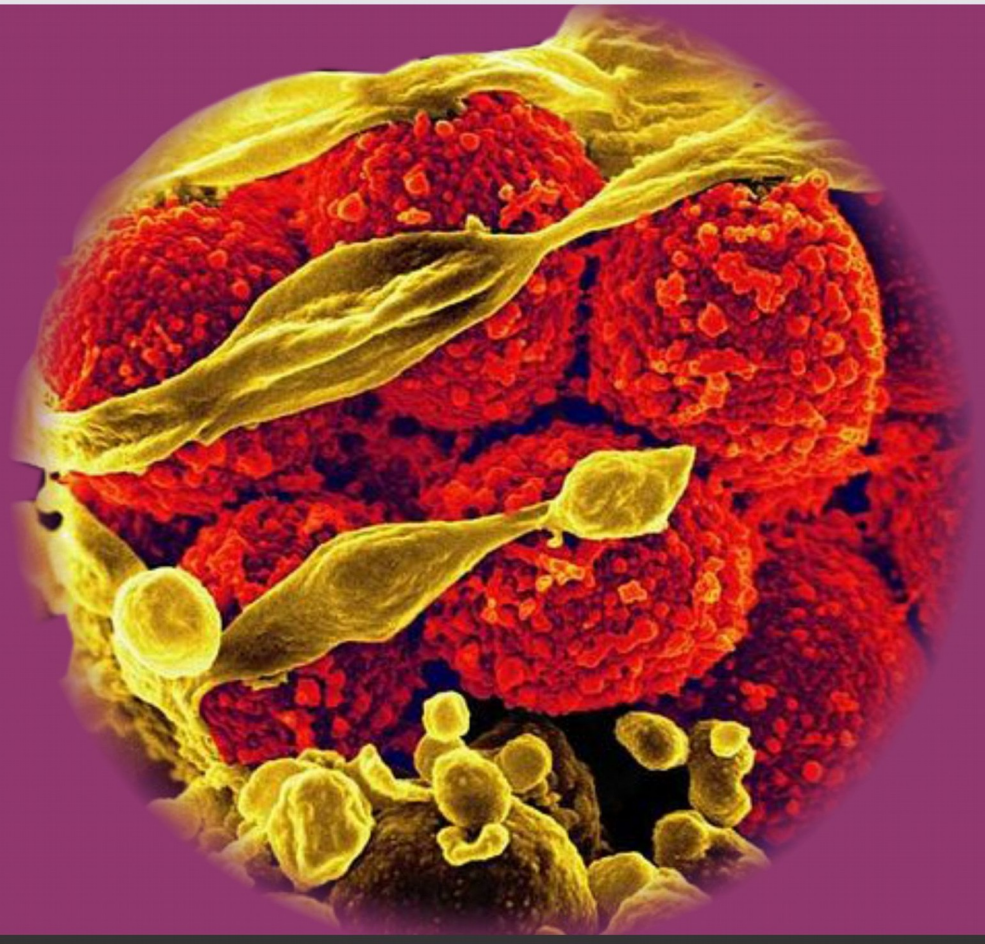
N S H B T

NIGERIAN JOURNAL OF HAEMATOLOGY

Journal of the Nigerian Society for Haematology & Blood Transfusion



ISSN: 2635-3024 **VOL. 2 NO. 1, MARCH 2019**

Special Feature:
Guidelines for the Management of Venous Thromboembolism in Nigeria.

ORIGINAL RESEARCH ARTICLE

Plasma Lead Levels among Children at a Tertiary Health Care Institution in Nigeria

[1]Nwankwo AF; [1]Shokunbi WA; [2]Asinobi AO; [3]Dairo MD; [4]Adebamowo EO

[1]Department of Haematology, College of Medicine, University of Ibadan; [2]Department of Paediatrics, College of Medicine, University of Ibadan; Department of Epidemiology and Medical Statistics Faculty of Public Health, College of Medicine, University of Ibadan; [4]Department of Civil Engineering, University of Ibadan.

Corresponding Author:
Anwuli Frances Nwankwo,
Department of Haematology, College of Medicine, University of Ibadan.
E-mail Address: nwankwoanwulijoy@gmail.com

ABSTRACT

Background:

A recent report of lead poisoning in children in Zamfara State, Nigeria, suggests the possibility of unacceptable levels of lead in the soil in this area. However, lead contamination from casual home contacts have been poorly documented in this setting.

