STUDY ON THE HEALTH HAZARDS OF SCRAP METAL CUTTERS

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ABSTRACT

Scrap metal cutters seemed to be left out in most preventive programmes as the workers were mainly contract workers. The health hazards of scrap metal cutting in 54 workers from a foundry and a ship breaking plant were evaluated. Environmental sampling showed lead levels ranging from 0.02 to 0.57 mg/m^3 (threshold limit values is 0.15 mg/m^3). Exposure to lead came mainly from the paint coat of the metals cut. Metal fume fever was not reported although their main complaints were cough and rhinnitis. Skin burns at all stages of healing and residual scars were seen over hands, forearms and thighs. 96% of the cutters had blood lead levels exceeding 40 μg/100 ml with 10 workers exceeding 70 μg/100 ml. None had clinical evidence of lead poisoning. The study showed that scrap metal cutting is a hazardous industry associated with significant lead exposure. With proper medical supervision, the blood lead levels of this group of workers decreased illustrating the importance of identifying the hazard and implementing appropriate medical surveillance programmes.

Keywords: Scrap metal cutting, lead exposure, medical monitoring

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INTRODUCTION

In modern industries, the potential health hazards were often taken into consideration during the design stage and control measures were implemented whenever feasible. Scrap metal industries, however, were thought to be "temporary" industries employing mainly contract workers who were unfamiliar with health and safety programmes. Here, welding and cutting of metal parts were carried out. Although these processes were present in many industries, they were especially hazardous in scrap metal industries as the work environment was often left uncontrolled and the workers were not aware of the potential hazards involved.

In April 1986, we diagnosed a case of metal fume fever in a scrap metal cutter. This condition is caused by the inhalation of metal oxide fumes. Typically, it begins within 4 to 8 hours after exposure to the metal oxide and is preceded by a foul taste in the mouth. Other symptoms such as dryness of the mouth, nausea and/or vomiting, fever and/or chills, headache, cough, rhinnitis and muscular aches may occur. Many physicians often overlook this condition as it is self-limiting and the symptoms resemble influenza or upper respiratory tract irritation. As the health hazards of this group of workers had not been identified in Singapore and there was no recent reports published, this study was carried out to evaluate the extent of the problem among scrap metal cutters in a foundry and shipbreaking plant where the hazards of scrap metal cutting seemed forgotten.

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MATERIALS AND METHODS

A list of all scrap metal cutters was obtained from an industry in which the case of metal fume fever was diagnosed. 54 scrap metal cutters currently employed were included in this study. They (all males) were matched with controls (construction workers) by sex, ethnic group and within 5 years of age. All were interviewed on their occupational and smoking history, the usage of personal protective equipment and symptoms of metal fume fever experienced over a 3-month period. Examination with emphasis on the skin and chest was carried out. Full vital capacity (FVC) and forced expiratory volume in 1 second (FEV_1) were measured with an autospiror Hi-498.

Midweek early morning urine was collected and analysed for arsenic, chromium, manganese and mercury in the first 30 samples. Subsequent samples were analysed only for arsenic as the results showed negligible amount of the other metals. In addition, blood was taken and analysed for cadmium and lead contents.

Environmental assessments were carried out for lead, cadmium and arsenic levels. A total of 10 personal samplings was taken near the breathing zone of the scrap metal cutters using the NIOSH analytical method P & CAM 173. The scrap metals and their paint coats (scraped from the metal) were also analysed for the same heavy metals. All analyses were carried out at the Department of Scientific Services using the graphite furnace absorption method.

RESULTS

A total of 54 scrap metal cutters together with 54 control subjects (all males) were studied. Their mean age was 30.4 years and the mean period of scrap metal cutting was 34.8 months (range 4 months to 18 years).

