

Zinc Levels in HIV-positive Children at the University of Nigeria Teaching Hospital

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Abstract

Background: Zinc is an abundant trace element in the body involved in many physiological processes. Its deficiency has been described in HIV-infected children, especially in advancing illness. This study, therefore, seeks to assess zinc levels in HIV-positive children attending the HIV clinic at University of Nigeria Teaching Hospital (UNTH). **Materials and Methods:** This was a descriptive, cross-sectional study among HIV-positive children aged 5–60 months attending the HIV clinic at UNTH. A 100 participants were enrolled from August 2013 to May 2014. Data were obtained using a pro forma developed by researchers, and blood samples were collected and analysed using an absorption spectrophotometer. Serum zinc level deficiency was defined as the values $<80 \mu\text{g/dL}$. Data analysis was conducted using the SPSS version 26. **Results:** Most participants were males (53.0%). Their mean age was 47 months (standard deviation = 15.7). The median serum zinc level was $55.5 \mu\text{g/dL}$ (IQR = 35.0–84.8). The majority of the participant (72%) had zinc deficiency. There was a statistically significant relationship between serum zinc level and participants' socioeconomic status ($P < 0.05$) – higher socioeconomic status was associated with higher zinc levels. **Conclusion:** The study showed a high prevalence of zinc deficiency in children living with HIV, with a significant relationship between serum zinc level and the participants' socioeconomic status. There is a need for zinc supplementation for HIV children, especially the indigent ones.

Keywords: Children, HIV, zinc

INTRODUCTION

Zinc is the second-most abundant essential biologic trace element after iron and is indispensable for life. It takes part in a lot of physiologic processes of the human body. Its homeostasis is tightly controlled at the subcellular, cellular, and tissue levels by several proteins, with zinc transporters being essential.^[1]

Zinc is sourced in high concentrations from pork, beef, poultry, and fish and lower concentrations from eggs and dairy products.^[2] On the other hand, phytates in plants (such as sorghum, maize, and millet) form complexes with zinc and reduce its absorption from the jejunum.^[3]

Zinc deficiency in humans is now known to be an important malnutrition problem worldwide,^[4] and young children are at greater risk of zinc deficiency because of increased zinc requirements during growth.^[5] It manifests as increased severity and duration of diarrhea and pneumonia, poor wound healing, dermatitis, and in severe forms, dwarfism.^[6] Zinc

requirements for healthy children are 0.17 mg/kg/day at one to three years of age and those for malnourished children are considerably higher at $2\text{--}4 \text{ mg/kg/day}$ of body weight.^[7]

Zinc deficiency has also been described in HIV-infected children, especially in advancing illness, associated with reduced intake due to malabsorption and increased loss due to the release of HIV-associated cytokines. AIDS raises the requirements for zinc above the recommended daily concentrations.^[6,8]

The role of zinc in HIV infection is still evolving as an area of study; hence, determination of zinc levels in HIV-infected

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children will provide useful information on the role of zinc supplementation in this special population.

MATERIALS AND METHODS

Study site

This was a descriptive cross-sectional study conducted at the University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu State.

Study population

The participants were asymptomatic HIV-positive children aged 5–60 months who attended the Pediatric HIV Clinic at the University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu. These children would have attended the clinic at least once before the follow-up visit at which enrollment took place.

Sample size estimation

The sample size was derived using the online Rasoft Sample Size calculator,^[9] calculated based on a population size of 112 (the number of HIV-infected children registered in the Pediatric HIV clinic of the University of Nigeria Teaching Hospital, Ituku-Ozalla, as at the end of 2011), a response rate of 50%, a confidence interval of 95%, and a margin of error of 5%. A minimum sample size of 87 was calculated; however, a total of 100 responses were secured.

Consent

Parents/caregivers of these children were approached, and details of the study were fully explained to them. If willing to participate in the study, the parents/caregivers were requested to sign or thumbprint on the consent form provided.