Aim and Objectives:

This study was carried out to evaluate the plasma lead level (PLL) in children attending Paediatric Clinic, with the ultimate goal of detecting children that have plasma lead level above the permissible limit (<5µgPb/dl), in the University College Hospital (UCH), Ibadan, Oyo State.

Materials and Methods:

A closed ended questionnaire was administered to caregivers of children aged 12-120 months attending the Children's outpatient (CHOP) clinics and Paediatric wards, of the University College Hospital, Ibadan. Information was obtained on child and parental socio-demographic characteristics, status of house hold painting, source of drinking water and child's habit that may predispose to lead contamination. The children's blood samples were collected and analyzed for plasma lead levels (PLLs) using Flame Atomic Absorption Spectrometry (FAAS).

Results:

The mean (SD) plasma lead concentration was 2.6 (0.5) µg/dl (ranged 1.5-4.6 µgPb/dl), all the children had PLLs <5µgPb/dl. In multivariate analysis, sex (p=0.71), occupation of parents or guardian (p=0.63), religion (p=0.58), house painted (p=0.17), source of drinking water (p=0.79), paint peelings (p=0.08), sitting without support (0.68), crawling (p=0.39) and putting of objects in the mouth (p=0.82) had no statistical significant association with PLLs, but children biting the ends of pencils (p <0.001) was statistically significant.

Conclusion:

Lead contamination was variable in this group of Nigerian children. A significant contributory factor to lead contamination is the habit of biting the ends of lead pencils. Parental education to prevent such a risky habit is therefore advocated.

Keywords: Lead, plasma lead levels (PLLs), children

INTRODUCTION

Lead (Pb) is a highly toxic metal that is ubiquitous in our environment as a result of industrialization and it constitutes about 0.002% of the earth's crust. [1,2] Lead can be found in the soil, water and air mainly as a result of human activities over thousands of years. [3,4] Lead interferes adversely with the body processes, it is toxic to delicate organs, tissues and particularly among young children where hand to mouth action is very often. [4] The sources of exposure to lead in children are through ingestion of traditional medicines, leaded pipes used to convey drinking water, lead in canned food or lead glazed ceramics, leaded paints, toys, contaminated food, through inhalation from burning waste, industrial activity or cottage industries, leaded gasoline (traffic density) and through dermatological contact with traditional cosmetics like, *kohl, tiro and uhie.* [5,6,7,8]

Lead exposure is associated with some developmental problem like, fatigue, lack of muscular coordination, behavioral effect like Attention Deficit Hyperactivity Disorder (ADHD), delayed puberty development, hearing loss, reduced intelligence quotient. [7] High plasma lead levels (PLLs) in children can cause anaemia, encephalopathy, convulsions, paralysis, coma and death. [9,10,11] A PLL of <5µgPb/dl is considered as acceptable but an ideal lead level is 0µg/dl. [7,10,12,13] Studies have shown that even PLLs less than 5µgPb/dl have some pathological effect on children. [14] Several lead poisoning outbreaks had been reported in Nigeria. An outbreak of lead poisoning in UnguwanMagiri and UnguwanKawo communities in Rafi Local Government Area, Niger State, reported a total of 48 cases including 14 deaths (29.2%), following the activities of illegal gold mining as well as agriculture which are the predominant occupations in the affected community. The cases reported were mainly children between 7 months and11 years of both sexes (26 male, 22 female). [11] Blood samples of four of the hospitalized cases revealed high levels of PLL (171.5 – 224 µgPb/dl). Similarly, illegal gold mining practices in the villages of Dareta and Yarguma in Zamfara, Nigeria, were associated with lead poisoning. It was reported that over 500 children died from lead poisoning between January and July in 2010. [13]