Scrap metal cutting was carried out using oxy-acetylene gas. Objects cut included oil drums, old cars and ships, marine hardware, etc. While foundry workers worked in the open field, ship breakers worked in confined spaces especially during the dismantling of ships. During cutting, a dense cloud built up rapidly over the breathing zone of these workers. They wore goggles, long-sleeved shirts and trousers, leather gloves and boots during work. No respirators were provided or worn. Some wore handkerchiefs or towels as face masks. None were aware of the hazards of scrap metal cutting. They worked 8 hours per day with 2 fifteen minutes breaks and an 1 hour lunch break. Most were contract workers and were paid according to the amount of scrap metal cut per day.

Ten personal samples taken over the breathing zones of workers showed 8 containing lead levels ranging from 0.01 to 0.57 mg/m^3. Two of these samples had levels exceeding the threshold limit values of 0.15 mg/m^3 recommended by ACGIH (1). The cadmium and arsenic levels were very low. (The highest level detected was 0.009 mg/m^3 and 0.011 mg/m^3 respectively).

Samples of paint and base metal cut from the scrap metal showed that the paint coat contained between 0.02 to 8.80% w/w of lead, while cadmium and arsenic content were very low. (The highest being 0.01 and 0.006% w/w respectively). The base metal contained between non-detectable levels and 0.06% w/w of lead while arsenic was negligible and cadmium was not detected.

35 (64.8%) of the metal cutters and an equal number of control subjects had 1 or more complaints (Table I). The common complaints among the scrap metal cutters were cough, rhinnitis and skin burns. These symptoms were more prevalent than in the control group ($p < 0.05$).

Burn marks in all stages of healing and residual scars were seen in 29 scrap metal cutters mainly over the hands, forearms and thighs. These were significantly higher than in the control group ($p < 0.05$). They accepted these as a matter of course from the sparks generated during cutting.

No cases of metal fume fever was reported on the company's medical register although we diagnosed a case of metal fume fever based on a history of recent metal fume exposure and the worker's complaints of nasal irritation, fever and foul taste in the mouth.

Table I
PREVALENCE OF SYMPTOMS AMONG STUDY GROUP

Type of Symptoms	Exposed	Control	P (using fischer's exact test)
Foul taste in mouth	1	4	>0.05
Dryness of mouth	11	9	
Nausea + vomiting	1	5	
Fever + chills	9	4	
Headache	8	13	
Cough	20	8	<0.05
Rhinnitis	11	3	<0.05
Muscular aches	8	13	>0.05
Painful eyes	5	1	
Skin burns	18	1	<0.05
Others	2	3	>0.05

Table II shows the mean blood lead and cadmium levels and the urinary arsenic levels of the study group. These levels were all below their biological threshold limit values (BTLV), although they were significantly higher in the scrap metal cutters. Blood lead levels ranged from 36 to 90 μg/100 ml with levels exceeding the BTLV (2) of 70 μg/100 ml in 10 workers. Among the scrap metal cutters, there was no significant difference

Table II
MEAN BLOOD LEAD AND CADMIUM AND URINARY ARSENIC LEVELS IN THE STUDY GROUP

Mean parameter	Metal cutters	Control	P	BTLV
blood lead (μg/100 ml)	57.61	18.35	<0.001	70
blood cadmium (μg/L)	4.27	2.33	<0.001	10
urine arsenic (mg/L)	0.21	0.12	<0.001	0.5

in these levels between smokers and non-smokers. There was also no significant difference in the results between shipbreakers and cutters. No correlation was found between duration of oxy-acetylene cutting and blood lead and cadmium and urinary arsenic levels. Those who indicated that they had symptoms on cutting had about the same blood lead and cadmium and urinary arsenic levels as those without the symptoms. The results for the other heavy metals were very low.

No significant difference in the FEV_1 and FVC results was noted between scrap metal cutters and the control group. The results were normal.

Workers with high blood lead levels (exceeding 70 μg/100 ml) were removed from burning for about 3 months. All were advised on the usage of appropriate respirators. Subsequent 6 monthly blood lead results were below the BTLV. The mean blood lead level was also much lower (38.28 μg/100 ml) compared to the earlier mean level of 57.61 μg/100 ml.

