ORIGINAL ARTICLE

Respiratory Conditions in Malaysian Asbestos Cement Workers

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Summary

A cross-sectional study was conducted to determine the prevalence and type of respiratory conditions including asbestos-related diseases among Malaysian asbestos cement workers. The study population consisted of 1164 workers who had undergone medical surveillance from 1995 to 1997, including full history, physical examination, chest radiography and spirometry. More than half the male workers were smokers or ex-smokers, with smokers having more respiratory symptoms and signs, and reduced FEV^1 compared with non smokers. The five most common respiratory conditions diagnosed were bronchial asthma, chronic bronchitis, pulmonary tuberculosis, upper respiratory tract infections and allergic rhinitis. On follow-up, there were also two cases of asbestosis and one case of bronchial carcinoma. The asbestosis cases were probably related to heavy occupational exposure to asbestos fibres in the past, before governmental regulations were gazetted in 1986. Further follow-up is essential for continued monitoring of the health status of asbestos workers.

Key Words: Asbestosis, Occupational respiratory diseases, Malaysian workers

Introduction

Asbestos is a collective generic term given to naturally occurring fibrous mineral silicates which includes chrysotile (white asbestos), crocidolite (blue asbestos) and amosite (brown asbestos). The chemical composition of asbestos is basically silicates of magnesium or other minerals. It is mined from the earth's crust in various countries including Canada, Russia, South Africa, Zimbabwe, China, etc. The wide industrial use of asbestos is mainly due to its mechanical, heat resistant and insulation properties, and chemical stability[1-2].

In Malaysia, the asbestos industry is confined mainly to manufacturing of asbestos cement products such as pipes and roofing sheets, friction materials and gaskets. The earliest factory operations started in 1963, and the industry currently employs about 2000 workers[3]. Before

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the Factories and Machinery (Asbestos Process) Regulations were gazetted in 1986, there was little or no industrial hygiene monitoring data available. However, from job descriptions given by the workers and factory management sources, there appeared to be significant occupational exposure to asbestos dust in the past, including the use of crocidolite till 1975, and amosite till 1983 by pipe manufacturers.

Dust monitoring data after 1986, however, showed personal exposure levels to be below the previous Permissible Exposure Level (PEL) of 1 fibre/ml of air (averaged over an eight-hour period), with occasional levels of 0.2-0.3 fibre/ml. This was largely due to strict control measures in compliance with the Asbestos Regulations. The PEL has recently been changed to 0.1 fibre/ml.

Health effects of asbestos exposure are mainly associated with inhalation of fibres longer than 5 microns and less than 3 microns diameter size. These asbestos related diseases include asbestosis, bronchial carcinoma, mesothelioma and benign pleural conditions such as plaques, effusions and thickening[4-8].

Up to date, there has been little or no scientifically documented data on asbestos-related diseases and conditions in Malaysia. Consequently, a cross-sectional survey was conducted to determine the prevalence and type of respiratory conditions including asbestos-related disease among workers in the Malaysian asbestos cement industry. Such data could also provide baseline information for prospective follow-up of the cohort populations.

Materials and Methods

The cross-sectional study was conducted utilizing information collected from the medical surveillance programmes of the various asbestos cement factories in Malaysia. Statutory medical surveillance was conducted biennially under the 1986 Asbestos Regulations, and included:

1. Full history, including occupational, smoking and respiratory symptoms, taken by the examining physician using a questionnaire adapted from the British Medical Research Council (MRC) Respiratory Symptoms Questionnaire.
2. Physical examination, conducted by the examining physician.
3. Chest radiography, using full size postero-anterior views (35.6cm X 43.2cm) conforming to International Labour Office (ILO) standards. The radiographs were read and interpreted independently by three consultants (two occupational physicians and one radiologist) using the format of ILO 1980 International Classification of Radiographs of Pneumoconioses.
4. Spirometry, conducted by a trained industrial nurse or technician using a Vitalograph (British) spirometer, calibrated to meet the American Thoracic Society (ATS) criteria[9]. The best of three acceptable readings was taken. All measurements were converted to standard body temperature, ambient pressure and saturated water vapour (BTPS).

