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Lead Contents in Collected Human Hair and Blood Samples Around Sargipalli Mine area Sundargarh, Odisha

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Abstract

Lead is proved to be toxic at various levels for human beings and other animals. In the present piece of study Blood and Hair samples from people of five different villages around a lead mine area were collected and analyzed by AAS. In most cases samples contain higher concentrations of lead in the blood and hair suggesting lead toxicity in that area.

Keywords: Blood Lead Level (PbB), Hair Lead Level (PbH), APDC, EDTA,

Introduction

According to WHO health criteria (1995), Mining, smelting, and refining, as well as the manufacture of lead-containing compounds and goods, can give rise to lead emissions. According to a study of the industrial sources of air pollution by lead in the USA, Davis (1973) reported that 9% of the total of 18 000 tonnes generated from such sources was attributable to the production of primary lead.

Mining and Smeltting of lead ores are well known to create pollution problems in local areas. Their influence on the surrounding air and soil depends to a large extent on the height of the stack, the trapping devices in the stacks, the topography, and other local features. The emissions can cover a considerable area. The zone of air pollution for one large smelter in the USA extended to approximately 5 km from the smelter while soil contamination extended as far as 10 km (Landrigan et al., 1975). The larger area of the zone of soil pollution compared to the zone of air pollution probably was due to the fact that current emission control devices are more effective than earlier ones used to be. The opposite situation was found around the Mezica mine and smelter in Yugoslavia (Kerin, 1973). In this case, the zone of air pollution extended as far as 10 km from the smelter stack. Soil was grossly contaminated (>200 mg/kg) as far away as 7 km. There was also heavy pollution of water courses through effluents. Health hazards of the human environment including undue exposure to lead remains serious public health concerns (WHO 1995). Lead Plays no known role in the human body, so a trace amount in the body causes adverse health effects (Elsevier 1985).Lead impairs the renal, haemopoietic and nervous systems and it has been suggested that lead is causually related to deficiency in cognitive functioning (Jergback et.al 1992).In general, the blood lead level is a good indicator of recent exposure. It is a good indicator of the current level of lead in human body, but not a good indicator of the total body lead burden (Ahmed and Elmubarak 1990). Hair has been used indicator filaments for lead accumulation in human body because lead concentration in hair is probably correlated to lead storage in bone(Eltayab M A H , Gricken R E V (1990). Therefore hair is suitable as a biopsy material to assess the exposure of human being to toxic metals and their absorption in general population .

Materials and Methods

The Study Area

The present study concentrate on blood lead level (PbB) and lead in hair(PbH) in population living around Sargipali lead mine area of Odisha which operated from 1983 to 2003 by the Hindustan Zinc Limited company. Five villages around the 5km were taken as case study area for sampling as shown in the trace map. The village Bharatpur is nearby to mining site and other villages are of 1km distance from each other in between 5km radius. The village Jhimirmaul

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is nearby to tailing dam and river Ichha nala, which is the main drainage system of the mine.

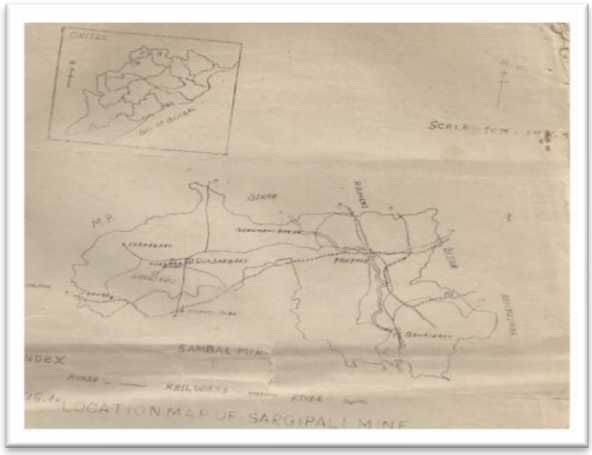

Fig.1: Location Map of Different Villages Around Sargipalli Lead Mines at Sundargarh, Odisha, India

Collection of Blood and Hair Samples

A total of 367 blood samples and 340 hair samples were collected from the villages such as Bharat pur (BP), Sargipalli (SP), Jhargaon (JG), Jhimirimoul(JM), and Sribhubanpur (SB).Here the hair samples were obtained who donated their blood voluntarily. Samples obtained were divided into two groups, one is less than equal to twelve years and another adult group irrespective of sexes.