Since March 2010 an estimated 18,000 children and adults were affected by widespread lead contamination resulting from the informal extraction of gold from lead-bearing ore. [3] Plasma lead levels of children in two acutely affected Zamfara villages averaged 119 Pbµg/dl (range; 33.3 - 445 µgPb/dl), [3] with 118 of the 463 resident children dying during May 2009 - May 2010. [3] Parents reported that 82% of the children who died experienced convulsions before death, a sign of severe lead poisoning, [3] as at July 2010, approximately 100 children from these villages were receiving chelation therapy while another 2,000 in five other villages were identified as being in need of chelation. [15] Preventive measures put in place by a team of international, Nigerian Federal, and State public health agencies, environmental remediation specialists, health-care providers and educators in Zamfara State, is already yielding positive results in children less than 5 years of age. [15] Lead was also found in rice, corn, spices and medicinal herbs, but at much lower levels up to 146 parts per million. [15,16] It was suggested that primary exposure of children to soil contamination is through hand-to-mouth route and inhalation of lead-contaminated dust. [15,16] These recent reports of lead poisoning in children living in Niger and Zamfara States of Nigeria, suggest the possibility of unacceptable levels of lead in the Nigerian soil. However, lead contamination from casual home contacts have been poorly documented in this setting. [15] According to WHO, 18 children died in ThiaroyesurMer, Senegal, during November 2007 - March 2008 from encephalopathy caused by severe lead intoxication as a result of environmental contamination from informal used lead acid battery (ULAB) recycling. [15] Plasma lead levels (PLLs) of 50 children (3 months-19 years-old) included in the WHO investigation ranged from 39.8 - 613.9 µgPb/dl, with a mean (SD) of 129.5 (92.4) µgPb/dl. Of North American children, 7% had plasma lead levels above 10 µgPb/dL, whereas among Central and South American children, the percentage was 33 to 34%. [16] About one fifth of the world's disease burden from lead poisoning occurs in the Western Pacific, and another fifth is in Southeast Asia. [16] Therefore, this study was carried out to determine the level of lead contamination in children living in southwestern Nigeria, from casual contacts in the home or the environment.

MATERIALS AND METHODS

Study Area

This study was conducted in the Paediatric Wards and Clinic of the University College Hospital, Ibadan, Oyo State. Oyo State is an inland state in southwestern Nigerian, with its capital at Ibadan. It is bounded in the north by Kwara State, in the east by Osun State, in the south by Ogun State, and in the west partly by

Ogun State and partly by the Republic of Benin. The University College Hospital is strategically located in Ibadan, the largest city in West Africa which is also the seat of the first University in Nigeria. The University College Hospital, Ibadan, was initially commissioned with 500 bed spaces. Currently the hospital has 850 bed spaces and 163 examination couches, current bed occupancy rates ranges from 55-60%.

Study Design and Sampling Technique

The study design is a prospective, cross-sectional study. The study population are the children in the Paediatric Ward and those attending the Paediatric Clinic in the University College Hospital, Ibadan, from the ages of 12-120 months, while children with sickle cell disorder were excluded from the study. A purposive sampling technique was used to select the study participants and a total of 151 children were selected for this study.

Instrument of data collection

Institutional ethical approval was obtained from the UI/UCH Ethics Committee, University College Hospital, Ibadan (UI/EC/13/0055) and a written consent was obtained from a parent and guardian. A structured questionnaire was used to obtain information on socio-demographic characteristics of the children, caregivers, status of household painting, source of drinking water and habit of the child that may predispose to lead contamination from a parent and or guardian.

Laboratory methods

Two milliliters of venous blood was collected into a lead-free red top vacutainer bottles and centrifuged to separate the plasma, which was decanted into plain lead-free bottles and stored at -20 °C prior to analysis. The frozen plasma samples were thawed and brought to room temperature. The samples were deproteinised with 2ml hydrochloric acid; Hcl (1:3). The digested samples were centrifuged at 1163 g for 5 minutes and the resulting supernatant was aspirated into the flame atomic absorption spectrometry (AAS; ALPHA 4 model, Chem Tech Germany) to measure the plasma lead levels as described by Kaneko (1999). Four working standard solutions (in parts per million) were prepared for lead. All analytical measurements for plasma lead level were carried out at the Central Laboratory, Obafemi Awolowo University, Ile-Ife.

Data management

Data collected were analysed using Statistical Package for Social Sciences (SPSS) IBM version 20 (2015). Descriptive statistics such as frequency, mean and standard deviation were used to summarize quantitative variables, while inferential statistics such as Student t-Test and Pearson Correlation Coefficients were used to compared data between and groups between variables respectively; P-values≤ 0.05 defined statistical significance.

