RESPIRATORY SYMPTOMS AND PULMONARY FUNCTION AMONG MALE QUARRY WORKERS IN KELANTAN, MALAYSIA.

Razlan Musa1, Lin Naing1, Zulkifli Ahmad1 & Rusti Nordin1

ABSTRACT

The relationship between dust exposure and lung function were investigated in a cross sectional study of 70 male quarry workers. The investigation included spirometric testing and detailed personal interviews using a structured questionnaire adapted from British Medical Research Council questionnaire on respiratory symptoms. Respiratory symptoms commonly reported by the male workers were shortness of breath (42.9%), chest tightness (37.1%), morning phlegm (20.0%) and morning cough (10.8%). Prevalence of respiratory symptoms was greater in current smokers. Age and duration of employment also had significant relationship with chest tightness. Both FEV1 and FVC of these workers were significantly reduced when compared to healthy population. Smoking status, age, and duration of employment were also associated with reduced pulmonary function (p<0.01).

Key words: respiratory symptoms, lung function and quarry workers

INTRODUCTION

Quarry workers are continuously exposed to free silica and hence at risk of developing silicosis. There is no doubt that advanced silicosis is usually associated with significant restrictive lung function impairment.

In the early stage of the disease or in a simple silicosis, the lung function shows little or no functional abnormality1. Studies have shown that dust exposure, significantly associated, independent of silicosis, with lung function loss2. There were limited local data published since the preliminary report1.

The present study is a cross sectional survey of the prevalence of respiratory symptoms and impaired pulmonary function in quarry workers exposed to silica dusts.

METHODOLOGY

The study population consisted of all workers employed at the Government owned quarry in Kelantan. Altogether there were 72 (70 males and 2 females) workers employed at the time of study. The study was conducted between April and May 1998 in the quarry factory in Kelantan, Malaysia. All of the workers (with exception of administrative staff) were invited to participate in this study.

The subjects were interviewed by using a standard questionnaires which was based on the British Medical Research Council5 questionnaire on respiratory symptoms. The questionnaires were pertaining to the respiratory symptoms, past medical history, smoking status and occupational history. Respiratory symptoms included were shortness of breath, chest tightness, morning phlegm, and morning cough. The current smoker was defined as those who smoked a tobacco product at time of the study.

Lung function was measured with a spirometer (MicroLab 3300 series). Each subject was asked to inhale deeply in standing position with the nose clamped, blowing rapidly and completely as possible. The procedure was explained and demonstrated to each subject. At least three measurements were taken on each subject. Only the best blow was recorded and printed. Results were automatically corrected to body temperature, Height and weight were recorded to the nearest 0.5 cm and 0.5 kg respectively.

Data analysis was done by Epi Info Software7. The results were compared to healthy Malaysian Standard8 using appropriate statistical analysis.

RESULTS

Seventy-two workers (70 males and 2 females) with mean age of 39.9 years ± 8.33 SD were assessed. Mean duration of employment was 10.54 ± 7.08 SD years. Since the number of female workers was small, they were excluded from further analysis. Sixty one percent of workers were current smokers.

Respiratory Symptoms

Symptoms were grouped into 4 main categories namely morning cough, morning cough with
phlegm, chest tightness and shortness of breath. Shortness of breath was the most common symptom (42.9%), followed by chest tightness (37.1%), morning phlegm (20.0%) and morning cough (10.0%) (Figure 1).

![Distribution of symptoms experienced by workers](image)

Figure 1: The distribution of symptoms experienced by workers

Sixty percent of male workers have at least one of the above symptoms, 37.1% at least two symptoms, 11.4% and 1.4% of workers have at least three and four symptoms, respectively.

Age (OR=3.57; 95% CI: 1.28, 10.0; p=0.013) and duration of employment (OR=2.80; 95% CI: 1.03, 7.62; p=0.041) were significantly related to chest tightness. Chest tightness was reported more in older age group (50% of age ≥41 versus 23% of age <40), and more among those who worked for ≥12 years (50% of those worked for 12 years and 26% of those worked <12 years). Table 1 show the association of respiratory symptoms with the characteristic of the workers.

### Lung function

Mean value for forced expiratory volume of the first second (FEV1) was not significantly different from predicted value for healthy Malaysian population (p=0.464) whereas for the mean forced vital capacity (FVC), it was significantly reduced (p<0.001) (Table 2).