Recruitment of subjects

Participants were enrolled consecutively from August 2013 to May 2014. Participants sociodemographic characteristics were obtained and recorded in a pro forma developed by researchers. Three milliliters of blood samples were drawn from each participant for zinc analysis. Blood sample was obtained with 23G veroject into a trace element-free plain tube; samples were collected before noon, i.e., 12 pm. The samples were allowed to stand for about 90 min, (to allow for clotting and retraction),^[10] after which it was spun with a centrifuge at 3000 revolutions/min for 10 min. Subsequently, the serum, (usually about 1.5 mL), was separated with a bulb pipette into trace element-free plain tubes for analysis. Analysis was done using atomic absorption spectrophotometer (Model 210, manufactured by Buck Scientific Cooperation, Connecticut, USA). The machine operates at a wavelength range of 190–900 nm with typical sensitivity in the parts per million range.^[11]

Data analysis

Data was analysed using the SPSS version 26 (IBM, Chicago, USA). Serum zinc level deficiency was defined as serum zinc level <80 µg/dL.^[7] Socioeconomic class (SEC) was determined using occupation and educational levels of caregivers of study

participants as described by Oyedeji.^[12] The mean difference for nonparametric data was assessed with the Mann–Whitney *U* and Kruskal–Wallis tests for two and more than two categorical data, respectively. Level of a statistical significance was set at $P < 0.05$.

Ethical considerations

Ethical clearance was obtained from the Health Research and Ethics Committee of the University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu.

RESULTS

Age and gender distribution of HIV-positive children

The majority of the participants were within the ages of 48–60 months for both genders. The mean age of the participants was 47 months (standard deviation [SD] = 15.7), whereas the median age of the participants was 51 months (interquartile range = 36–60). The age and gender distribution of HIV-positive participants is shown in Table 1.

Sociodemographic characteristics of the study population

Majority of the study population was of Igbo tribe (99.0%). All respondents were Christians. Moreover, most of the participants (34%) were in SEC III. The sociodemographic characteristics of the study population are shown in Table 2.

Serum zinc levels among HIV-positive children

Figure 1 shows the serum zinc levels of HIV-positive children. The greater proportion of participants (72%) had zinc

Table 1: Age and gender distribution of HIV-positive children

Age (months)	Male, <i>n</i> (%)	Female, <i>n</i> (%)	Total, <i>n</i> (%)
5–12	1 (1.9)	1 (2.1)	1 (2.0)
>12–24	10 (18.9)	3 (6.4)	13 (13.0)
>24–36	8 (15.1)	6 (12.8)	14 (14.0)
>36–48	5 (9.4)	8 (17.0)	13 (13.0)
>48–60	29 (54.7)	29 (61.7)	58 (58.0)
Total	53 (100)	47 (100)	100 (100.0)

Table 2: The sociodemographic characteristics of the HIV-positive children

Variable	Frequency, <i>n</i> (%)
Tribe	
Igbo	99 (99.0)
Tiv	1 (1.0)
Religion	
Christian	100 (100.0)
Muslim	0
Socioeconomic class	
Class I	7 (7.0)
Class II	19 (19.0)
Class III	34 (34.0)
Class IV	26 (26.0)
Class V	14 (14.0)

deficiency with serum zinc level <80 µg/dL. The median serum zinc level was 55.5 µg/dL (interquartile range = 35.0–84.8).

Serum zinc levels in different age groups of HIV-positive children

The mean serum zinc level was the highest (87.3 µg/dL) among children within ages 13–24 months. It was lowest (39.9 µg/dL) among children within the ages of 37–48 months. There was no statistically significant difference in the mean serum zinc levels across different age groups ($F [4, 95] = 6.231, P = 0.183$) [Table 3].

Serum zinc levels by gender among HIV-positive children

The mean serum zinc level was the highest (67.2 µg/dL) among male participants. There was no statistically significant difference in the mean serum zinc levels across gender ($U[98] = 1113.0, P = 0.360$) [Table 4].

Serum zinc levels by socioeconomic class among HIV-positive children

The mean serum zinc level was the highest (97.6 µg/dL) among participants belonging to SEC 1, followed by participants belonging to SEC 2 (77.6 µg/dL). There was a statistically significant difference in the mean serum zinc levels across different socioeconomic status ($F [4, 95] = 25.413, P < 0.05$) [Table 5].

