

HAIR LEAD CONTENT IN CAR RADIATOR REPAIRERS AND PRINTING SHOP WORKERS IN KHON KAEN, THAILAND

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สารตะกั่วในเส้นผมของช่างบัดกรีซ่อมหม้อน้ำรถยนต์ และคนงานในโรงพิมพ์ ในจังหวัดขอนแก่น

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บทคัดย่อ

การศึกษาเชิงพรรณนาโดยการวิเคราะห์สารตะกั่วที่ปนเปื้อนในเส้นผมของช่างซ่อมหม้อน้ำรถยนต์ และคนงานในโรงพิมพ์ ซึ่งทำการเก็บตัวอย่างเส้นผมและสัมภาษณ์ตามแบบสอบถามจากคนงาน 163 คน ใน 7 ร้านซ่อมหม้อน้ำรถยนต์ และ 21 โรงพิมพ์ในจังหวัดขอนแก่น การวิเคราะห์สารตะกั่วในเส้นผมโดยใช้เครื่อง ICP (Inductively Coupled Plasma Spectrometry) พบว่ามีสารตะกั่วในเส้นผมของช่างบัดกรีซ่อมหม้อน้ำรถยนต์ทุกราย โดยพบว่ามีจำนวน 15 ราย มีปริมาณสารตะกั่วในระดับที่สูงและอันตรายมาก (มากกว่า 25 มก./กก.) ซึ่งพบในระหว่าง 42-999 มก./กก. จากการสังเกตพบว่า สารตะกั่วในส่วนนี้มีส่วนเกี่ยวข้องกับการปนเปื้อนจากการปฏิบัติงาน ดังนั้นการบัดกรีซ่อมหม้อน้ำรถยนต์จึงเป็นกิจการที่มีความเสี่ยงสูงต่อการได้รับสารตะกั่ว ส่วนคนงานในโรงพิมพ์ 148 ราย พบระดับสารตะกั่วในเส้นผมอยู่ในระหว่างค่า 0.6-307 มก./กก. โดย 61 ราย มีระดับสารตะกั่วสูงกว่าค่าปกติ (ระดับสารตะกั่วปกติในเส้นผม < 5 มก./กก.) ในจำนวนนี้ 47 รายมีระดับสารตะกั่วอยู่ในช่วง 5-25 มก./กก. และ 14 ราย มีระดับสารตะกั่วในขั้นอันตรายคือ > 25 มก./กก.

การปนเปื้อนของสารตะกั่วในระดับที่สูงเช่นนี้ อธิบายและประเมินได้จากแบบสอบถามที่เกี่ยวข้องกับการปฏิบัติงาน การกินอาหารในสถานที่ทำงานเป็นต้น แต่โดยสรุปไม่สามารถอธิบายได้ในทุกรายที่พบ แต่อย่างไรก็ตามการปนเปื้อนของสารตะกั่วจะเพิ่มสูงขึ้นจากการปฏิบัติงานที่เกี่ยวข้องกับสารตะกั่วและสูดดมามัยส่วนบุคคลอย่างเห็นได้ชัด

ABSTRACT

The descriptive study utilised hair lead analysis to measure past lead exposure in car radiator repairers and printing shop workers. Hair samples and questionnaires were taken from 163 workers at 7 car radiator repair businesses and 21 printing shops in Khon Kaen, Northeast Thailand. Hair samples were analysed by inductively coupled plasma spectrometry (ICP). Hair lead (PbH) content of all radiator repairers ($n = 15$) showed severe past exposure (> 25 mg/kg), with PbH results ranging from 42 to 999 mg/kg. Observation of work practices in the repair shops revealed the source of contamination. The radiator repair industry is a high risk activity for lead exposure. In the printing shops ($n = 148$) hair lead levels ranged from 0.6 to 307 mg/kg. There were 61 workers over normal limit for hair lead content (normal level is < 5 mg/kg) with 47 workers having hair lead levels between 5 to 25 mg/kg and 14 workers being in the severely exposed category, that is > 25 mg/kg. These 14 workers had heterogeneous jobs within the printing shop. Explanations for the findings were researched by evaluating each worker according to their primary work task and whether they responded positively to confounding variables in the questionnaire such as living on work premises, eating in the workplace. Conclusive answers could not be found in all cases but certain work activities and hygiene practices within the industry increase the likelihood of lead contamination.

