Nutrición Hospitalaria

Original / *Pediatría*

Evaluation of blood zinc, calcium and blood lead levels among children aged 1-36 months

Xiaojun Ji[1], Hong He[2#,] Lisheng Ren[2], Ji Liu[2] and Chunhua Han[2]

[1]Department of Emergency Neurology, the Affiliated Hospital of Qingdao University Medicine College, Shandong province, 266003 People's Republic of China. [2]Department of Clinical Laboratory, Affiliated Hospital of Qingdao University, Qingdao city, Shandong province, 266003 People's Republic of China.

Abstract

Background: Early childhood lead exposure is associated with numerous adverse health effects. Biomonitoring among susceptible populations, such as children, has not been previously conducted. The aim of the study is to evaluate the blood lead (Pb) and total blood calcium (Ca) levels; blood zinc (Zn) levels.

Methods: A cross-sectional study was designed to collect healthy children age 1- 36 months (Mean ± SD: 1.5 ± 0.6 age, 60% boys) in the study from January 2010 to September 2011.

Results: The overall mean blood Pb levels were 42.18 ± 12.13 μg/L, the overall mean blood Zn and total blood Ca concentrations were 62.18 ± 12.33 μmol/L and 1.78 ± 0.13 mmol/L, respectively. The prevalence of elevated blood Pb levels in all children was 1.3%. A significant difference was found between female and male subjects for the blood Pb and Zn. After controlling for gender and age, there was a weak positive correlation between total blood Ca and Zn level.

Conclusions: The blood Pb levels had a significant negative correlation with total blood Ca level after adjusting for age and gender, and these findings suggest that Pb had effect on positive blood Zn and total blood Ca levels; parents should pay more attention to the nutrition of girls

(*Nutr Hosp.* 2014;30:548-551)

DOI:10.3305/nh.2014.30.3.7502

Key words: *Biomonitoring. Zinc. Total blood calcium. Lead.*

EVALUACIÓN DE SANGRE, ZINC, CALCIO Y EL NIVEL DE PLOMO EN LA SANGRE ENTRE LOS NIÑOS DE 1 A 36 MESES

Resumen

Antecedentes: La primera infancia la exposición al plomo se asocia con numerosos efectos adversos a la salud. Biomonitoring entre poblaciones sensibles, como niños, no ha sido previamente realizado. El objetivo del estudio es evaluar la sangre de plomo (PB) y el total de los niveles de calcio en la sangre (CA), zinc (Zn) los niveles de sangre.

Métodos: Un estudio transversal fue diseñado para recoger los niños sanos de edad 1 - 36 meses (media ± SD: 1,5 ± 0,6 edad, 60% de los niños) en el estudio a partir de enero de 2010 a septiembre de 2011.

Resultados: La media global sangre PB niveles fueron 42.18 ± 12.13 μg / l, la media general y total de sangre sangre Zn ca las concentraciones eran 62,18 ± 12.33 μ mol / l y 1,78 ± 0,13 mmol / l, respectivamente.La prevalencia de sangre elevados niveles de PB en todos los niños fue de 1,3%.Una diferencia significativa se encontró entre hembra y macho sujetos para la sangre, Pb y Zn.Despues de controlar por edad y género, existe una débil correlación positiva entre el total de sangre CA y Zn.

Conclusiones: La sangre PB niveles había una correlación negativa significativa con total sangre CA nivel tras ajustar por edad y género, y estos hallazgos sugieren que la PB tuvo efecto en la sangre total positivo de Zn y sangre CA Los niveles; los padres deben prestar más atención a la nutrición de las niñas

(*Nutr Hosp.* 2014;30:548-551)

DOI:10.3305/nh.2014.30.3.7502

Palabras clave: *Biomonitoreo. Zinc. Calcio total de la sangre. Plomo.*

Correspondence: *Hong He.*
Department of Emergency Neurology Affiliated Hospital of Qingdao University.
No. 16 Road Jiangsu, Qingdao city, Shandong province, 266003. People's Republic of China.
E-mail: xiaojunji101@163.com

Introduction

Over the past several decades there has been a remarkable reduction in environmental sources of lead, improved protection from occupational lead exposure, and an overall decreasing trend in the prevalence of elevated blood lead levels (BLLs) in U.S. adults. As a result, the U.S. national BLLs geometric mean among adults was 1.2μg/dL during 2009-2010[1]. Previous study revealed that elevated blood Pb level has negative effects on the body mass index(BMI)[2], hematopoietic system[3,4], immune system[5], also anemia[6]. Children are the most vulnerable and affected group to lead exposure. Thus, Pb poisoning is now recognized as a severe environmental health threat to children. Meantime, Zn and Ca are also important metal cofactors for many enzymes and proteins, which play important role in human metabolism[7].

Therefore, the aim of this study was to analyze the correlation between whole blood Pb and Zn, Ca levels in children. Our analyses were based on population-based screening data, which were collected from a total of 120 children aged 1- to 36 -month.

