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Lead Concentrations in the Blood of Residents of the Mineralized and Mining Environs

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Abstract: Lead ion concentration in blood samples of the hospitalized patients of the mineralized area of Ishiagu environs, were assayed. Ishiagu has lead and zinc deposits and active mining of these minerals. Lead concentration in the blood of selected hospital patients range between 0.40 and 2.00 ppm. The lead (Pb) concentration varied with age. Residents within the age of 5-20 years have lead concentration of 0.40-1.00 ppm while age within 21-60 years have lead concentration of 1.00-2.00 ppm. A correlation between length of exposure and age was established. A group within 33-44 years has the highest lead concentration in their blood.

Key words: Lead, blood, concentration, age, mineralized.

Introduction

The Ishiagu-Abakiliki area located southeast on the trough of Nigeria, features important faults trending north-south, with thick sedimentary cover of Abian rocks known to be rich in galena (PbS) and sphalerite (ZnS) minerals. The lead-zinc deposits of Nigeria are all similar in type and occur with one small exception, in rocks of lower cretaceous age. The most important mineral of lead is galena and zinc is sphalerite and many times galena and sphalerite are found in association (Ofor, 1997).

For over a century now, mining activities have been going on in various locations in Ishiagu and Abakiliki area. Various systems of mining are being used while local mining activities are common in the area as it serves as a source of revenue to the miners. Despite the mineral abundance, Ishiagu and Abakiliki people are predominantly farmers with women carrying out 70% of the farming processes. Lead-zinc mining has left a number of physical hazards and environmental problems which include open mine shafts, collapsed mine shafts and subsidence areas which have claimed lives and created avenues for water to enter and leave the mines (Kansas, 2006). The water became contaminated by metallic sulphides; in addition it becomes very acidic and contains dissolved metals some of which are very toxic. This water in turn contaminates local groundwater spring and surface water.

Researchers (Dekunle, 2003; CDCP, 1997; Millar, 1978) have found that the release of these metals in concentrations beyond the stipulated threshold is essentially due to anthropogenic activities. Today elevated blood levels are due mostly to ingestion of contaminated dust, paint and soil. High concentration of lead in blood is an important signal of risk. Childhood exposure to lead contributes to hyperactivity disorder (Tuthill, 1996) and distractibility (Calderon, J. et al., 2001; Mendelsohn et al., 1998). Also soil and dust that are contaminated with lead are incorporated into food web and become bio-concentrated (Mielke and Reagan, 1998; President's Taskforce, 2000).

The aim of this study is to assay the lead level in blood of residents in the mineralized zones of Ishiagu in Ebonyi state, Nigeria. Investigation of the relationship between lead levels in blood and age will be carried out.

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Materials and Methods

The samples collection was limited to communities around the Ishiagu mineralized areas. The following communities were assayed: Ihetutu, Okue, Amagu, Ogwo, Amuta, Amaokwe, Amaeze and Amaita.

Persons were selected at random in the local clinics and health centres. The personal records such as age and ill health were obtained from the official clinic records. The blood samples as collected were stabilized in standard sample bottles. Aliquots of 3 ml portion were ashed in porcelain dishes at 600°C in a furnace for eight hours. The ash was digested with 5 ml concentrated hydrochloric acid and made up to 100 ml using de-ionized water. The metals were assayed using Unicam 919 Atomic Absorption spectrophotometer at the Research Centre Laboratory, University of Uyo, Akwa-Ibom State.

Results and Discussion

Figure 1 shows the geological map of Ishiagu, Nigeria, and its environs with the distribution of lead deposits within the area.

Table 1 is the classification of concentrations of Pb in the blood of the patients with respect to their various localities. The range of concentration of Pb ions obtained were: 0.30-1.50 ppm, 0.50-2.00 ppm, 0.70-2.20 ppm, 0.30-1.70 ppm, 0.30-1.50 ppm, 0.60-1.50 ppm, 0.40-1.90 ppm, for Ihetutu, Okue, Amuta, Amaokwe, Amaeze, Amaita and Ogwo respectively. The higher level of Pb ion was obtained at 2.50 ppm from Ihetutu village, which hosts the major mining activities. The other villages host minor mining deposits with significant levels of Pb ions in their blood stream.

