Respiratory health status of ceramic workers

P Lalith R Liyanage [1] and W Ranjit De Alwis [2]

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Abstract

Objective: To assess the respiratory health status in ceramic workers.

Methodology: Sixty nine workers with continuous employment in eight sections of a ceramic factory and a matched control group of workers not exposed to dust at work were studied using an interviewer administered questionnaire on respiratory symptoms. Clinical and radiological examinations and assessments of ventilatory functions and dust levels were also performed.

Results: The mean age of the male and female workers were 40.3 and 45.1 years respectively. Prevalence of acute respiratory symptoms was significantly higher in the study group than in the controls. Chronic bronchitis was not seen. Though the prevalence of all chronic respiratory symptoms - chronic cough, chronic phlegm, dyspnoea and asthma were higher among the ceramic workers than the controls, only dyspnoea grade 3 was significantly higher in the ceramic workers.

Mean Forced Vital Capacity (FVC) of the male workers (2.90 L) was significantly lower than in the controls (3.17 L). The dust measurement revealed levels higher than the threshold limit value for free silica.

Conclusions: Ceramic workers are at a higher risk of developing respiratory problems with an associated decline in ventilatory capacity.

Key words: ceramic workers, respiratory symptoms, ventilatory functions, dust levels

Introduction

Occupational exposure to airborne particles is very common and frequently poses a potential hazard to health of workers. Ceramic dust is a composite mixture of various inorganic particles, the composition of which varies with the process and the raw materials used. Ceramic dust contains free silica and there is a potential risk of lung disease among those exposed (1). Ceramic dust also contains kaolin which could cause pulmonary changes when inhaled as a dust.

Silicosis is a very rare condition in Sri Lanka. Only one patient out of 150,000 persons examined routinely at the Kandy Chest Clinic was diagnosed as having silicosis (2). Prevalence of silicosis in the ceramic industry in other countries four decades ago has been shown to be 50% (3). At present the prevalence has declined, mainly due to engineering dust control methods and tight regulations.

The only study carried out among workers in the ceramic industry in Sri Lanka, assessed the respiratory status of kaolin workers (4). No significant findings were recorded which the authors attribute to the short duration of exposure of the subjects. This study investigated the respiratory status of ceramic workers.

Methodology

The study was carried out in a state owned factory which manufactures crockery and earthenware. The factory employs around 900 men and women. Based on the manufacturing process, the factory could be divided into thirty two sections of which eight were identified as having a dust problem. The study was restricted to the workers in these eight sections.

[1] Medical officer, Maternal and Child Health, RDHS Office, Colombo

[2] Deputy Commissioner of Labour (Occupational Health), Ministry of Labour.

Table 1: Age , height and smoking habits of study and control groups

	Age in years	Height in cm.	Cigarettes/day			
	Mean (SD)	Mean (SD)		1-4	5-9	>=10
Males: Study n=53	40.3(6.05)	163.9 (6.23)	n=30	13(43.3)	13(43.3)	04(13.3)
Control n=53	40.4(6.43)	164.0 (6.20)	n=30	13(43.3)	14(46.6)	03(10.0)
Females: Study n=16	45.1(6.58)	150.8 (5.01)	n= 0	-	-	-
Control n=16	54.0(5.36)	150.6 (4.93)	n= 0	-	-	-

(% are in parentheses)

Workers, who worked continuously since the date of first appointment in the selected sections were included in the study. A group of workers matched for sex, age, height and smoking habits was selected from the security division of the same factory, the office of the local hospital and that of the Medical Officer of Health as controls.

The following data collection methods were used:

1. A questionnaire interview on respiratory symptoms - This questionnaire was based on the Medical Research Council Questionnaire on respiratory symptoms (5) and modified to suit local conditions.
2. A clinical examination of all subjects - The clinical examination placed emphasis on the respiratory system.
3. Ventilatory function measurements - The dry spirometer, Vitalograph was used. The Forced Vital Capacity (FVC) and the Forced Expiratory Volume in the first second (FEV_1) were measured. The best of three forced expirations following two practice expirations was taken for the analysis.
4. Radiological examination - A postero-anterior view of the chest was done in workers with over 15 years of service.
5. Environmental measurement - Total and respirable dust levels were measured in the sections of the factory under study. Only one measurement was performed.

