International Journal of Medical Laboratory 2015;2(3):194-199.

International Journal of Medical Laboratory
Shahid Sadoughi University of Medical Sciences

Original Article

Comparison of Trace Elements of Zinc and Copper Between Children with Giardiasis and Healthy

Ali Fattahi Bafghi[1]* Ph.D., Mahboubehsadat Sadeghian[2] B.Sc., Akbar Baghiani[2] B.Sc., Arefeh Dehghani Tafti[3] M.Sc.

[1]Medical Parasitology & Mycology Department, Faculty of Medicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.
[2]Yazd Blood Transfusion Organization, Yazd, Iran.
[3]Biostatics and Epidemiology Department, Faculty of Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

Article history
Received 15 Jul 2015
Accepted 27 Sep 2015
Available online 30 Nov 2015

Key words
Copper
Giardia lamblia
Trace elements
Zinc

A B S T R A C T

Background and Aims: *Giardia lamblia* infection is a common cause of food and water-borne diarrhea in non-sanitary communities. Infections are common in children, particularly in child-care centers, backpackers, travelers, and homosexuals. Zinc is necessary for the immune system functions. Zinc deficiency is associated with acute diarrhea. Copper is essential for the production of red blood cells, hemoglobin formation and absorption of iron, and for the activity of various enzymes. However, the association between trace elements and Giardiasis has rarely been investigated. The aim of this experiment was comparison of trace elements of zinc and copper between children with Giardiasis and healthy.

Materials and Methods: The study was carried out between 30 children with Giardiasis and 30 children of control group. It was undertaken in both children aged 3 to 10 years without any history of Giardiasis and children with symptomatic Giardiasis. The hematological examination was performed. Serum zinc and copper levels were measured. Finally, the data was analyzed using SPSS version 19 statistical software.

Results:. Zinc levels in the study group was remarkably lower than the control group (68.94 vs. 153.99 µg/dl, p=0.001). In addition, there was a significant difference in serum copper levels between case (309.27 µg/dl) and control (253.19 µg/dl) groups (p=0.003).

Conclusion: Giardiasis elevated the serum copper levels, while it decreased the serum zinc.

*Corresponding Author: Medical Parasitology & Mycology Department, Faculty of Medicine, Shahid Sadoughi University of Medical Sciences, Shohadaye Gomnam Blvd, Safaeeyeh, Yazd, Iran, **Tel:** +98(35)38203410, **Email:** afbafghi@ssu.ac.ir

Introduction

Giardiasis is a global disease and caused by an intestinal flagellate, protozoa, *Giardia lamblia (GL)*. It infects nearly 6-8% of children and 2% of adults in developed countries worldwide, and nearly 33% of people in developing countries have had Giardiasis. People become infected with *GL* by swallowing *GL* cysts (hard shells containing *GL*) found in contaminated food or water. Cysts are instantly infectious once they leave the host through feces. An infected person might shed 1-10 billion cysts daily in their feces (poop) and this might last for several months. However, swallowing as few as 10 cysts might cause someone to become ill. *GL* may be passed person-to-person or even animal-to-person. Beside, oral-anal contact during sex has been known to cause infection. Symptoms of Giardiasis normally begin 1 to 3 weeks after a person has been infected [1-5]. The presence of zinc deficiency was established by plasma and hair zinc concentration, and efficacy of zinc treatment in the context of likely adequate status of other micronutrients, for cell-mediated immunity. Growth, cognition and psychomotor function to facilitate adequacy of other micronutrients a broad mixture of micronutrients was administered [6]. It has been suggested that 4.5 billion people worldwide are affected by deficiencies of iron, vitamin A and iodine; zinc is of increasing concern [7]. Zinc deficiency is also a serious public health problem, affecting mostly young children and pregnant women. Growth retardation linked to zinc deficiency in childhood leads to 6-8% loss of productivity in adulthood. The first 2 years of life are very important in the development of children and 60-70% of all childhood deaths are associated to malnutrition. Malnutrition diminishes motivation and development, consequently impairing mental and cognitive abilities. Poverty, one of the causes of malnutrition, is also a consequence, as malnutrition blunts intellects and saps the productivity and potential of entire societies. Zinc is an essential trace element for the optimal health and growth of humans and is required for the activity of over 200 enzymes involved in major metabolic pathways [8]. Copper is essential for the production of red blood cells, hemoglobin formation and absorption of iron, and for the activity of various enzymes. However, the association between trace elements and Giardiasis has rarely been investigated cognitive function, abnormal immune functions and death. The most important vital elements in the human body are zinc and copper. Zinc is especially vital for the immune system functions and its depletion is associated with decline in lymphocyte and thymus functions. Due to its role in immune system functions, zinc deficiencies make infants suffer from acute diarrhea. Zinc deficiency is another increasing public health problem. Its global prevalence was estimated at 31%, ranging from 473% across developing countries. Zinc deficiency has been found to be caused by poor intake and Malabsorbtion, and has been associated with growth, changes,

impaired cognitive function, abnormal immune functions and death. Copper is essential for producing red blood cells, hemoglobin formation and absorption of iron and for the activity of various enzymes. Copper and zinc are cofactors for cytosolic superoxide dismutase, and their decreasing levels affect on the activity of cytosolic superoxide dismutase. Superoxide dismutase is a metalloenzyme capable of scavenging superoxide radicals by catalyzing their dismutation to reactive oxygen species. Reactive oxygen species can cause peroxidation of lipids leading to damage of permeability, loss of enzyme activity, DNA damage leading to mutagenesis, carcinogenesis and apoptosis of cell [9-11]. The aim of this experiment was comparison of trace elements of zinc and copper between children with Giardiasis and healthy.