The survey team comprised two occupational physicians, a radiologist, two medical officers and other support personnel. Medical surveillance data from 1995 to 1997 were utilized in the study. Altogether, a total of about 1000 workers from five factories manufacturing asbestos cement pipes, building materials and brake linings were examined.

Occupational hygiene data on asbestos dust levels in the factory premises after 1986 were obtained from sampling records provided by the industry as well as the Department of Occupational Safety and Health. Monitoring was carried out by competent technicians, according to the Asbestos International Association (AIA) method using 25mm Millipore filters and a flow

rate of 1 litre/min over 8 hours. Fibre counting was done by an accredited competent technician using AIA method by phase contrast microscopy (Leitz, Germany), with external quality control performed by the Chemistry Department of Malaysia.

Results

A total of 1164 workers from the five asbestos cement factories were included in the survey. Table I shows the distribution of workers by age, sex, ethnic group and smoking habit. The great majority of workers were males (1055, or 90.6%). About 48.3% of males and 41.3% of females were aged 40 years and above. Most of the male workers were Malay (646, or 61.2%), while female workers comprised roughly equal proportions of Malays (34, or 31.2%), Chinese (40, or 36.7%) and Indians (34, or 31.2%).

More than half the male workers were smokers (510, or 48.4%) or ex-smokers (90, or 8.5%), but only a small percentage (2, or 1.8%) of female workers smoked. Most of the smokers were aged between 30-49 years (312, or 62.9%), while the proportion of ex-smokers were mainly 40-59 years (65 or 71.4%). Smoking was most common among the Malays (390, or 57.4%), followed by the Indians (50, or 24.6%) and Chinese (23.2%).

Generally, smokers also appeared to have more clinical symptoms and signs of cough, phlegm, dyspnoea, crepitations, rhonchi, etc, compared with non-smokers, (Table II). There were also significantly more smokers with reduced forced expiratory volume in one second (FEV_1)(56.4%) compared with non smokers (37.2%), ($p<0.01$), although there was no significant difference in their forced vital capacity (FVC), (Table III). This probably reflects the possible health effects of smoking as well as potential confounding factor on FEV_1. Table IV shows the distribution of FEV1 and FVC values for all the workers. 15.5% of workers had FVC less than 80% predicted values, while 16.1% had FEV_1 less than 80% of predicted value. The lowest mean FVC% (89.4%) and mean FEV_1% (89.4%) were observed among workers with the longest duration of employment (30 years and above) although other differences were not significant ($p>0.05$) (Table V). The clinical types of disease conditions diagnosed in the subjects examined are listed in Table VI. The great majority of the 1164 workers (1087 or 93.39%) were normal, viz with no respiratory disease conditions; 37 or 3.2% had current respiratory disease; 40 or 3.4% had past history of respiratory disease. In those with current respiratory disease, there were 19 cases of bronchial asthma, 8 cases of chronic bronchitis, one case of pulmonary tuberculosis, one case of bronchiectasis, one case of pleurisy and 7 cases of upper respiratory tract infections.

Two cases of asbestosis and one case of bronchogenic cancer were also diagnosed on follow-up in 1997-1998.

For those with a past history of respiratory disease, Table VII shows the types of diagnosis: 20 cases of bronchial asthma, 8 cases of pulmonary tuberculosis, 4 cases of chronic bronchitis, 2 cases of pneumonia, 2 cases of nasopharyngeal carcinoma and 4 cases of allergic rhinitis.

Table I: Distribution of workers by age, sex, ethnic group and smoking habit

AGE	MALAY						CHINESE						INDIAN						OTHERS						TOTAL
	MALE			FEMALE			MALE			FEMALE			MALE			FEMALE			MALE			FEMALE			
	N	E	S	N	E	S	N	E	S	N	E	S	N	E	S	N	E	S	N	E	S	N	E	S	
15-19	4	1	22	3	0	0	0	00	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	33
20-29	29	9	89	4	0	0	7	0	2	11	0	0	13	0	4	4	0	0	31	0	13	0	0	0	216
30-39	71	7	118	16	0	0	15	1	10	9	0	0	56	6	25	16	0	0	3	1	6	1	0	0	361
40-49	62	22	107	9	0	0	57	11	28	10	0	1	33	5	16	9	0	0	0	0	1	0	0	0	371
50-59	38	13	52	2	0	0	31	12	10	9	0	0	2	1	2	3	1	1	1	0	0	0	0	0	178
60 & ABOVE	0	0	2	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	5
TOTAL	204	52	390	34	0	0	110	24	50	39	0	1	107	12	50	32	1	1	35	1	20	1	0	0	1164

