Disease Patterns Amongst Mine Workers at Kushk (Iran)

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A cross-sectional survey of 651 workers at a remote lead and zinc mining complex has shown the following clinical evidence which may indicate the presence of occupational diseases. The incidence of all symptoms was 30% ranging from 9.7% in workers under 20, to 80% in those over 60 years old, the relationship between age and the frequency of symptoms being approximately linear. Respiratory symptoms were the most frequent, affecting 7.2% of the workers, digestive disorders 6.9%, back pain 3.7%, eye strain 2.8%, dermatitis and hearing loss 2.1% each. In addition to the mineral ores, the workers are exposed to a variety of potentially toxic chemical agents, so that in addition to the study of a control population, specific tests need to be applied to determine whether there are exposure related occupational diseases in this population.

Occupational diseases can be suspected when symptoms are more frequent in a working population than in the population from which the workers are drawn. Occupational disease can be expected when workers are exposed to hazardous materials without adequate control of the working environment or without the provision of proper personal protection. The mining population in this study works in a mountainous region (Kushk) in Iran at an average height of 1850 m above sea level in the Bafq district of Yazd Province. Surface and underground mining with rock blasting, stone cutting and the loading of transport are the main activities. But some chemical treatment of the ore and quality control testing is also carried out. The main hazard is heavy metal poisoning due to inhalation or ingestion which can cause both acute and chronic disease. Health and safety experts world wide are increasingly concerned with long-term effects even at the low levels of exposure which have been permitted up to the present.1-7

This preliminary survey can only indicate the probability of occupational disease at this site because of the absence of facilities for biological testing for intoxication in the workers or any examination of a control population.

Methods and Materials

This is a cross-sectional survey of 622 regular workers and 29 daily wage and shift workers out of a total work force of 681 (some of them were at compulsory military training while some others were absent or were desk workers) carried out between January and August 1990. Underground tunnel, surface, mill and service workers were included from different areas of the mine.

Information was collected by interview using the post-employment periodic check-up form prescribed by the Iranian Health Ministry supplemented by an additional questionnaire. Standard statistical methods were used in the analysis.8 No controls could be included because the workers were brought to the site by company transport from the district towns 45 km away.

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Figure 1. Age distribution of workers ($n = 622 + 29$).

Figure 2. Proportionate morbidity curve in relation to respective age group.

Where the specific diagnoses are included in the analysis, the workers had been notified to the Labour Ministry and the Department of Social Insurance Services while the diagnoses were confirmed by the Iranian Board of Specialists. The diagnoses were based on clinical history, occupational history, routine haematology, chest X-rays and other standard laboratory tests as required. Atomic absorption tests for lead in body fluids were not available.

**Results**

All workers on the site were male.

The age distribution of the workers studied is shown in Fig. 1 and the relationship between age and the frequency of symptoms is shown in Fig. 2. This relationship was approximately linear indicating that the risk (if present) and the onset of symptoms started from the beginning of the employment and was progressive in all susceptible workers.

Half the workers fell in the age group 21–30 years and 24% of these had symptoms; this rose to 40% in the 31–40 year age group. The increases in the older age group were consistent with this trend but the numbers were small.

While the main hazards were due to exposure to metal ores and silica-containing rock, some workers were also exposed to toxic chemicals used in ore testing and processing. These are listed in Table 1.

Table 2 shows the distribution of symptoms. Those affecting the respiratory system were the most common...
Table 1

<table>
<thead>
<tr>
<th>Chemicals used in mine mills department and laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper sulphate: CuSO₄, 5H₂O</td>
</tr>
<tr>
<td>Zinc sulphate: ZnSO₄, 7H₂O</td>
</tr>
<tr>
<td>Cyanides (Na/K): S²⁻</td>
</tr>
<tr>
<td>Amyl xanthate: R-OC-C-SM (M = Na⁺/K⁺)</td>
</tr>
<tr>
<td>Aeropromoter 404: Mercaptohexanethiol</td>
</tr>
<tr>
<td>Aerodepressant 633: Mixture of organic colloids, dyes and cresols</td>
</tr>
<tr>
<td>Frother: MIBC-Methylisobutylcarbinol</td>
</tr>
<tr>
<td>Benzene or derivatives</td>
</tr>
<tr>
<td>Methyl isobutyl ketone</td>
</tr>
<tr>
<td>Lime or other inorganic/organic solvents</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Disease distribution</th>
<th>Total no</th>
<th>% of 651</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory symptoms</td>
<td>47</td>
<td>7.22</td>
</tr>
<tr>
<td>Alimentary symptoms</td>
<td>45</td>
<td>6.91</td>
</tr>
<tr>
<td>Low backache</td>
<td>24</td>
<td>3.69</td>
</tr>
<tr>
<td>Eye strain</td>
<td>18</td>
<td>2.76</td>
</tr>
<tr>
<td>Dermatitis</td>
<td>14</td>
<td>2.15</td>
</tr>
<tr>
<td>Hearing deficiency</td>
<td>14</td>
<td>2.15</td>
</tr>
<tr>
<td>Neurological deficits</td>
<td>12</td>
<td>1.84</td>
</tr>
<tr>
<td>Hypersensitive to mine environment</td>
<td>11</td>
<td>1.69</td>
</tr>
<tr>
<td>Others</td>
<td>13</td>
<td>2.00</td>
</tr>
<tr>
<td>Total morbidity</td>
<td>198</td>
<td>30.41</td>
</tr>
<tr>
<td>Healthy workers</td>
<td>453</td>
<td>69.59</td>
</tr>
</tbody>
</table>