Figure 2 gives the mean Pb concentration in ppm across the selected age groups treated within the last six months of this study. The lead concentration in the blood samples of age groups 5-8, 9-12 and 13-16 ranged from 0.40 ppm to 1.00 ppm. A range of 1.00-2.0 ppm was obtained for age groups of 25-28, 29-32, 33-36 etc. These lead concentrations above 1.00 ppm show that a particular period of time, their blood lead (Pb) was above 10 ppm because 99% must have been excreted (ATSDR, 1997), and this exceeded the blood Pb concentration of 10 ppm, which is dangerous to health (Duggan and Inskip, 1985). The highest concentration of lead was observed at the

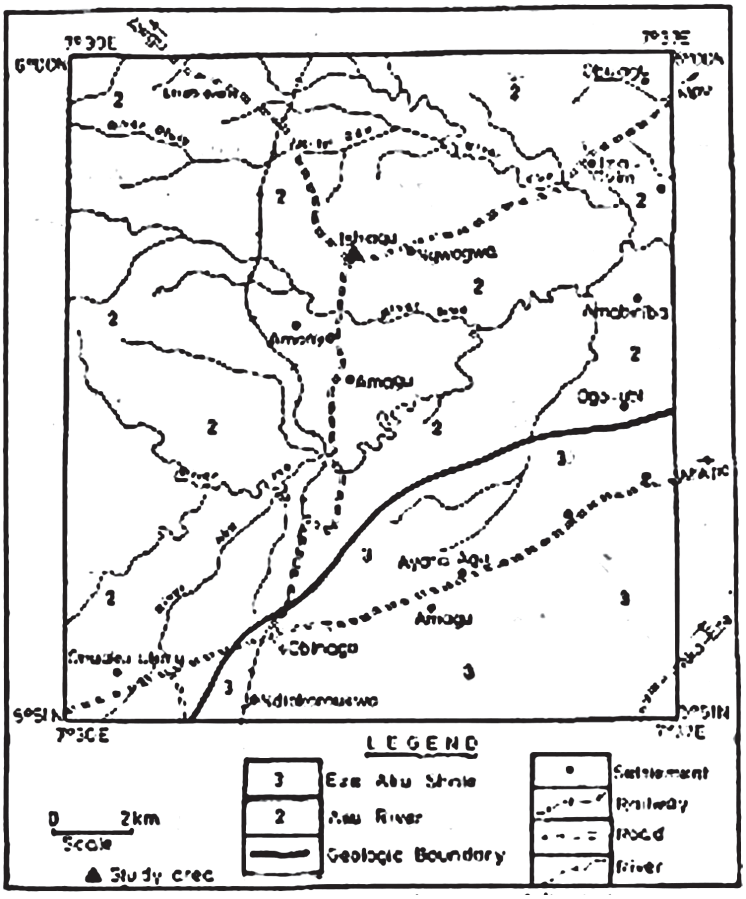

Figure 1: Geological map of Ishiagu and its environs showing lead distribution.

Table 1: Concentration of Pb (ppm) × 10^{-1} in the sampled blood of Ishiagu residents according to locality

Week	*Ihetutu*	*Okue*	*Ogwo*	*Amuta*	*Amaokwe*	*Amaeze.*	*Amaita*
1	18.0±5.7	14.0±5.8	–	15.0±3.9	4.0±4.1	6.0±2.8	–
2	–	–	19.0±4.4	3.0±3.9	–	14.0±2.8	15.0±4.6
3	–	–	14. 0±4.4	–	–	15.0±2.8	10.0±4.6
4	13.0±5.7	12.0±5.8	7. 0±4.4	13.0±3.9	15.0±4.1	11.0±2.8	5.0±4.6
5	14.0±5.7	18.0±5.8	11. 0±4.4	17.0±3.9	17.0±4.1	–	4.0±4.6
6	18.0±5.7	12.0±5.8	22. 0±4.4	10.0±3.9	15.0±4.1	12.0±2.8	–
7	8.0±5.7	20.0±5.8	10. 0±4.4	14.0±3.9	3.0±4.1	–	19.0±4.6
8	–	22.0±5.8	19. 0±4.4	–	8.0±4.1		16.0±4.6
9	12.0±5.7	13.0 ±5.8	15. 0±4.4	–	8.0±4.1	14.0±2.8	–
10	25.0±5.7, 18.0±5.7	3.0±5.8	15. 0±4.4	18.0±3.9	5.0±4.1	–	10.0±4.6
11	–	17.0±5.8	14. 0±4.4	12.0±3.9	10.0±4.1	–	–
12	–	5.0±5.8	–	15.0±3.9	–	–	–
13	16.0±5.7	16.0±5.8	20. 0±4.4	15.0±3.9	–	14.0±2.8	13.0±4.6
14	25.0±5.7	15.0±5.8	15. 0±4.4	9.0±3.9	–	–	16.0±4.6
15	13.0±5.7	14.0±5.8	–	14.0±3.9	10.0±4.1	13.0±2.8	16.0±4.6
16	18.0±5.7	4.0±5.8	–	14.0±3.9	5.0±4.1	15.0±2.8	16.0±4.6