Sample Analysis

Blood samples were collected from vein in small glass bottles by adding dipotassium salt of EDTA (1mg/ml) and Neomycin sulphate(100gμ/ml) and preserver at 4^oC. Out of this sample 3ml of blood was used for a single analysis. The lead in blood was complexed with ammonium pyrrolidine dithiocarbamate (APDC) and extracted into n-butyl acetate . Lead was determined in organic phase by Flame AAS following Australian Standard Method (AS -2411).

Hair samples were collected in small polyethylene bags. First of all, samples were washed by detergent and then by distilled water to remove oil and particulate matter, dried in 80^oC. 1gm of hair sample was digested in a mixture of HNO_3 and HCl_4 (5:1 V/V) for about 1hour, until the brown fume disappears, cooled and volume made up to 50ml and analyzed by flame AAS (Rout and Naik 2013 a).

Concentration of lead in blood and hair was expressed in units of μg/ml and μg/gm respectively. All the apparatus used are thoroughly washed many times by HNO_3 for low blank value and to avoid contamination.

Results and Discussion

The observations of blood lead contents among children and adults in all the villages located around Sargipalli Lead mine area is shown in the table 1. As per WHO guidelines the recommended maximum level (RML) of lead in blood (PbB)values for adult is 0.4 μg/ml and that of children is 0.3 μg/ml (WHO 1995). The mean PbB of the adults in Bharatpur and Jhingirimoul exceeds RML and Sargipalli tends to RML. According to Wibowo (1980) lead poisoning seldom occurs in adults with PbB < 0.8 μg/ml. However, the degree of tolerance varies from individual to individual. About 15% and 8% of the adult blood samples in Bharatpur and Jhingirimoul respectively exceeds 0.8 μg/ml, but none of the PbB value exceeds this limit in village Sargipalli, Jhargaon and Sribhubanpur. In case of children the PbB value of Bharatpur exceeds RML and in Jhingirimoul it is equivalent to RML. About 25% , 18% and 11% of the blood samples of children in Sargipalli, Jhargaon and Sribhubanpur respectively exceeds RML but the mean PbB of all locations except Bharatpur is found to be lower than the mean of 0.33 μg/ml for children of acid factory workers in London (Elwood et. al. 1977).Study shows in most of the cases male PbB value exceeds female PbB value of the same age group upto a certain age(60 Years) and then decreases a little.

Table 1
Mean Concentration of Blood Lead (PbB) in Children and Adults Residing in Different Villages Around Sargipalli Lead Mine Area, Sundargarh, Odisha, India.

Location	Blood Lead Level μg/ml (PbB)		
	Children ≤12 years	Adults > 12 years	Total population studied
Bharatpur (BP)	0.348±0.04 n = 24	0.524±0.08 n=54	0.471±0.10 n=78
Sargipalli (SP)	0.239± 0.02 n= 33	0.381±0.06 n=57	0.323±0.08 n=90
Jhargaon (Jg)	0.207±0.02 n=17	0.321±0.05 n=19	0.296±0.06 n=36
Jhimirimoul (JM)	0.293±0.07 n=26	0.463±0.07 n=35	0.394±0.08 n=61
Sribhubanpur (SB)	0.143±0.01 n=47	0.234±0.02 n= 51	0.180±0.03 n=98

Also table 1 shows blood lead level for combined population without considering age and sex for all the locations in the study area. The mean PbB value of village BP, SP, Jg, and JM was found to be higher than the mean of 0.29 μug/ml as reported by Sartor and Rondia(1980).