(affecting 7.2% of workers) as might be expected from a mining environment, but digestive disorders at 6.9% were nearly as high.

Among the workers with respiratory symptoms there were 55% smokers of more than 10 cigarettes daily compared with 37.1% 'never smokers' in the study group as a whole (6 of 10 cases of silicosis were in smokers). The diagnoses of the cases with respiratory symptoms are shown in Fig. 3.

The age of the persons already diagnosed as having silicosis and the duration of their employment is shown in Table 3. Grades II and III silicosis are shown here.

Grade I was diagnosed as chronic bronchitis because of the inadequacy in diagnostic tools. The period of work before diagnosis seems to indicate a relatively high level of exposure. Two cases of tuberculosis could be established in addition to these 10 silicosis cases.

Of the 45 workers with digestive symptoms 19 had been diagnosed endoscopically or radiologically as suffering from peptic ulcer. Fourteen complained of abdominal cramps and 12 from other symptoms such as anaemia and constipation. It was hard to be certain whether a lead line was present on the gums because of pigmentation due to other causes.

Hypertension was present in four workers and polythemia in five, but anaemia was present in 13. Anaemia was reported to be the microcytic hypochromic type with no basophilic stippling in any case. This conforms with the nutritional status of the locality from where these workers originate.

The twelve workers with neurological disorders include four cases of epilepsy, some others with depression and neuropathy but none with definite wrist or foot drop.

Discussion

The scope of this study was determined by factors which are common to many remote areas in the Third World. The co-operation of the workers was limited by illiteracy, disbelief and suspicion born of poor communication and fear of loss of wages or employment. There was a shortage of health and safety staff and facilities. A control population was not available because of multifactorial reasons. Dose-response relationship could not be tested because of the limitations of individual exposure measurements. It was also not possible to grade the severity of the symptoms and signs of possible occupational disease in the workforce.

The majority of the workers were in the 21-40 year age group and the progressive rise
in symptoms within this group indicates that if these symptoms are work-related then the hazard is relatively serious. By the time the men reach the age of 60 years four out of five develop symptoms and are in fact employed in low risk areas waiting retirement. Most of the symptoms in the younger group are gastrointestinal or skin related, but in the older groups respiratory and metabolic symptoms predominate.

The symptoms of chronic bronchitis were present in 22 workers (nine of whom smoked occasionally and three heavily) but there was exposure to sulphur dioxide, oxides of nitrogen and other irritants in the mine complex which may have provoked these symptoms.9

The ten cases of silicosis already detected were in men with a moderate period of employment, but international safety standards are aimed at preventing silicosis in spite of a lifetime employment.10,11 While it is possible that some of these cases were due to previous employment, the evidence suggests inadequate control of the risk in this mine area.

Peptic ulcer is common in the general population in this part of Iran so that the high incidence amongst the workers may not be significant. But the high incidence of cramps, constipation, anaemia etc. raises the possibility of chronic poisoning from inhalation or ingestion of lead-containing dust.12,13

Deafness in 14 men may not be unusual in this sort of population but if it occurs in relatively young men then the control of the many noisy operations and the wearing of hearing protection may not be enforced adequately.

Back pain was often found in the drivers of heavy vehicles and similar machinery. It appears to be due to a bad seating position and poor layout of the controls and steering wheel. Closer attention to this aspect of the work environment should prevent these symptoms in the future and increase productivity.

Conclusion

The high levels of symptoms in this workforce, which increase progressively with age, suggest that the working environment is partly responsible. A more detailed study, using more sophisticated environmental hazard measurements and more sophisticated biological monitoring of the work force is indicated. At present the evidence does not directly point at a lead hazard, but there is sufficient evidence to justify the use of blood lead analysis to monitor the health of workers most likely to be at risk.14 There is also a general need to improve hygiene measures and the training of both staff and workers in the application of engineering and personal protective measures which are standard for this type of operation.

The study also demonstrates the difficulties of carrying out a hazardous operation like mining lead and zinc ore in a remote part of a Third World country. The difficulties encountered by those responsible for health and safety are just part of the problem.

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References