Values are mean ± SD of two determinations.

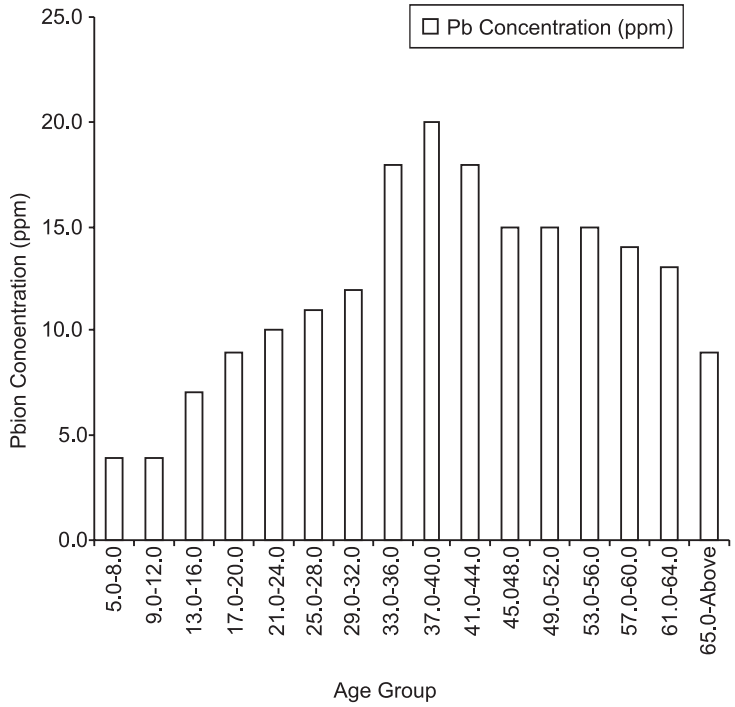

Figure 2: Mean concentration of Pb ions in the blood of Ishiagu residents according to age groups. (Vertical axis amplified 10 times)

age groups of 33-36, 37-40, 53-56, 57-60 with linking significant health problems of decreased libido, frequent abortion, high blood pressure and aberrant sperm (Bolt and Bruggenwert, 1978). An alarming concentration of 1.80 ppm and 2.00 ppm was observed at the age groups of 33-36, 37-40 and 41-45; this is an indication of accumulative effect on exposure to lead contaminated environment because this age group represent the most active age of farming and local mining activities in Ishiagu. It was observed that from the age group of 33-36 the concentration of Pb decreases with age showing reduced exposure and possible removal from the body system through several means such as urinary (Bamgbose et al., 2007).

The assayed concentrations of lead represented about 1% of lead that enters into the adult's body because 99% are excreted within a couple of weeks (ATSDR, 1997). Serious implication of these could be reduced population growth and decreased socio-economic activities of the affected people.

Conclusion

Analysis showed that concentration of lead in the blood sample of residents of Ishiagu mineralized areas increases as the age increases upto a maximum age group of 37-40 and as exposure to environment through farming and mining activities. This study also showed that the concentration of Pb within adult ages in Ishiagu area are greater than 1.00 ppm (which is the tolerable limit) (Duggan and Inskip, 1985). These also showed that Ishiagu area are contaminated with lead metal due to the mining activities of the galena-sphalerite deposit. This calls for continuous monitoring of the environment and application of adequate measures to preserve the health and safety of communities in the mineralized area of Ebonyi state.

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