Subjects and Methods

Subjects

Healthy children age 1-36 months were recruited in the study from January 2010 to September 2011. About one third of them were selected randomly from our outpatient. And the rest consisted of children who recruited from the child health center of our hospital for physical examination. A total of 120 healthy children were recruited for the study.

All participants were given informed consent. All subjects agreed to provide their personal information regarding the purpose and the procedures of our study.

Methods

We collected 10 ml of venous blood to test the blood Pb, total blood Ca and blood Zn levels. Whole blood Pb levels were analyzed using an atomic absorption spectrometer (283.3 nm) equipped with a tungsten atomizer (BH2100, Bo hui, Beijing, China); blood Zn and total blood Ca levels were analyzed by flame atomic absorption spectrometry (BH5100, Bo hui, Beijing, China) using hollow cathode lamps (213.9, and 422.7nm for Zn and Ca, respectively). Reference values were as follows: Ca: 1.55–2.65 mmol/L, Pb: 0–100 μg/L, and Zn: (0–12 months) 58–100 μmol/L. Intoxication levels are as follows: Pb: $\geq$100 μg/L, These reference values were based on the U.S. Centers for Disease Control criteria for Pb poisoning[8].

Statistics Analysis

Data analyses were performed using R software programming language[9]. Student's unpaired t-test was used for comparison of blood Pb and Ca and Zn between male and female subjects. Pearson's partial correlation coefficient was used to determine an association between blood Pb, Ca and Zn. All statistical tests were two-sided, and value of $P < 0.05$ was considered statistically significant.

Ethics Statement

All parents and/or guardians on behalf of the children agreed to provide their personal information regarding the purpose and the procedures of our study, and written informed consent .The study was performed in accordance with the Declaration of Helsinki. Approval was obtained from the Institutional Review Board of Qingdao University Medicine College.

Results

A total of 120 healthy children were recruited for the study. The mean age of the children studied was 1.5 ± 0.6 ages, and 60% of the subjects were male. The overall mean blood Pb levels were (42.18 ± 12.13) μg/L.

Zinc

The overall mean blood Zn concentration was 61.19 ± 11.30 μmol/L. Levels of Zn increased gradually with age, 24.1% of them were Zn deficient, and the prevalence of Zn deficiency decreased with age from 43.1% to 11.3%; however, Zn deficiency was still very common.

Table I
Comparison of trace element levels in the blood according to age groups

Age (months)	n	Pb (µg/L)	Zn (µmol/L)	Ca (mmol/L)
< 6	42	32.41 ± 11.20	45.12 ± 7.61	1.74 ± 0.22
6–12	44	42.21 ± 13.07	56.17 ± 8.14	1.62 ± 0.20
> 12	34	44.17 ± 12.43	67.11 ± 12.21	1.84 ± 0.19

Evaluation of blood zinc,
calcium and blood lead levels
among children aged 1-36 months

Nutr Hosp. 2014;30(3):548-551

549

Calcium

The overall mean blood Ca concentration was (1.78 ± 0.13) mmol/L. Overall, 6.06% of children was low blood Ca levels. No significant differences in blood Ca concentrations were found between female and male subjects. Significant differences were found between female and male subjects for the blood Pb and Zn levels as showed in table II.

Element correlations

After controlled for age and gender, we found that there were significant negative correlations between Pb and Ca (r = -0.649, p < 0.01) .Weaker positive correlations were also noted between Ca and Zn (r = 0.289, *p* < 0.01). Multiple logistic regression analysis was performed to further the identification of the correlations between blood Pb, Ca and Zn. Multiple logistic regression analysis also showed that Pb had weaker negative correlations with Ca and Zn (*B*= -5.23, -5.741, *p*<0.01).

Discussion

Our results showed that there was a weak positive correlation between blood Ca and Zn level after controlling for gender and age. The data from the present study indicate that the levels of Pb was lower than previous reported in Shandong city (China) in 2012[10], Changchun(China)[11] and sub-Saharan African [12]. The mainly reason maybe that the level of lead exposure have a area difference. Overall, the results of our research showed that the mean blood Pb level in children is lower than that of the criteria from the U.S. Centers for Disease Control[13] . Another finding of our study is that there are significant differences in the blood Pb and Zn level between female and male subjects . the possible reason maybe that parents pay more attention to the health status of boy than that of girl in China. Thus , boy have more chance to play games outside, air lead may have an effect on children's blood lead levels[14].

Deficiencies of essential metals can increase the hazard of lead exposure[15], Previous study revealed that deficiency of zinc and calcium can increases lead absorption and toxicity[16]. Children who have a lower dietary intake of Ca or Zn have a higher Pb absorption[17].

Some research also found that blood Pb was negatively correlated with blood Ca[18],which is consist with our study. Recent researches also showed that many essential trace metals have effect on the blood Pb level[19]. The relationship between blood Pb and essential trace metals is still should be further research in Chinese children population.