Results

Of the 69 ceramic workers 53 (76.8%) were men. Table 1 shows the distribution by age, height and smoking habits which are relevant to the indices of respiratory disease under study.

There were 30 (43.5%) current smokers, all of whom were males. Table 1 shows that the prevalence of smoking was similar in the study and the control groups. There is no significant difference between the study and controls in respect of age (males, t=0.373, p=0.98; females, t=0.058, p=0.95) or the height (males, t=0.074, p=0.96; females, t=0.088, p=0.93).

Acute and chronic respiratory symptoms experienced by the workers during work are shown in Tables 2 & 3. The commonest acute symptom reported was dryness of throat while on duty (39.1%). Cough and burning of throat were reported by 29% and 10% respectively. These symptoms were significantly higher in the study group (Table 2).

The prevalence of all chronic respiratory symptoms was higher in the ceramic workers except dyspnoea grade 4. Only the prevalence of dyspnoea grade 3 was significantly higher in the study group (13.2%) than in the controls (4.3%). There was no difference in the prevalence of chronic respiratory symptoms in the different sections of the factory.

Among the ceramic workers who were smokers 40% had respiratory symptoms while among the controls who admitted to smoking, respiratory symptoms were seen only in 10%. This difference was statistically significant (Z=3.12, P=0.003).

On clinical examination, only two workers had respiratory signs. They had lung crepitations and rhonchi. Both gave a history of asthma.
Radiological examinations were carried out on 35 workers of whom two had evidence of pulmonary tuberculosis. No control subjects were X-rayed.
The ventilatory function measurements are shown in Table 4. The FVC among both male and female workers was lower than that of the controls. The difference was significant only in the case of men. The FEV_1 did not show a significant difference in the study and controls subjects.

Environmental dust levels are shown in Table 5. The total and respirable dust levels for free silica in all sections were higher than the recommended threshold limit values.

Table 2: Prevalence of acute respiratory symptoms

	Study n=69	Control n=69	X^2 df=1	P Value
Cough	20(29)	5(7.2)	10.95	<0.001
Breathing difficulty	6(8.7)	2(2.9)	2.26	>0.05
Nose bleeds	0(0)	1(1.4)	-	-
Dryness of throat	27(39.1)	8(11.6)	13.85	<0.001
Burning throat	7(10.1)	2(2.9)	3.09	<0.05
Throat irritation	11(15.9)	7(10.1)	1.02	>0.05
Sneezing	10(14.5)	6(8.7)	1.13	>0.05

(% are in parentheses)

Table 3: Prevalence of chronic respiratory symptoms

	Study n=69	Control n=69	X^2 df=1	P Value
Chronic cough	3(4.3)	1(1.4)	1.29	>0.05
Chronic phlegm	7(10.1)	4(5.8)	0.89	>0.05
Chronic bronchitis	0(0)	0(0)	-	-
Dyspnoea grade 3	9(13.2)	3(4.3)	3.29	<0.05
Dyspnoea grade 4	1(1.4)	1(1.4)	0.51	1.0
Asthma	12(17.4)	8(11.6)	0.94	>0.05

(% are in parentheses)

Table 4: Ventilatory functions of study and control groups by sex

	Male			Female		
	Study n=53	Control n=53	P Value	Study n=16	Control n=16	P Value
FVC in L(SD)	2.90(0.54)	3.17(0.55)	0.045	1.95(0.42)	2.04(0.30)	0.26
FEV1 in L(SD)	2.47(0.46)	2.60(0.52)	0.106	1.65(0.35)	1.65(0.22)	0.92
FEV1/FVC%	82.9	82.3	-	84.8	81.3	-

