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Original Article

Blood zinc, calcium and lead levels in Chinese children aged 1-36 months

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Abstract: The aim of the study is to evaluate the blood lead (Pb), total blood calcium (Ca) levels and blood zinc (Zn) levels among children. A cross-sectional study was designed to collect healthy children age 1-36 months (Mean ± SD: 1.4 ± 0.3 age, 55% boys) in the study from January 2012 to September 2013. The overall mean blood Pb, Zn and Ca levels were (41.18 ± 11.13) μg/L, (62.18 ± 13.33) μmol/L and (1.76 ± 0.13) mmol/L, respectively. The prevalence of elevated blood Pb levels and low blood Ca levels were 1.5% and 5.2%, respectively. The prevalence of Zn deficiency varied from42% to 49% among different age group. Biomonitoring trace element levels have a significant important to children health. Our findings suggest that parents should pay more attention to the nutrition status, especially for Zn status among children.

Keywords: Biomonitoring, zinc, total blood calcium, lead

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 1.2 μg/dL during 2009-2010 [1]. Children are the most vulnerable and affected group to lead exposure. Thus, Pb poisoning is now recognized as a grave 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 [2].

Therefore, the aim of this study was to evaluate the blood lead (Pb), total blood calcium (Ca) levels and blood zinc (Zn) levels among children.

Subjects and methods

Subjects

A cross-sectional study was designed to collect healthy children age 1-36 months (Mean ± SD: 1.4 ± 0.3 age, 55% boys) in the study from January 2012 to September 2013. A total of 400 children who were recruited in our study taken part in a physical examination in the child health center of our hospital. 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 422.7 nm 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: ≥ 100 μg/L, These reference values were based on the U.S. Centers for Disease Control criteria for Pb poisoning [3].

Table 1. 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	120	31.41 ± 12.20	46.12 ± 8.61	1.64 ± 0.12
6-12	180	41.21 ± 11.07	55.17 ± 7.14	1.69 ± 0.20
> 12	100	45.17 ± 11.43	68.11 ± 11.21	1.94 ± 0.19
F		43.69	172.87	90.05
P		< 0.05	< 0.05	< 0.05

Table 2. Comparison of trace element levels in the blood according to gender

Gender	n	Pb (μg/L)	Zn (μmol/L)	Ca (mmol/L)
Female	180	42.96 ± 18.30	57.42 ± 11.11	1.63 ± 0.11
Male	220	35.14 ± 12.31	61.61 ± 13.02	1.81 ± 0.16

Table 3. Percentages of children above and below normal thresholds in the various study populations

Group (months)	Total (n)	Pb > 100 (μg/L)	Pb > 70 (μg/L)	Zinc# (μmol/L)	Ca < 1.55 (mmol/L)
< 6 (n, %)	120	1 (0.8)	5 (4.2)	50 (42)	6 (5)
6-12	180	3 (1.7)	8 (4.4)	88 (49)	12 (6.7)
> 12	100	2 (2)	17 (17)	21 (21)	5 (5)

Note: Values are absolute numbers (percent) Zn#: (0-12 months) 58-100 μmol/L; (12-24 months) 62-110 μmol/L; (24-48 months) 66-130 μmol/L; and (48-72 months) 76.5-140 μmol/L.

Statistics analysis

Data analyses were performed using R software programming language [4]. Student's unpaired t-test was used for comparison of blood Pb and Ca and Zn between male and female subjects. 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.

Results

A total of 400 healthy children were recruited for the study. The mean age of the children studied was 1.5 ± 0.6 ages, and 55% of the subjects were male. The overall mean blood Pb levels were (41.18 ± 11.13) μg/L. The prevalence of elevated blood Pb levels was 1.5% (**Table 3**). Trace element levels were increased gradually with age (**Table 1**).

Zinc

The overall mean blood Zn concentration was (62.18 ± 13.33) μmol/L. Levels of Zn increased gradually with age, the prevalence of Zn deficiency varied from 42% to 49 % among different age group; however, Zn deficiency was still very common (**Table 3**).

Calcium

The overall mean blood Ca concentration was (1.76 ± 0.13) mmol/L. Overall, 5.2% 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 2**.

Above the normallevel of include element

The number of children with blood Zn and Ca levels below the normal threshold or Pb levels above the normal threshold in the various study populations are shown in **Table 3**.

Discussion

Our results showed that the prevalence of elevated blood Pb levels and low blood Ca levels were low. However, Zn deficiency was still very common. The data from the present study indicate that the levels of Pb was lower than previous reported in Shandong city (China) in 2012 [5], Changchun (China) [6] and sub-Saharan African [7]. The mainly reason maybe that the level of lead exposure have a area difference. 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.

Deficiencies of essential metals can increase the hazard of lead exposure [8], Previous study

revealed that deficiency of zinc and calcium can increases lead absorption and toxicity [9]. Recent researches also showed that many essential trace metals have effect on the blood Pb level [10]. 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

Biomonitoring trace element levels have a significant important to children health. Our findings suggest that parents should pay more attention to the nutrition status, especially for Zn status among children.

Disclosure of conflict of interest

None.

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