Ethical consideration

Ethical approval for this study was obtained from the UI/UCH Ethics Committee, University College Hospital, Ibadan (UI/EC/13/0055).

RESULTS

Socio-demographic characteristics of the children and caregivers: The age of the children ranged from 12 – 120 months; 29.1% were between 12 – 24 months old; 31.8% were between 24 - 60 months old; and 39.1% were 60 months old and above. Majority of the participants were males (60.3%), while 39.7% were females (Table 1).

Table 1: Plasma lead levels in children in relation to their age groups

Age Groups (months)	Frequency n =151 (100%)	PLLs (µgPb/dl) Mean (±SD)
12-24	44 (29.1)	2.48 (0.5)
24-60	48 (31.8)	2.67 (0.6)
60-120	59 (39.1)	2.57 (0.5)
Total	151 (100)	2.57 (0.5)

Prevalence of lead contamination: The plasma lead level ranged from 1.5 to 4.6 µgPb/dl with a mean (SD) of 2.6 (0.5) µgPb/dl.

Distribution of risk factors for lead contamination among the participants: Of the 151 participants, 67.5% had their houses painted and 32.5% did not paint their houses. Majority had no paint peeling (85.4%) and 14.6% had paint peelings in their houses. 31.1% of the patients drank sachet water, any water (19.9%), borehole water (14.6%), well water (13.2%), tap water (8.6%), boiled water (7.3%), bottled water (3.3%) or river water (2.0%) as shown in Figure 1.

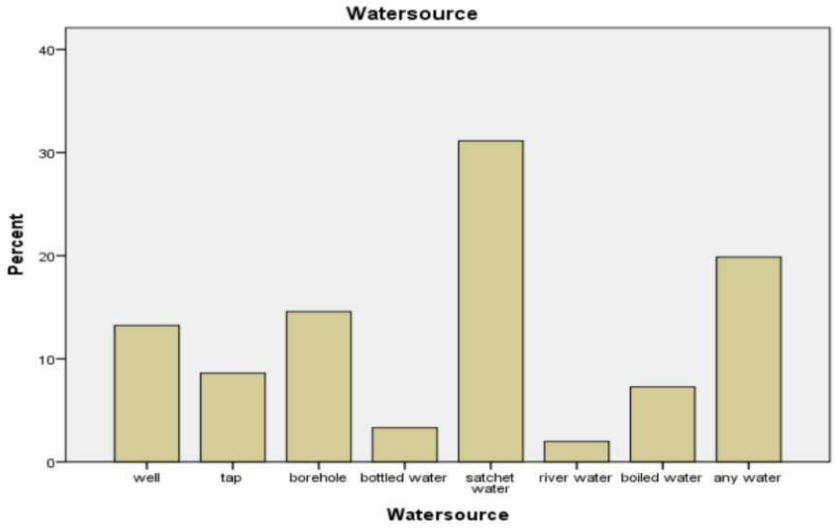


Figure 1: Source of drinking water of the children

Habits of children predisposing to lead contamination: Very few of the participants were crawling (6.6%) and 93.4% were not crawling. Almost half of the participants put objects in their mouth (45.7%) and 54.3% do not put objects in their mouth. 15.9% bite the end of their pencils, 83.4% do not bite the ends of pencils and 0.7% are not sure.

Table 2: Socio-demographic characteristics, risk factors and habits of children predisposing to lead contamination in relation to plasma lead levels

Variables	Frequency n=151 (%)	P-value
Sex		
Male	60.3	
Female	39.7	0.71
Religion		
Christian	61.6	
Muslim	38.4	0.58
Occupation of parents/guardian		
Professional	8.6	
Civil servants	23.8	
Self employed	50.3	
Artisans	6.6	
Housewives	8.6	
Students	2.0	0.63
House painted		
Yes	67.5	
No	32.5	0.17
Paint peelings		
Yes	14.6	
No	85.4	0.08
Sitting without support		
Yes	93.4	
No	6.6	0.68
Crawling		
Yes	6.6	
No	93.4	0.39
Puts objects in the mouth		
Yes	45.7	
No	54.3	0.82
Bite ends of pencils		
Yes	15.9	
No	83.4	
Not sure	0.7	<0.001*