Further analysis revealed that age was significantly related to FEV1 (p<0.001) and FVC (p<0.001). Duration of employment was also significantly related to FEV1 (p=0.041) and FVC (p=0.023). However, in age-adjusted multiple linear regression model, duration of employment was not related to FEV1 and FVC. Smoking was not significantly related to FEV1, FVC and FEV1/FVC (Table 3).

### Table 1: Relationship between respiratory symptoms and age, duration of employment and smoking status in 70 male quarry workers

| Symptoms          | Demographic characteristic | OR (95% CI)  
|-------------------|-----------------------------|--------------|
| Shortness of breath | Age group  
|                   | Duration of employment  
|                   | Smoking  
| Chest tightness  | Age group  
|                   | Duration of employment  
|                   | Smoking  
| Morning phlegm  | Age group  
|                   | Duration of employment  
|                   | Smoking  
| Morning cough  | Age group  
|                   | Duration of employment  
|                   | Smoking  

1 Odds ratio (95% confidence interval)
2 Age group: 40 years & below (reference group) versus 41 & above;
3 Duration of employment: 11 years & below (reference group) versus 12 & above
4 Smoking: current smokers versus none current smokers (reference group)

### Table 2: Pattern of FEV1, and FVC in 70 male quarry workers

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Quarry worker</th>
<th>Malaysian healthy population</th>
<th>Mean difference</th>
<th>p.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV1</td>
<td>2.611</td>
<td>2.659</td>
<td>0.0481</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>FVC</td>
<td>2.733</td>
<td>3.457</td>
<td>0.7241</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>0.966</td>
<td>0.764</td>
<td>0.202</td>
<td>P&lt;0.001</td>
</tr>
</tbody>
</table>
Table 3: Relationship between each respiratory function parameters and age, duration of employment and smoking status

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Independent Variable</th>
<th>Univariate(^1)</th>
<th>Multivariate(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(b = -0.040)</td>
<td>(b = -0.041)</td>
</tr>
<tr>
<td>FEV(_1)</td>
<td>Age (years)</td>
<td>(95%\text{CI}: (-0.05, -0.03))***</td>
<td>(95%\text{CI}: (-0.058, -0.028))***</td>
</tr>
<tr>
<td></td>
<td>Duration of Employment (years)</td>
<td>(95%\text{CI}: (-0.04, -0.01))*</td>
<td>(95%\text{CI}: (-0.010, 0.025))</td>
</tr>
<tr>
<td></td>
<td>Smoking (yes=1, no=0)</td>
<td>(95%\text{CI}: (-0.05, 0.47))</td>
<td>(95%\text{CI}: (-0.019, 0.023))</td>
</tr>
<tr>
<td></td>
<td>Age (years)</td>
<td>(b = 0.270)</td>
<td>(b = 0.024)</td>
</tr>
<tr>
<td></td>
<td>Duration of Employment (years)</td>
<td>(95%\text{CI}: (-0.048, -0.024))***</td>
<td>(95%\text{CI}: (-0.055, -0.024))***</td>
</tr>
<tr>
<td></td>
<td>Smoking (yes=1, no=0)</td>
<td>(95%\text{CI}: (-0.09, 0.43))</td>
<td>(95%\text{CI}: (-0.223, 0.213))</td>
</tr>
<tr>
<td></td>
<td>Age (years)</td>
<td>(b = 0.170)</td>
<td>(b = 0.005)</td>
</tr>
<tr>
<td>FVC</td>
<td>Duration of Employment (years)</td>
<td>(95%\text{CI}: (-0.007, 0.04))*</td>
<td>(95%\text{CI}: (0.012, 0.024))</td>
</tr>
<tr>
<td></td>
<td>Smoking (yes=1, no=0)</td>
<td>(95%\text{CI}: (-0.014, -0.032))*</td>
<td>(95%\text{CI}: (-0.425, 0.077))</td>
</tr>
<tr>
<td></td>
<td>Duration of Employment (years)</td>
<td>(b = 0.222)</td>
<td>(b = 0.174)</td>
</tr>
<tr>
<td></td>
<td>Smoking (yes=1, no=0)</td>
<td>(95%\text{CI}: (0.403, 0.064))</td>
<td>(95%\text{CI}: (-0.284, 0.302))</td>
</tr>
<tr>
<td></td>
<td>(95%\text{CI}: 0.736, 7.35))</td>
<td>(b = 4.04)</td>
<td>(b = 4.04)</td>
</tr>
</tbody>
</table>

