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Total blood and urinary lead levels in battery charging artisans in two metropolitan cities of South West Nigeria

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ABSTRACT
Objectives: Battery charging workers in urban centers in Nigeria are exposed to excessive inhalation of lead fumes, oral ingestion and dermal absorption of lead particles when dismantling disused lead accumulators, washing the lead cells in water and smelting the cells. This study investigated the likely effects of this exposure on health
Methodology and results: Blood and urine samples of a total of forty battery charging workers and twenty control subjects randomly drawn from Lagos and Ibadan towns were analyzed for total lead concentrations using atomic absorption spectrophotometer. For the mean blood lead levels in Lagos and Ibadan were 112.5±14.24 and 93.85±16.70 µg/dL respectively, which far exceeded the normal level of 40 µg/dL and even the permissible maximum of 80µg/dL. Mean urinary lead was 46.9±7.94 and 54.0±10.42 µg/dL for Lagos and Ibadan, 45.60±10.27µg/dL in blood and urine respectively, which was significantly lower than the exposed group. A total of 53 of the 60 subjects studied (controls inclusive) had blood and urinary lead levels greater than the normal limit of 40 µg/dL. The greater economic activity in Lagos could possibly have contributed to the significantly higher blood levels of battery chargers as compared to Ibadan.
Conclusion and application of findings: Our findings confirm earlier reports indicating that lead pollutants have shifted from the category of an occupational hazard to an environmental one. Considering the health implications associated with *plumbism* or sub chronic lead poisoning, it is hereby suggested that awareness campaigns should be initiated to reduce exposure and risk to human health in Nigeria

Key words: Artisans battery blood, lead, plumbism, urine.

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INTRODUCTION

Lead is one of the most useful materials in the world (Behrman *et al.*, 1996), but also recognized as one of the five most toxic metals (Riedel & Tompkins, 2005). Substantial lead is found in numerous industrial products such as gasoline, glazed ceramics, plumbing fixtures, lead solders, ammunitions and even some locally brewed gin in Africa (Crutcher 1963; Ademoroti; 1986; Baeyer, 1995). The increased dependence on lead for modern day life has led to suggestions that lead intoxication is probably the most common and dangerous (Jarrah, 2003). A shift of lead poisoning from an industrial to an occupational hazard has for long been widely recognized (Browder *et al.*, 1973; Anonymous 2005; CDCP, 1997)

Workers or artisans handling lead in large manufacturing concerns or small-scale enterprises, e.g. battery chargers in Nigeria, are known to be exposed to lead intoxication and in severe cases plumbism or chronic lead poisoning (Sofolowe *et al.,* 1973; Asogwa, 1979; Ayoola, 1979). Consistent observations have shown that occupational hazards associated with lead processing including long- term inhalation of lead fumes from smelters, inhalation or oral ingestion of lead dust and dermal absorption of dissolved lead could cause elevated blood and urinary lead levels, and urinary delta-aminolaevulinic acid (Asogwa, 1979; Ayoola, 1979; Jarrah, 2003). Severe clinical cases of lead poisoning were established in randomly selected battery charging artisans in some Nigerian cities.

Clinical symptoms of lead poisoning in adults that occur at blood lead levels above 80µg/dL (3.9µmole/L) could include abdominal pains, headache, irritability, joint pains, fatigue, anaemia, peripheral motor neuropathy, short memory and hypertension (Williams *et al.*, 1999; Anon. 2005). Other toxicity syndromes include central nervous systems dysfunction (both cognitive and behavioral), circulatory disorders such as hypertension, anemia, aborted pregnancies, and renal failure (White *et al.,* 2001). Children can also be exposed through leaded paints' peels from walls of old or dilapidated buildings (Hu, 1998; Burns *et al.*, 1999; Anon., 2006)

After prolonged exposure to pollutants, lead accumulates in several parts of the body especially the bone marrow matrix. Lead has a half-life of 25 days in human blood, and thus blood lead level is a useful indicator of current exposure (Florence *et al.*, 2003), although urinary lead is a more useful indicator of the total lead load in an individual (Hoekman, 2005).

The present study investigated the extent of lead poisoning in battery charging artisans that were randomly selected from two large metropolitan cities in South West Nigeria.

MATERIALS AND METHODS

Study population: A total of twenty battery charging artisans with an average age 0f 29.4± 0.12 years, and an average age of ten years of professional practice (years of apprenticeship inclusive) were randomly selected from Lagos and Ibadan cities. Selection was also based on anthropometric measurements such as body weight and height as indicators of the health status of subjects. The same criteria of age and anthropometric factors were used to select twenty control individuals that had never worked with lead batteries nor lived near a battery manufacturing factory. All the sixty subjects were males to avoid any bias that sex differences could introduce, and also since majority battery artisans are male.