Table 2: Mean Concentration of Hair Lead (PbH) in Children and Adults Residing in Different Villages Around Sargipalli Lead Mine Area, Sundargarh, Odisha, India

Location	Mean Hair Lead Level μg/gm (PbH)		
	Children ≤12 years	Adults > 12 years	Total population studied
Bharatpur (BP)	42.12±2.44 n = 24	54.37±1.53 n=54	51.93±2.32 n=78
Sargipalli (SP)	4139± 3.12 n= 33	34.26±4.42 n=57	37.31±2.76 n=90
Jhargaon (Jg)	35.16±1.23 n=17	31.37±3.96 n=19	33.12±2.13 n=36
Jhimirimoul (JM)	37.07±2.43 n=26	44.53±3.08 n=35	42.05±2.34 n=61
Sribhubanpur (SB)	24.12±0.01 n=47	26.77±2.17 n= 51	26.13±2.02 n=98

Table 2 shows mean PbH value for Children and adults of this area. The recommended maximum level for children and adult PbH value is 30 μg/gm

(Fergusson et. al. 1981) when it exceeds 90µg/g then it is considered to be dangerous. The mean PbH values for adults and children in BP. SP. JG and JM village exceed RML value but still lower than a mean of 90.30 µg/gm for a group of fisherman community living near a smelting plant of Brazil (Carvalho et al. 1984). In case of children in village SB the mean PbH value for children is higher than the adult, which shows that probably children are more prone to PbH, perhaps due to hand picking and direct contact with soil at the time of ploughing.

A correlation coefficient between Lead level in Hair (PbH) and Blood lead level (PbB) worked out by Parson's method (Fig. 2) shows a highly significant value for each case, whether children adult or both taken into consideration

In rural and remote areas, lead in soil is derived mainly from natural sources. There natural sources account for 1-30 mg lead/kg, but where soils are derived from lead-mineralized rocks, natural concentrations may range from several hundred to several thousand mg/kg. Typical values for lead in several soils in the United Kingdom are 15-106 mg/kg with a geometric mean of 48mg/kg for 2780 samples has also been reported. Concentrations of lead in of lead up to 10960 mg/kg have been reported for urban garden soils in the USA. In general lead concentrations in soils near roads are high where road traffic density is high. Concentrations decrease exponentially with distance from the road (IPCS, 1989). Continuous application of sewage sludge results in an accumulation of lead in soil.

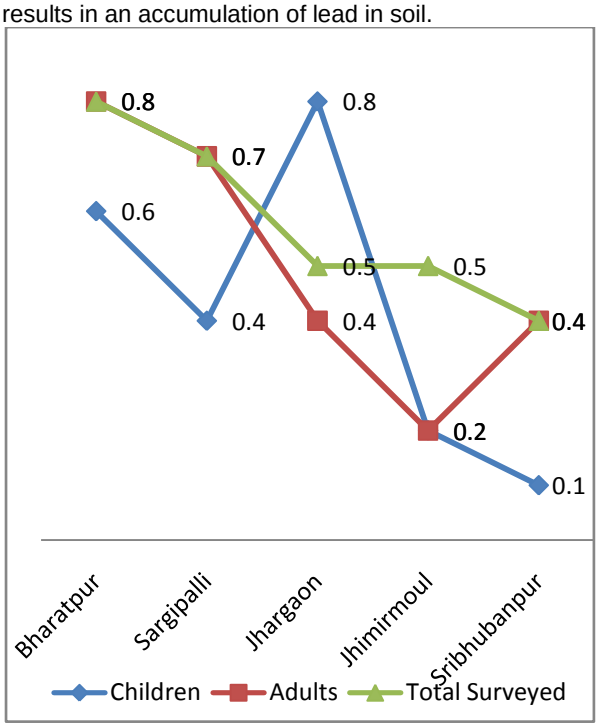

Fig.2:- Parson's Correlation Coefficient (r) between PbH and PbB in Different Villeges

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