INTRODUCTION

Lead is a heavy, soft, easily fusible metal of dullish grey colour and principally obtained from the ore, lead sulphide. It is amphoteric and it forms many salts, oxides and organometallic compounds (Parker, 1992). Lead can be absorbed via inhalation, ingestion, placental transfer and the skin (Herrick and Dement, 1994). Lead is not distributed homogeneously in the body and the stability of stored lead is

affected by diet and other physiological factors (Gossel and Bricker, 1994). Lead exposure tends to be regarded in two contexts, lead contamination acquired from environmental sources and that which originates from the workplace. On a worldwide scale lead poisoning is the most common of the occupational poisoning (Raffles, *et al.*, 1994) but accurate measures of work-related diseases may be difficult to obtain due to under-reporting by the worker and the health professionals, failure to recognise problems, disincentives to reporting and implications of blame (Levy and Wegman, 1995). This study was designed to evaluate the risk factors for lead exposure in car radiator repairers and printing shop workers in Khon Kaen.

METHODOLOGY

Hair lead analysis was chosen to evaluate past lead exposure for this study. It is easy to collect and store without deterioration and trace elements are relatively high in hair, where they are stable and not susceptible to metabolic influences (Suzuki, 1987). All 7 car radiator repair businesses and 21 of 22 printing shops in the Municipality of Khon Kaen participated in the study. Data collection involved taking hair samples and individual questionnaires from a total of 163 participants and workplace observation check lists from their 28 places of business. The hair samples were analysed at Envirotech Analytical Laboratories in Brisbane, Australia, using inductively coupled plasma spectrometry (ICP).

MAIN OBJECTIVE

To study hair lead content in occupationally exposed workers in printing and car radiator repair businesses in the Municipality of Khon Kaen, Thailand.

RESULTS

The reference values for hair lead content in this study are guidelines defined by Porter and Moyer (1994), that is, the normal hair lead content is defined as lower than 5 mg/kg and hair lead concentration greater than 25 mg/kg indicates severe lead exposure.

Hair Lead (PbH) Results in Radiator Repairers

Hair lead (PbH) levels of radiator repairers (15) ranged from 42 mg/kg to 999 mg/kg, the mean and median values were 248.1 and 145.0 mg/kg respectively, demonstrating severe exposure levels for all workers. The radiator repairers were all male and their ages ranged from 14 to 63 years. By place of residence, 8 persons lived off the worksite and 7 lived within. Mean PbH were 224 mg/kg and 276 mg/kg, respectively. The 6 persons who ate food in the workplace had mean PbH 173 mg/kg, 2 persons who ate food in a special dining room had mean PbH 150 mg/kg, and the remaining 7 persons who ate food away from the workplace had mean PbH 341 mg/kg. The hair lead content among radiator repairers and their duration of exposure can be seen in Table 1.

Most of the radiator repairers thought that they themselves were responsible for their health in the workplace, but they did not know how to prevent lead contamination in their workplace. Most of them, however, knew that lead could make them ill.

Table 1 Hair lead contents and the duration of exposure (years) of radiator repairers in Khon Kaen, Thailand, 1995.

Duration of exposure (years)	Number of workers	Hair Lead Content (mg/kg)
0-4	7	42,140,141,141,148,575,699
5-9	3	58,68,158
10-14	1	145
15-19	2	52,154
30-34	1	202
35-39	1	999
Total	15	42-999*

* the lowest and highest PbH content

Hair lead contents in printing shop workers

Of the 148 printing shop workers, 59% had PbH levels <5mg/kg, 32% had PbH levels 5-25 mg/kg, and the remaining 9% had PbH levels >25 mg/kg (Table 2). The PbH results had a range of 0.6 to 307 mg/kg, the median and the mean PbH values were 3.8 mg/kg and 13.63 mg/kg, respectively. Hair lead content among the workers and their duration of exposure is shown in Table 3.

Table 2 Hair lead Content of printing shop workers in Khon Kaen, Thailand, 1995.

Hair lead level	No. of workers (female/male)	Percent
< 5 mg/kg	87 (39/48)	58.8
5-25 mg/kg	47 (12/35)	31.7
>25 mg/kg	14 (4/10)	9.5
Total	148 (55/93)	100

Table 3 Hair lead content of printing shop workers and their duration of exposure in Khon-Kaen, Thailand, 1995.