Table 5: Total and respirable dust levels in selected sections of the factory

Section	Total dust mg / cm^3	Respirable dust mg/cm^3
Slip house 1	9.66	0.46
Slip house 2	8.18	0.25
Sanitaryware	9.47	1.65
Production	1.28	0.71
Biscuit firing	1.87	0.58
Colour project	15.7	2.73
Fritt kiln	44.6	6.95

Discussion

This study was carried out among workers who were exposed to a work environment of ceramic dust from the date of first appointment. Hence their occupational dust exposure has been only to ceramic dust. The controls were selected from settings where there was no occupational dust exposure. The study group was matched by age, sex, height and smoking habits and the minor differences observed between the two groups were not statistically significant (Table 1).
The effect of diurnal variation on ventilatory function was avoided by performing all tests in the morning session. A standard, uniform procedure was followed in all cases and tests were carried out by one experienced technician. He was able to obtain maximum effort from the subjects for the ventilatory function measurements. All radiographs were taken by the same technician and all X-rays were read by two consultants independently.

The questionnaire used for data collection was a standard, validated questionnaire used internationally for research on occupational respiratory disorders. All interviews were held by one person and hence there was no inter-observer bias. Subject bias could not be ruled out as the workers were aware of and concerned about the effect of dust. Therefore there may have been a tendency to exaggerate symptoms. Workers were briefed at the start on the objectives and the importance of giving correct responses.

Thirty two percent of the ceramic workers had at least one chronic respiratory symptom, whereas in the controls it was 15.9%. This was a statistically significant difference ($z=2.23$, $p=0.024$). Similar prevalence of at least one chronic respiratory symptom has been reported in most studies on occupational dust exposures. There were no workers with chronic bronchitis in this study, whereas it is a common finding in workers with occupational dust exposures in other countries.
Chronic bronchitis is a rare condition in Sri Lanka. This is thought to be due to lower levels of air pollution unlike in developed countries.
Prevalence of asthma was 17.4%. An occupational aetiology cannot be concluded from this study. This rate is almost similar to the prevalence of asthma for tea workers (18.4%) described by De Alwis (6).
Among the ceramic workers who were smokers, 40% of had at least one chronic respiratory symptom, while for the controls it was 10%, indicating the synergistic effect of smoking and ceramic dust.

This study failed to show a significant difference in the prevalence of acute and chronic respiratory symptoms between the different sections of the factory even though different dust levels were detected. The number of workers from each section was too few to be able to draw conclusions. Further the dust level measurements were cross sectional and does not indicate either past exposures or the frequency of exposure.

A significant difference in the prevalence of chronic respiratory symptoms was seen only in male workers. This may be due to the fact that there were few women in the study group. One also has to consider the possibility of men being involved in heavy work needing increased respiratory effort and therefore take in air through the mouth as well, bypassing the nasal protective mechanism.

Prevalence of tuberculosis (3%) is high compared with the national figure of 0.03 percent (7). Uragoda and Rajendra also reported a figure of 3.4% for the prevalence of tuberculosis among graphite workers (8). The close relationship between silicosis and tuberculosis is well known.

No cases of silicosis were detected among ceramic workers although the dust levels measured were well above the recommended safety level. This may be due to several reasons. Dust generating activities are not continuous and did not last for the duration of eight hours of work. Workers are also not all the time exposed to dust. Silicosis has a long latent period of over 30 years. The condition is rare in Sri Lanka.

Ventilatory function is dependent on race, sex, age, height, smoking habits and dust exposure. The study group and the controls were matched by sex, age, height and smoking. Both the study and control groups were of one race. A significant difference of the mean FVC among males in the study and control groups was detected. The findings indicate an early restrictive effect in the lung functions of ceramic workers.

Conclusions

Engineering methods to control dust emission need to be adopted. Workers should be encouraged to wear respiratory protective equipment. On the job rotation of workers is desirable as it would also reduce the effective time of exposure to dust. Periodic medical examinations and monitoring of ventilatory functions would also be helpful in early detection of respiratory problems for prevention of further exposure.

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