The present study showed that blood Zn levels gradually increased with age, which was consistent with the previous reports. Considering the importance of these nutritional essential metals, the supplementation of trace elements during children growth stage is important. However, there are some limitations in this study, for example, smaller sample study, lacking of information related to feedings habits, socioeconomically status of the families, type of plumbing or paintings in the houses and so on. Thus further researches on supplementation of trace elements should included more information. The interaction between toxic and nontoxic essential metals also should be further research in Chinese children population.

Conclusion

These findings suggest that Pb had weaker positive correlations with Zn and Ca; parents should pay more attention to the nutrition of girls. Meanwhile, further long-term follow-up are still needed.

References

1. Very high blood lead levels among adults - United States, 2002-2011. *MMWR Morb Mortal Wkly Rep* 2013, 62(47):967-71.
2. Saavedra Juarez N, Chavez Ramos JE, Gomez Alonso C, Rodriguez-Orozco AR: [Low height and weight associated with lead-chronic intoxication in a group of children from families potters]. *Nutr Hosp* 2010, 25(3):470.
3. Wang J, Zhu H, Yang Z, Liu Z: Antioxidative effects of hesperetin against lead acetate-induced oxidative stress in rats. *Indian J Pharmacol* 2013, 45(4):395-8.
4. Herman DS, Geraldine M, Venkatesh T: Evaluation, diagnosis, and treatment of lead poisoning in a patient with occupational lead exposure: a case presentation. *J Occup Med Toxicol* 2007, 2:7.
5. Wang L, Wang JY, Bai H, Li XF, Wan F: [Impact of excessive blood-lead levels on T cell subsets in lead exposed workers]. *Zhongguo Shi Yan Xue Ye Xue Za Zhi* 2011, 19(6):1509-11.
6. Turgut S, Polat A, Inan M, Turgut G, Emmungil G, Bican M *et al*: Interaction between anemia and blood levels of iron, zinc, copper, cadmium and lead in children. *Indian J Pediatr* 2007, 74(9):827-30.

Table II
Comparison of trace element levels in the blood according to gender

Gender	n	Pb (µg/L)	Zn (µmol/L)	Ca (mmol/L)
Female	60	43.96 ± 19.30	58.42 ± 11.11	1.77 ± 0.21
Male	60	36.14 ± 16.31	62.61 ± 14.07	1.81 ± 0.26

7. Papageorgiou T, Zacharoulis D, Xenos D, Androulakis G: Determination of trace elements (Cu, Zn, Mn, Pb) and magnesium by atomical absorption in patients receiving total parenteral nutrition. *Nutrition* 2002, 18(1):32-4.
8. Leads from the MMWR. Preventing lead poisoning in young children--United States. *JAMA* 1985, 253(15):2182-3.
9. Johns KA: The Programming Environment for Statistical Tabulation. *Int J Biomed Comput* 1986, 19(3-4):161-73.
10. Zhao TT, Chen B, Wang HP, Wang R, Zhang H: Evaluation of toxic and essential elements in whole blood from 0- to 6-year-old children from Jinan, China. *Clin Biochem* 2013, 46(7-8):612-6.
11. Xu J, Sheng L, Yan Z, Hong L: Blood lead and cadmium levels in children: A study conducted in Changchun, Jilin Province, China. *Paediatr Child Health* 2014, 19(2):73-6.
12. Ngueta G, Ndjaboue R: Blood lead concentrations in sub-Saharan African children below 6 years: systematic review. *Trop Med Int Health* 2013, 18(10):1283-91.
13. Preventing lead poisoning in young children. A statement by the Center for Disease Control. *J Pediatr* 1978, 93(4):709-20.
14. Zahran S, Laidlaw MA, McElmurry SP, Filippelli GM, Taylor M: Linking source and effect: resuspended soil lead, air lead, and children's blood lead levels in Detroit, Michigan. *Environ Sci Technol* 2013, 47(6):2839-45.
15. Farkas E, Batka D, Pataki Z, Buglyo P, Santos MA: Interaction of desferrioxamine B (DFB) model dihydroxamic acids with some essential and toxic metal(II) ions: effects of the structure and length of connecting chains on the metal ion selectivity. *Dalton Trans* 2004(8):1248-53.
16. Kerper LE, Hinkle PM: Cellular uptake of lead is activated by depletion of intracellular calcium stores. *J Biol Chem* 1997, 272(13):8346-52.
17. Park JD, Cherrington NJ, Klaassen CD: Intestinal absorption of cadmium is associated with divalent metal transporter 1 in rats. *Toxicol Sci* 2002, 68(2):288-94.
18. Ahamed M, Singh S, Behari JR, Kumar A, Siddiqui MK: Interaction of lead with some essential trace metals in the blood of anemic children from Lucknow, India. *Clin Chim Acta* 2007, 377(1-2):92-7.
19. Wang H, Shi H, Chang L, Zhang X, Li J, Yang Y *et al*: Association of blood lead with calcium, iron, zinc and hemoglobin in children aged 0-7 years: a large population-based study. *Biol Trace Elem Res* 2012, 149(2):143-7.

Evaluation of blood zinc,
calcium and blood lead levels
among children aged 1-36 months

Nutr Hosp. 2014;30(3):548-551

551