\(p < 0.05\) \(\star \quad p < 0.01 \quad \star \star \quad p < 0.001 \)

\(^1\) simple linear regression

\(^2\) multiple linear regression (independent variables: age, duration of employment, & current smoking status)

\(b = \) regression coefficient

**DISCUSSION**

This study found that 60.0% of the quarry male workers complained of at least one respiratory symptom. The most common symptom reported was shortness of breath (42.9%) while only 10.0% of the workers had morning cough. This result is comparable with the study by Lemie et al., who found that 63.3% of quarry workers in Brazil complained of one or more respiratory symptoms – there were cough in 31.9%, expectoration in 41.7% dyspnoea in 9.7% and wheezing in 33.3% of the workers\(^5\). In this study too, the risk of chest tightness was found to be significantly associated with the age-group of more than 40 years (OR 3.57) and duration of work of at least 12 years (OR 2.80). The risk of shortness of breath, production of morning phlegm and morning cough was not affected by both the age-group and duration of employment.

The results provide support that quarry workers have a high prevalence of pulmonary symptoms. Silicosis is a well-known occupational condition among quarry workers. Granite rock contains abundant quartz often comprising 30-45% of the parent rock, as grains visible to the naked eye, with the quartz content in the respirable dust fraction averaging 27%. However it may contain varying amounts of muscovite, kaolin, feldspar and other silicates or iron oxides, which could cause silicosis characterized radiologically by mainly irregular opacities. Workers with simple silicosis are often asymptomatic. Complicated silicosis causes mainly dyspnoea with and without cough. The lung function loss in silicosis is attributable to the lung fibrosis it produces. Radiological changes are normally present before any symptoms of breathlessness appear. Early diagnosis is essential, if a sufficiently large quantity of dust has been inhaled, the symptoms may progress even after exposure has ceased. The history of cough and expectoration may however be due to concomitant cigarette smoking by the workers but no significant association was found.

The diagnosis of silicosis is based primarily on history and radiographic findings. In this study, radiographs were not done and silicosis was not diagnosed. There is a possibility of other pulmonary conditions such as occupational asthma, which may be responsible for chest tightness, shortness of breath, morning cough with phlegm. Reversible wheezing, an important symptom in asthma, was not elicited in this study. Coronary artery disease can also be responsible for chest tightness, especially in an all-male study population. Smoking can also explain some of the respiratory symptoms reported, but no significant association was found. Perhaps detailed exposure such as number of cigarettes and duration of smoking may be associated with the respiratory symptoms reported.

The lung function tests done showed that FEV\(_1\) were comparable to healthy Malaysian population. Occupational asthma is rather unlikely as FEV\(_1\) will be reduced during acute attacks.
However, the FVC were found to be significantly reduced, indicating a restrictive type of pulmonary condition. Dust exposure with pulmonary fibrosis such as those found in silicosis may cause a concomitant reduction of both FEV1 and FVC. However, the FVC will be markedly reduced. Both the age and smoking status of the worker will influence FEV1 and FVC. Multivariate analysis done however showed only the age to be a significant factor in FEV1, FVC and FEV1/FVC while smoking was associated only with FEV1. The duration of employment was not found to be a significant factor.

This study was limited in that we did not allow for dust exposure or the extent of radiological opacities, which may be linked to the respiratory symptoms and lung function tests. The duration of employment is not a good indicator for exposure as there are various categories of quarry workers, each with a different level of exposure. Also, studies of currently employed workers have the possibility of selection bias, such that the subjects who were studied might have suffered less from their exposure than others who have left their employment, some possibly due to ill health sustained from their job exposure. A number of studies have shown that workers who have resigned or retired from active service had higher prevalence of radiological pneumoniasi. The nature of dust exposure is another varying factor that may explain the differences in results obtained in studies of silica exposed workers. The presence of other minerals in the dusts such as silicates rich in iron or aluminium, are well known to modify the biological effects of silica exposure.

In conclusion, our results suggest that working in quarries is associated with significant respiratory symptoms. There is a possibility that silicosis is responsible for these symptoms. There is no known effective treatment for silicosis currently. However, preventive measures are most effective against acquiring silicosis. Efforts should be made to eliminate or reduce respiratory exposure to silica dusts. Proper ventilation of the work area, use of wet techniques, wearing of appropriate masks, hoods or respirators; and other methods of controlling the environment would markedly diminish the occupational exposure to silica and its associated hazards.

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REFERENCES