*Statistically significant

DISCUSSION

This study shows that the children that attended the Paediatric clinics and wards in University College Hospital (UCH), Ibadan have PLLs <5µgPb/dl, although none had 0µgPb/dl, a level considered to be ideal. [16] The mean PLLs (2.6µgPb/dl) in this study, is lower than the findings previously documented in primary school children in Ibadan (12.3µgPb/dl). [19] Since lead poisoning is a cause of aneamia it is pertinent that PLLs are measured particularly in this group of children. The results of this present study suggest a downward trend in the PLLs of children in Ibadan. [19] A study carried out in Enugu Teaching Hospital, demonstrated a wider variation in levels of lead contamination where 31% of the children had PLLs <5µgPb/dl, 36% had levels between 5 and10µgPb/dl and 33% had levels greater than 10 µgPb/dl. [20] This may not be unrelated to the high contamination of well water in that area of the country that was reported about ten years ago. [1]

There was no significant association between

PLLs and the socio-demographic characteristics of the participants, (Table 2) which confirms a previous study carried out in Ibadan on primary school children. [19] Similarly, the study carried out in Otukpo local government area of Benue State, showed that there was no significant association between PLLs and socio-demographic characteristics of the participants. [4]

The risk factors for elevated plasma lead levels among participants:

Status of participants' houses (that is, house ever painted, presence of paint peelings) and source of drinking water were investigated. There was no significant association between the PLLs of participants and any of these variables (Table 2). These findings confirm the report of a study conducted in Kaduna and Ibadan [17,19] where risk factors such as source of water supply were not associated with elevated plasma lead levels. In this study very few participants drank water from rivers in Ibadan (Figure 1), which have been reported to contain varying levels of lead contamination (1.3 - 13µgPb/l). [18] Information obtained from the quality control department of the water corporation indicated that neither lead pipes nor leaded solder were used to supply water to households in Ibadan. [18] The concentration of lead in the drinking water of participants was outside the scope of this study.

There is poor documentation of air contamination with lead in Ibadan. One of the known causes of air contamination is leaded gasoline, but this has been phased out in Nigeria since 2003 and should therefore not be a contributory factor presently. [4,16,18,19]

Biting the ends of pencils was, however, the only habit that predisposed children to lead contamination (Table 2). This study has confirmed previous reports that the habit of biting the ends of pencils is associated with a higher risk of lead metal contamination in children than other factors. [3,4,6,7,10] Parents and teachers should discourage children from biting the ends of their pencils. Mechanisms should be adopted for regular monitoring of PLLs in Nigerian children so as to ensure that their PLLs are at the ideal level of 0µgPb/dl if possible. In addition, we recommend that manufacturers of lead pencils should not let the lead reach the end of the pencil where children usually bite, thus reducing the risk of contamination.

All the children in this study showed evidence of contamination with lead, since none had zero level, but the sources of contamination are many and only a few have been investigated in this study. Other than water, some contaminants include food, soaps and other toiletries/cosmetics, drugs and toys. Unfortunately there is inadequate information on the lead content of the staple foods and these items in Nigeria. [9] Therefore, a comprehensive survey of food and other sources of lead contamination that may contribute to elevated PLLs in this environment is required.

CONCLUSION

This study showed that the children have varying levels of lead metal contamination and none had an ideal PLL of zero, which may be difficult to achieve in any given population. Biting the ends of lead pencils was found to be a major risk factor in this study. Some recommendations were made to reduce this habit and its consequences.

Acknowledgement:

Mr. and Mrs. P.N. Nwankwo, for their encouragement and financial support. Residents in Paediatrics for their assistance in the recruitment of subjects and sample collection; and the Staff of the Haemotology Research Laboratory, for their assistance.

Disclosure: The authors declare that they have no conflict of interest

Author's Contribution:

AFN conceptualised the research work, did the laboratory work except for the Plasma Lead

Level analysis. WAS supervised the work and corrected the manuscript. AOA co-supervised the work and provided the subjects recruited from the Paediatric Ward Clinic. MDD did the statistical analysis and corrected the manuscript. EOA provided literature on lead in Nigeria and corrected the manuscript.