(N = Nonsmoker E = Ex-smoker S = Smoker)

Table II : Symptom and Smoking Distribution

Category	Non Smoker		Ex-Smoker		Smoker		Total	
	No.	%	No.	%	No.	%	No.	%
Cough	41	7.2	4	4.3	55	10.4	100	8.4
Phlegm	0	0.0	0	0.0	1	0.2	1	0.1
Dyspnea	17	3.0	4	4.3	20	3.8	41	3.4
Creptitations	1	0.2	1	1.1	2	0.4	4	0.3
Rhonchi	1	0.2	0	0.0	4	0.8	5	0.4
Others	18	3.1	5	5.3	24	4.6	47	4.0
Normal	494	86.3	79	85.0	420	79.8	993	83.4
Total	**572**	**100.0**	**93**	**100.0**	**526**	**100.0**	**1191**	**100.0**

Table III : Smoking and below 80% FEV and FVC Distribution

Category	Non Smoker		Ex-Smoker		Smoker		Total		p-value
	No.	%	No.	%	No.	%	No.	%	
FEV1<80%	70	37.2	12	6.4	106	56.4	188	100.0	<0.01
FVC<80%	83	45.9	12	6.6	86	47.5	181	100.0	>0.05

Table IV : FEV1 and FVC Distribution

Lung Function	Percentage of Lung Function	No. of Workers	%
FVC	<60	16	1.4
	60 - 79	165	14.1
	80 & above	983	84.5
	Total	**1164**	**100.0**
FEV1	<60	21	1.8
	60 - 79	167	14.3
	80 & above	976	83.9
	Total	**1164**	**100.0**

Table V : Duration of Employment and Ventilatory Function

Duration of Employment (years)	No. of Workers	Mean FVC%	Mean FEV1%
0-4	306	94.5	97.5
5-9	55	93.4	94.7
10-14	106	91.8	95.6
15-19	343	101.1	104.0
20-24	152	100.1	103.5
25-29	119	104.9	108.9
30 & above	83	89.4	89.4
Total	**1164**	**97.6**	**100.5**

Table VI: Diagnosis of Respiratory Conditions

Diagnosis	No.	%
Normal	1087	93.3
Chronic Bronchitis	8	0.6
Bronchial Asthma	19	1.6
Emphysema	0	0.0
Pulmonary Tuberculosis	1	0.1
Pheumonitis/pneumonia	0	0.0
Lung Cancer	1	0.1
Asbestosis	2	0.2
Mesothelioma	0	0.0
Pleural Plaque	0	0.0
Pleurisy	1	0.1
Bronchiectasis	1	0.1
Upper Respiratory Tract Infection	7	0.6
Normal with Past History	40	3.4
Total	**1167**	**100.1**

Table VII : Past Diagnosis of Respiratory Conditions

Diagnosis	No.	%
Chronic Bronchitis	4	10.0
Bronchial Asthma	20	50.0
Emphysema	0	0.0
Pulmonary Tuberculosis	8	20.0
Pheumonitis/Pneumonia	2	5.0
Lung Cancer	0	0.0
Asbestosis	0	0.0
Mesothelioma	0	0.0
Pleaural Plaque	0	0.0
Pleurisy	0	0.0
Nasopharyngeal carcinoma	2	20.0
Allergic Rhinitis	4	10.0
Total	**40**	**115.0**

Table VIII : Five Most Common Respiratory Conditions

Diagnosis	Present Cases	Past Cases	Total No. of Cases	% of Total No. of Workers
Bronchial Asthma	19	20	39	3.3
Chronic Bronchitis	8	4	12	1.0
Pulmonary Tuberculosis	1	8	7	0.8
Upper Respiratory Tract Infection	7	0	4	0.6
Allergic Rhinitis	0	4	3.3	0.3