DISCUSSION

The majority of the participants were within the ages of 48–60 months, with a mean age of the participants was 47 months (SD = 15.7). The median serum zinc level in HIV-positive participants was 55.5 µg/dL (interquartile range = 35.0–84.8). A greater proportion of participants (72%) had zinc deficiency with values <80 µg/dL. This is higher than the prevalence noted in other parts of Africa, as observed by Ndeezi *et al.*^[13] in Uganda (53.3%) and Eley *et al.*^[14] in South Africa (20%). Unlike the above-mentioned studies, no attempt was made at nutritional supplementation before subject recruitment in this study. This could explain the higher prevalence of low serum zinc level observed in this study. Although Ndeezi *et al.*^[13] in Uganda and Eley *et al.*^[14] in South Africa, each recruited HIV-seropositive children

aged one to five years, these children were already receiving zinc and other micronutrient supplements at the time of zinc assay. A study by Yarhere *et al.*^[15] conducted in Southern Nigeria, also showed a slightly higher prevalence of 60%. The generally higher prevalence of zinc deficiency in this region is in keeping with the finding by Wessells and Brown assessing global prevalence of zinc deficiency, which showed inadequate dietary zinc intake is mostly common in Sub-Saharan Africa and South Asia.^[15]

There was no significant difference in the mean serum zinc level by gender and age group of participants. However, there was a significant relationship between serum zinc levels and socioeconomic status among participants ($F [4, 95] = 25.413, P = 0.000$) – participants who belonged to the higher SEC had higher mean serum zinc levels. Similar findings were reported in 2014 by Yarhere *et al.*^[15] in Port Harcourt, Nigeria, and Anyabolu *et al.*^[16] in South Western Nigeria. A study done in Ethiopia found that dietary intake of zinc is associated with the household income and educational status of caregivers/mothers, with zinc intake found to be high among communities of higher socioeconomic status.^[17] Children of low-socioeconomic class have limited access to food rich in zinc and consume diets rich in phytate, thereby decreasing their serum zinc levels. They are also prone to recurrent infections

Table 3: Serum zinc levels in different age groups of HIV-positive children

Age (months)	Mean (SD)	F	P
5–12	79.0 (8.5)	6.231	0.183
13–24	87.3 (66.1)		
25–36	64.6 (38.2)		
37–48	39.9 (22.5)		
49–60	63.7 (41.8)		

F: Kruskal–Wallis test statistics. Test statistics is significant at 0.05 level. SD: Standard deviation

Table 4: Serum zinc levels by gender among HIV-positive children

Gender	Mean (SD)	U	P
Male	67.2 (42.5)	1113.0	0.360
Female	60.7 (46.0)		

U: Mann–Whitney U-test statistics. Test statistic is significant at 0.05 level. SD: Standard deviation

Table 5: Serum zinc levels by socioeconomic status among HIV-positive children

Socioeconomic status	Mean (SD)	F	P
Class I	97.6 (47.6)	25.413	0.000*
Class II	77.6 (33.8)		
Class III	74.0 (44.4)		
Class IV	47.7 (47.0)		
Class V	35.6 (19.6)		

*Test statistics is significant at 0.05 level. F: Kruskal–Wallis test statistics. SD: Standard deviation

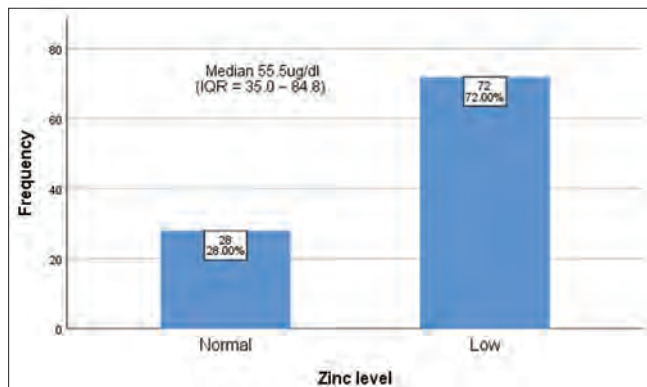


Figure 1: A histogram of serum zinc levels among HIV-positive children

and subsequent reduction in immunity as their system attempts to fight these infections.^[15]

CONCLUSION

Our study showed a high prevalence (72%) of zinc deficiency in children living with HIV. Our study also showed that there was a significant relationship between serum zinc level and the socioeconomic status of participants. Thus, there is a need for zinc supplementation for HIV children, especially the indigent ones.

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Conflicts of interest

There are no conflicts of interest.

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