Collection and preparation of samples for analysis: Volumes of 5ml intravenous blood and 10ml early morning urine were collected from all the sixty individuals using approved procedures. A trained nurse collected the blood samples using sterile hypodermic syringes (one per subject) into sterilized sample bottles. The subjects assisted in collecting their own urine samples using washed polypropylene plastic bottles that were given to them the night before. All the sample bottles were tightly covered and well labeled for proper identification, prior to storage in refrigerators. Two milliliters (2 ml) of each of the blood and urine samples were transferred using automatic micropipettes into 100 ml volumetric flasks in duplicates, and diluted to 100ml volume using lanthanum nitrate solution. The contents of each flask were thoroughly shaken to mix.

Analysis of total lead: A portion of each sample prepared as described above was transferred into the sample cell of Buck Scientific Atomic absorption spectrophotometer (Model 200A) at a wavelength of 283nm, which was generated, from a lead cathode lamp.

RESULTS AND DISCUSSION

No battery charger in Lagos had less than the permissible maximum of 80µg/ dL total blood lead while the only five (5) battery chargers in Ibadan had values slightly lower than this permissible maximum (69 - 79) Total blood lead in the control individuals were less than those in professional practice. All the subjects excreted lead in varying amounts that are positively correlated to the total blood lead (r = + 0.5). The level of economic activity in Lagos which is far greater than that of Ibadan may account for the significantly higher ($p < 0.05$) mean blood lead of 112.5±14.94µg/ dL compared to 93.85± 16.70 µg/ dL (table 2). Lagos is the economic nerve center of the whole of Nigeria, and the number of automobiles and industries producing lead products could be thrice that in Ibadan. Based on oral interviews and inspection of the artisans' working premises it is obvious that workers in Lagos handle more batteries on a daily basis than their counterparts in Ibadan. The data show that the artisans are in danger of possible lead poisoning.

Table 1: Mean blood and urinary lead levels (µg/dL) for battery charging artisans in Lagos and Ibadan cities in Nigeria.

LAGOS (artisans)		IBADAN (artisans)		CONTROLS (Non-artisans)	
Blood µg/dL	Urinary	Blood	Urinary	Blood	Urinary
112.5	46.90	93.85	54.05	45.60	31.2
SD=14.94	SD=7.94	SD=16.70	SD=10.42	SD=10.27	SD=6.77

Urinary lead excretion is greater for artisans in Ibadan than those in Lagos, though the difference between mean values (46.90±7.94 and 54.05 ± 10.42 µg/dL for Lagos and Ibadan, respectively) is not statistically significant ($P \geq 0.05$). Lead clearance from the body is a function of health status of an individual and many metabolic processes of the body may affect the process.

Mean blood lead in excess of 80µg/dL (Table 3) indicates lead intoxication in all the twenty artisans in Lagos and fifteen artisans in Ibadan. The mean blood lead levels of the control individuals is less than half of the mean values for artisans in Ibadan and Lagos, which indicates that occupational practice is the most likely factor influence the results.

Table 2: Distribution frequency of mean blood lead levels amongst battery charging artisans in Lagos and Ibadan cities in Nigeria.

City	Blood Lead concentration ranges in µg/dL				
	<40 Normal	40 – 80 Acceptable	80 – 120 Excessive	>120 Dangerous	TOTAL (n)
Lagos	0	0	15	5	20
Ibadan	0	5	14	1	20
Controls	7	13	0	0	20
Total	7	18	29	6	60

The urinary lead levels were 45.6 and 54.05 µg/dL for Lagos and Ibadan, respectively. These levels were significantly higher than 15µg/dL considered being safe (White 2001). Even the control individuals with a mean value of 31.2µg/dL were found to have excessive urinary lead excretion. Total lead in excess of 15µg/dL is as an indicator of high lead load and 90 % of the total body lead load is eliminated via the renal route.

This study clearly demonstrates that the total blood and urinary lead levels in battery chargers in Lagos and Ibadan are positively influenced by their occupational practices, and they are in danger of exposure to toxicity.The results also show that lead in the environment is getting into the body system of people that are not directly involved in battery charging enterprises.

It is thus recommended that the attention of all stakeholders including governmental and non-governmental health authorities, the battery chargers, and the general public should be drawn to the real danger posed by overexposure of man to lead pollutants. Practical ways to achieve this may include aggressive mass media campaigns on the radio and TV to educate the general public on lead pollution, and enactment of relevant legislations that can regulate the handling and disposal of lead containing industrial materials.

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