REFERENCES

1. Ogbu IS, Onyekwere TO. Lead content of well water in Enugu South-East Nigeria. *Int J Med and Health dev. 2*004; Vol 19, No 2, 119-120.
2. World Health Organization (WHO). Epidemic and Pandemic alert and response, 2015.
3. World Health Organization (WHO). Childhood lead poisoning, 2010; ISBN 978 92 4 150033 3, *WHO press,* Pg 13-20. World Health Organization, 20 Avenue, Appia, 1211, Geneva 27, Switzerland
4. Oladele A, Ogunseitan SR, Timothy SR. The cost of environmental lead (Pb) poisoning in Nigeria. *Afr. J. Environ. Sci. Tchnol,* 2007; 1 (2): 027-036.
5. Flora SJS, Flora G, and Saxena G. Environmental occurrence, health effects and management of lead poisoning. Doi: 10.1016/B978-044452945-9/50004-X. Lead in the Environment: Chemistry, Analytical Aspects, Environmental impacts and Health effects. Editor, Cascas, SB. 1st Edition, *Elsevier Science B.V.* 2006; pp. 158–228.
6. Centre for Disease Control and Prevention (CDC). Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention. 2012; Pg 9
7. Advisory committee on childhood lead poisoning prevention (ACCLP) of the (CDC) Center for Disease Control and Prevention in United States. Recommendation in low level lead exposure harms children; A renewal call of primary prevention. 2012, www.cdc.gov/nech/Lead.
8. Karri SK, Saper B, Kales SN. Lead Encephalopathy Due to Traditional Medicines. *Current drug safety.* 2008; 3 (1): 54–9.
9. Nnorom IC, Igwe JC, Oji-nnorum CG. Trace metal contents of facial (make-up) cosmetics commonly used in Nigeria. *Afr. J. Biotechnol.* 2005; Vol. 4 (10), pp. 1133-1138. ISSN 16845315. http://www.academicjournals.org
10. Morris M. Lead poisoning. Nelson Paediatrics text book, 5th edition, 2004; chapter 703, Pg. 2358-2362
11. Guidotti TL, Ragain L. Protecting children from toxic exposure: three strategies". *Pediatric clinics of North America.* 2007. 54 (2): 227–235.
12. Sindiku OK and Osibanjo O. Some priority heavy metals in children toy's imported to Nigeria. *J. Toxicol. Environ. Health Sci.* 2011; Vol. 3(4) pp. 109-115, ISSN 2006-9820. http://www.academicjournals.org.
13. Sanders T, Liu Y, Buchner V, Tchounwou PB. Neurotoxic effects and biomarkers of lead exposure. *Res Environmental Health*, 2009; 24: 15–45.
14. Patrick L. Lead toxicity part II: the role of free radical damage and the use of antioxidants in the pathology and treatment of lead toxicity. *Alternmed Rev. 2006;* 11:114–127
15. Alison LC, Henry F, Anne MR. Mapping global environmental lead poisoning in children. *Journal of Health and Pollution.* 2011;2: 14 – 23.
16. Okechukwu EC, Okechukwu AS. Environmental Pollution Effect in Children, In view Of Achieving the Millennium Development Goals: Lead Poisoning in Developing Countries- Nigeria in Focus. *IOSR J Environ Sci Toxicol Food Technol (IOSR-JESTFT),* 2015; e-ISSN: 2319-2402, p-ISSN: 2319-2399.Volume 9, Issue 2; Ver. I, PP 04-10. DOI: 10.9790/2402-09210410. www.iosrjournals.org
17. Nriagu J, Oleru NT, Cudjoe C, Chine A. Lead poisoning of children in Africa, III Kaduna Nigeria. *Sci Total Environ.*1997; PHS 0048-9697 (96) 05408-3
18. Omokhodion FO. Blood lead and tap water lead levels in Ibadan, Nigeria. *Sci Total Environ,* 1994; SSD 10048-9697 (94) 3967-3977
19. Omokhodion FO, Morton J, Omokhodion SI, Snashall D. Blood lead levels of primary school children in southwest Nigeria. *Occupational Health and Environmental Health Journal,* 2012; (1): 15-19.
20. Ugwuja EI, Ogbu IS, Umeaku EA, Otuu FC. Blood lead levels in Children attending a tertiary hospital in Enugu South-eastern Nigeria. Paediatr Int Child Health, 2014; 34(3): 216-219.

ISSN 263530240-5