DISCUSSION

Most metals were encountered in shipyards. They occurred in the basic metal parts and protective coatings, galvanized or painted materials (3-6). Various reports had shown varying amounts of lead detected near the breathing zone of metal cutters (4, 5). These variations reflect differences in quantity of lead in the burned materials, duration of burning and local air movements.

In our study, lead-in-air levels ranged from 0.02 to 0.57 mg/m^3 among the shipbreakers and 0.02 to 0.17 mg/m^3 among the foundry workers. This was very low compared to levels exceeding up to 200 times the threshold limit values of 0.15 mg/m^3 reported (1,4,5,7). The variation in exposure among the shipbreakers and foundry workers was probably due to the better ventilation and air movement in the open field where the foundry workers worked as compared to the confined areas, where parts of the ship was dismantled. The lead-in-air levels correlated well with the amount of lead in the paint coat. When there was non detectable lead in the paint, the lead-in-air levels was either not detected or low (0.02 – 0.03 mg/m^3), while the highest air level of lead was well linked with the highest lead content in the paint coat. This burning of the paint coat was the main source of lead-in-air. This was expected as the materials cut were mainly oil drums, old ships and cars which had many coatings of anti-corrosive lead paint (3,4,5,8).

While the number of subjects and controls with complaints were of equal number, cough, rhinnitis and skin burns were more prevalent among the cutters. No cases of metal fume fever was reported in their company's medical register although upper respiratory tract symptoms were the most common complaints. This could be because the workers seldom seek medical advice for such symptoms. Also the attending physician could easily overlook the diagnosis as metal fume fever resembles influenza or upper respiratory tract irritation (9,10). Serious problems such as subclinical or even overt metal poisoning may later occur without recognition as most workers were not aware of the potential toxicity of the metals cut.

In our study, 10 workers had blood lead levels exceeding 70 μg/100 ml although none had clinical evidence of lead poisoning. There is every possibility of them progressing to overt poisoning if left undetected and if exposure was continued.

The lung function results were normal. No cases of pneumonitis were noted compared to other studies (9-12).

The blood lead levels of scrap metal cutters ranged from 36 to 90 μg/100 ml and is comparable with those reported in other studies (5,8,13). Various countries had adopted blood lead levels ranging from 40 to 70 μg/100 ml at which the affected worker is to be removed from further exposure (14,15). WHO (15) had recommended 40 μg/100 ml for the adult male as the health-based limit, which if exceeded would indicate the need for technical and personal preventive measures to be taken. 92.6% of our workers had blood lead levels exceeding 40 μg/100 ml and 10 had levels exceeding 70 μg/100 ml indicating that they were at high risk even though none had clinical evidence of lead poisoning. It was therefore very distressing to know that they were not under any medical surveillance or health education programmes. Recommendations were then made to the management on the usage of suitable respirators and elbow-length leather gloves and the need for 6 monthly blood lead examinations. Any worker with blood lead levels of 70 μg/100 ml or more will be transferred out of metal cutting work for at least 3 months. They could return to such work if the repeat test showed levels below 70 μg/100 ml and there is no clinical evidence of poisoning.

Subsequent tests done 6 months later showed a marked reduction in blood lead levels ranging from 20 to 60 μg/100 ml (mean: 38.28). This shows that with proper medical supervision, it is possible to achieve a degree of lead absorption which is acceptable by today's arbitrary standards.

CONCLUSION

The survey showed that scrap metal cutting is a hazardous industry associated with significant lead exposure. Thus, no worker, even contract worker should be neglected in any health surveillance program. While it is reasurring to know that no worker was found to have metal poisoning, 96% of them had blood lead levels exceeding 40 μg/100 ml with 10 workers having levels exceeding 70 μg/100 ml stressing the need for improved protection for workers in this type of industry. The reduction in subsequent 6 monthly blood lead results signals the need for mandatory medical and biomedical surveillance of such high risk workers.

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