³ of silica dust. This is below the TLV of 0.1 mg/m³ of silica dust recommended by the American Conference of Governmental Industrial Hygienists (ACGIH)(5). Likewise, the mechanics are usually stationed in the workshop which is away from the quarry face. Their exposure to silica dust is also minimal.

The 'Others' group also has a high prevalence rate of 73.3%. This group consists of the supervisors, engineers, plant managers, etc. This better-educated group may be more aware of the possible health hazard of silica dust.

The prevalence rates for the usage of respirators all the working time (Table 3) follow a similar pattern for the drillers, crusher attendants and 'Others'. The same reasons could apply.

'Breathing difficulty' was the commonest reason why individuals did not wear the respirators (Table 2). This was followed by complaints of 'Hot and sweaty' and 'Respirator smells after a while'. But for workers who wore respirators, 'Breathing difficulty' ranked fifth as the reason why they did not wear them all the time (Table 4). Respirators are known to cause breathing resistance to the users.(6,7,8,9) Thus the underlying cause for the workers not wearing the respirators may truly be that they caused some breathing resistance. This is further supported by the fact that workers who used the respirators, but not all the time, did not consider 'breathing difficulty' as a major reason.

This stresses the importance of ensuring that workers, who complain of breathing difficulty when using the respirators, should be assessed for fitness to wear them. Harber(7) has outlined 3 factors to consider in assessing if a worker is fit to wear a respirator: job environment, type of respirator, and characteristics of the individual worker.

In assessing the characteristics of the individual worker, medical and physical conditions and psychological assessments should be looked into. Pulmonary, cardiovascular and other diseases may interfere with respiratory function. These must be evaluated in the light of workers' complaints. Psychiatric disorders or certain personality traits may prevent safe respirator use. Workers who are not motivated to wear respirators may complain of 'breathing difficulty'.(10)

Singapore is a tropical country with a relative humidity of 85% and an average temperature of 28° C. Wearing respirators and working under the hot sun could pose a

Table 3
DISTRIBUTION OF FREQUENCY OF USAGE OF RESPIRATORS
BY OCCUPATION

Occupation	Frequency of Usage of Respirator		TOTAL
	All the working time	Not all the working time	
Driller	12 (75.0%)	4 (25.0%)	16
Crusher attendant	21 (77.8%)	6 (22.2%)	27
Driver	7 (53.8%)	6 (46.2%)	13
Mechanic	8 (57.1%)	6 (42.9%)	14
Others	16 (72.7%)	6 (27.3%)	22
Total	64	28	92

Table 4
REASONS FOR NOT WEARING THE RESPIRATORS ALL THE
WORKING TIME

	Reasons	No. of workers ^a	% of total (n = 28) who did not wear the respirator all the working time
1	Hot & sweaty	15	53.6%
2	Difficulty with communication	15	53.6%
3	Wanted to smoke	10	35.7%
4	Respirator smells after a while	7	25.0%
5	Breathing difficulty	7	25.0%
6	Did not fit well	2	7.1%

a: a worker can have more than one reason.

Table 5
REASONS FOR NOT WEARING THE RESPIRATORS ALL THE
WORKING TIME BY TYPES OF RESPIRATORS

	Reasons	Type of respirators used		Test of Significance
		Cartridge (% of workers)	Disposable (% of workers)	
1	Hot & sweaty	13.3%	16.9%	N.S.
2	Difficulty with communication	6.7%	18.2%	N.S.
3	Breathing Difficulty	6.7%	7.8%	N.S.
4	Respirator smells after a while	0.0%	9.1%	N.S.

N.S. = Not significant at $p < 0.05$

Table 6
USAGE OF RESPIRATORS BY SMOKING HABITS

Smoking Habits	Use respirator all the work-time	Did not use respirator/ Did not use it all the working time	Test of significance
Non Smoker	25	51	N.S.
Light Smoker	13	33	N.S.
Moderate Smoker	10	28	N.S.
Heavy Smoker	7	12	N.S.
Ex-Smoker	9	19	N.S.
Total	64	137	

problem to the workers. Workers can develop allergic contact dermatitis from the rubber chemicals in the respirators. This would be further aggravated by sweat resulting from the hot and humid environment. However, contact dermatitis of the face (allergy to rubber respirator) was not given as a reason for not using the respirators.

One is not surprised to find 'hot & sweaty' as the main reason why workers could not wear the respirators all the working time. This reason is true both for disposable and non-disposable respirators. Disposable respirators do not appear to have an advantage over the non-disposable as there was no significant difference for the reason. (Table 5)

Air-stream helmets would be ideal for this situation. But their cost is a large negative factor against their acceptance among the employers. For better compliance on the usage of respirators among these workers, bearing in mind their working environment, manufacturers of these protective devices must look into ways of developing more suitable respirators.

One valid reason why workers could not use the respirators all the working time is perhaps the need to smoke. However, this study showed that the usage of respirators was not influenced by smoking habits. Even

among the heavy smokers, there was no significant difference between those who used the respirators all the working time and those who did not.

There is also a need to ensure that workers, who complain of breathing difficulty when using respirators, are assessed for fitness to wear respirators before they are issued one.

Health education of workers should not be neglected. Workers must be educated on the importance of using the right respirators and wearing them all the working time. This should be directed especially at the younger workers and those with a short history of employment in the granite quarry. These are the groups with lower prevalence of usage of respirators.

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