Table IX : Clinical Summary of Asbestosis and Lung Cancer Cases

	Case 1 Asbestosis	Case 2 Asbestosis	Case 3 Lung Cancer
Age (years)	54	55	43
Sex	Male	Male	Male
Ethnic group	Malay	Malay	Malay
Workplace	AC pipes/sheet	AC pipes/sheet	AC pipes/sheet
Duration of work (years)	35	33	23
Smoking	No	Yes	Yes
Symptoms	Cough, mild dyspnoea on effort	Dyspnoea on effort	Cough, haemoptysis
Signs	Bilateral crepitations in lower lobes Reduced chest expansion	Bilateral crepitations in lower lobes Reduced chest expansion	Decreased entry in Right upper lobe
Chest Xray	Minimal pleural thickening at Right Costophrenic angle (Gd 0/0)	Pleural thickening along Left lung (apex and base) and Right lung; Opacitis in left lower zone (Gd 1/0)	Opacity in Right Upper lobe, with collapse
Lung FunctionTest (FEV1/FVC)	Mild restrictive	FEV, reduced, FVC normal	Normal
CT Scan	Bilateral pleural thickening and calcification in mild and lower zones posteriorly	Reticulonodular changes in left apex (old PTB); pleural thickening and calcification in both lower zones; interstitial changes in both lung base	Right Bronchial mass with upper lobe collapse
Biopsy	Interstitial tissue oedema and fibrosis	Not done	Inconclusive histological type

Discussion

The five most common respiratory conditions among the study population were bronchial asthma, chronic bronchitis, pulmonary tuberculosis, upper respiratory tract infections and allergic rhinitis (Table VIII). Altogether, there were 39 workers with bronchial asthma (3.3%), of which 19 were current and 20 past cases; 12 cases of chronic bronchitis (1.0%) (8 current and 4 past cases); 9 cases of pulmonary tuberculosis (0.8%) (1 current and 8 past cases); 7 workers with upper respiratory tract infections (0.6%); and 4 cases of allergic rhinitis (0.3%). The prevalence of asthma in the adult Malaysian population is slightly higher at about 7%[10]. On follow-up in 1997-8, there were also 2 cases of asbestosis (0.2%) and one case of bronchial cancer (0.1%), (Table IX).

A striking finding revealed by the study is the high prevalence of cigarette smoking among the male workers. More than half were either current smokers (512 or 44.0%) or ex-smokers (91 or 7.8%). Many of these were heavy smokers, consuming more than 20 cigarettes daily for periods exceeding 20 years. This is probably a major factor behind the high prevalence of chronic bronchitis, and possibly also an aggravating factor in many cases of bronchial asthma which constituted the most common respiratory condition. This is reflected in the lung function changes, of which 50% workers showed a mixed restrictive/obstructive pattern while 10% showed an obstructive ventilatory defect.

The two cases of asbestosis are probably related to their heavy dust exposure levels in the 1960's and early 1970's. It should be noted that no industrial hygiene monitoring data of dust exposure levels in the workplace were available before the enforcement of the Malaysian Asbestos Regulations in 1986. However, job descriptions given by the workers and factory management sources indicated considerable occupational exposure levels to asbestos dust had existed in the past, due to lack of proper dust control measures. After 1986, however, dust monitoring data showed the time-weighted average levels to be below the previous Permissible Exposure Level of 1 fibre/ml of air.

In the single case of bronchial cancer, it is difficult to fully evaluate the potential contribution of past asbestos dust exposure, but there were no clinical or radiological evidence of asbestosis having occurred prior to the development of his malignancy. However, it is possible that his disease is related to his heavy smoking habit (20 cigarettes/day for 23 years).

It is essential that follow-up of workers be continued to monitor their health status, particularly for early diagnosis of asbestos-related disease. In addition, there is a vital need for strict compliance with Asbestos Regulations in every aspect for the continued safe handling of asbestos in industry.

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Asbestos exposure becomes an issue if asbestos containing materials become airborne, such as due to deterioration or damage.Â Asbestos abatement or remediation workers and emergency personnel such as firefighters may also become exposed.[16] Asbestos-related diseases have been diagnosed in asbestos workers' family members, and in residents who live close to asbestos mines or processing plants.[17]. Common building materials containing asbestos[edit].Â The forces or conditions of usage that come into intimate contact with most non-friable materials containing asbestos are substantially higher than finger pressure. Smoking and asbestos[edit].