Duration of Exposure (years)	Number of workers Hair lead level (mg/kg)			Total
	< 5	5-25	>25	
0-4	32	17	5	54
5-9	26	5	4	35
10-19	20	10	4	34
20-50	9	15	1	25
Total	87	47	14	148

Of the 61 printing shop workers who had PbH above the normal limit (<5 mg/kg), 64% lived outside the workplace and the remaining 36% lived in the workplace. The mean PbH of those who lived off the premises (11 mg/kg) was less than those who lived in the premises (22 mg/kg). The printing shop workers who had PbH over the normal limit were printers, compositors, packagers and book binders representing 49.5%, 16.4%, 14.8% and 9.8%, respectively. Printing shop workers who ate in the workplace were at greater risk of having raised PbH levels. Of workers with PbH above the normal limit, 54% ate in the workplace, 28% ate in a special room within the workplace, and 18% ate away from the workplace. To prevent lead contamination in their workplaces, of 148 printing shop workers, 18% said use appropriate personal protection, 19% thought personal hygiene, 6% suggested improvement of ventilation and environmental hygiene, and 57% said that they did not know.

Observation of workplaces in radiator repair shops

The car radiator repair businesses repair only radiators in Khon Kaen and are housed in typical Thai shops fronting main thoroughfares. The number of workers ranged from 1 to 4 per shop and the work was carried out on the footpath. Most shops had

minimal waste which consisted of oil, lead or dust. Waste lead was collected and melted for re-use while lead dust was swept up and put out with other refuse for council collection. All shops had hand washing facilities equipped with soap or detergent. The method of repairing radiators was simple and the same in all shops. The radiator was checked for leaks with water, dissembled by melting the old solder joints with a torch, and prepared for soldering by brushing with a wire brush to remove accumulated dust and encrustation. The leaking site was then brushed with hydrochloric acid, the solder applied by melting with a buring torch fuelled by leaded petrol from a cylinder under pressure of compressed air, the excess solder dropping on to the footpath. The worker frequently leant over the area he was soldering and this positioned him directly above the ascending fumes being given off by soldering process. Some workers were smoking as they worked.

Observation of printing shop industry

All businesses were obviously busy and crowded with stacked paper, 23% having considerable amounts of discarded waste such as paper, oil, printing ink and empty ink containers. Two shops were fully airconditioned, 6 partially airconditioned, and the remaining 13 shops were hot, aircongested workplaces. If exhaust fans were in use they were dirty and appeared to be ineffective. 85% of shops had running water plus soap or detergent for handwashing. Most of the workers (95%) were not wearing protective clothing and food was seen in 7 printing shops and smoking noted in 11.

Discussion

Lead contamination in the study population workers was highly significant with almost half the 163 workers registering hair lead content above normal levels. Conclusions cannot be made that environmental factors were not contributors but for

radiator repairers, printers and compositors in the printing shops, there was strong evidence that there was occupational exposure to lead. However statistics only give an indication of the problem, the extent of sub-clinical disease being unknown and relationship with non-specific disease being difficult to establish a cause-effect relationship (Zenz, 1988).

The study was also to determine duration of exposure of the workers. Most exposures are calculated as permissible exposure limits (PEL) or time-weighted - averages (TWA) on the expectation that the duration of exposure will be over on 8-hour day and a 40 work week hour over a working lifetime (Rosenstock and Cullen, 1994). Activity and source of exposure were readily identified in the radiator repair shops because radiator repair was the only activity performed. In the printing shops activities were heterogeneous and the worker was trained usually for one particular task. Their exposure may have been related to the factors and their work activity but they were also exposed to the fumes from solvent-laden, lead-containing inks, which, although primarily a hazard due to inhalation, could also have been a significant route of exposure through skin contact (Herrick and Demet, 1994). Lead-containing dust can be generated by certain types of printers, for example, a letterpress with raised type made from lead alloy. As the machine runs at a very high speed, there is constant wear on the type and it is believed that fine particles of metal are released into the work environment. In conclusion, lead abatement programs should not be looked at purely from an occupational perspective but across the total environment.

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