Materials and Methods

The study was a lab trial experimental study that carried out between 30 children with Giardiasis and 30 children of control group in the year of 2014. Stool samples were collected in sterile clean stool cups from all volunteers. Examination of fecal samples for detection of *GL* cysts or trophozoites was carried out using the direct wet smear and formol-ether concentration method. Among these volunteers a total of 30 positive individuals for *GL* were enrolled as the study group. The control group consisted of 3-10 age and sex matched healthy volunteers. It was undertaken in both children aged 3 to 10 years without any history of Giardiasis and children with symptomatic Giardiasis after sampling from children with Giardiasis and healthy for separating serum from the blood cells used a tube without any anticoagulant, sterile empty tube. The samples were centrifuged at room temperature; 1500g for 10 minutes and then serum were separated quickly and kept in -70ºC until used. Zinc and copper levels were measured by diagnostics kit and colorimetric endpoint-method. Finally, the data was analyzed using SPSS version 19 statistical software. Chi-square test was used for data analysis of qualitative variables, and values were compared using independent T-test and Mann-Whitney test. Differences were considered significant at p-values of less than 0.05.

Results

Zinc levels in the Giardiasis children group were remarkably lower than the healthy group. In the Giardiasis positive group (p=0.002). The highest serum zinc was 69.77 µg/dl and lowest serum zinc was 68.14 µg/dl in the Giardiasis negative group**,** highest serum zinc was 144.64 µg/dl and lowest serum zinc was 143.31 µg/dl. In contrast to copper levels in the Giardiasis children group were remarkably higher than the healthy group. In the Giardiasis positive group, highest serum copper was 309.99 µg/dl and lowest Serum copper was 308.47 µg/dl in the Giardiasis negative group**,** highest Serum copper was 253.91 µg/dl and lowest serum copper was 252.51 µg/dl and there was a significant difference (p=0.03), (Table 1 and Fig. 1).

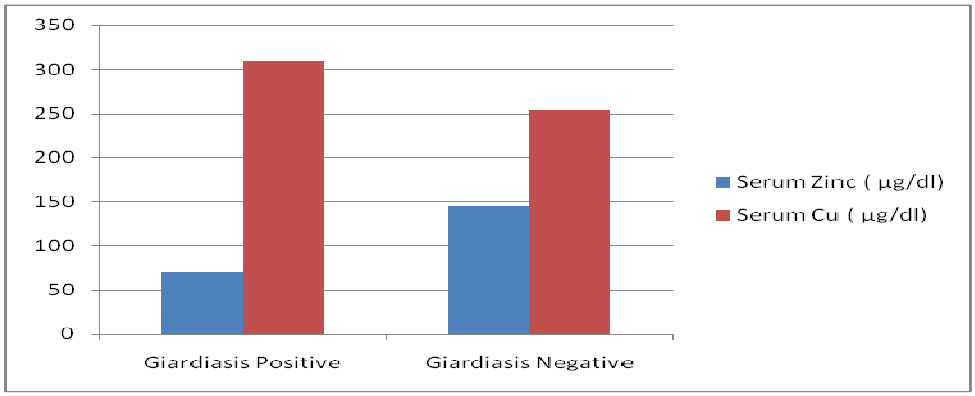

Fig. 1. Mean of serum levels of zinc and copper between children with Giardiasis and healthy.

Table 1. Mean of serum levels of zinc and copper between children with Giardiasis and healthy

Serum zinc (µg/dl)		Serum copper (µg/dl)	
Giardiasis Positive	**Giardiasis Negative**	**Giardiasis Positive**	**Giardiasis Negative**
69.77	144.64	309.99	253.91
69.72	144.60	309.97	253.84
69.67	144.56	309.91	253.78
69.61	144.50	309.85	253.71
69.51	144.48	309.80	253.66
69.45	144.45	309.74	253.61
69.41	144.40	309.71	253.59
69.38	144.35	309.68	253.56
69.34	144.30	309.64	253.51
69.31	144.28	309.60	253.46
69.27	144.20	309.54	253.38
69.16	144.15	309.50	253.35
69.11	144.11	309.44	253.30
69.01	144.09	309.39	253.26
68.91	144.01	309.32	253.20
68.84	143.96	309.28	253.14
68.80	143.90	309.22	253.09
68.78	143.84	309.18	253.01
68.70	143.80	309.12	252.96
68.65	143.77	309.05	252.94
68.60	143.75	308.97	252.93
68.54	143.70	308.91	252.88
68.50	143.66	308.85	252.85
68.45	143.61	308.79	252.81
68.41	143.54	308.72	252.77
68.36	143.49	308.67	252.72
68.30	143.44	308.61	252.67
68.27	143.40	308.56	252.61
68.20	143.36	308.51	252.56
68.14	143.31	308.47	252.51
Mean=68.94	Mean=143.99	Mean =309.27	Mean =253.19
p=0.001		p=0.03	

Discussion

It is estimated that two out of five children are stunted in low-income countries, indicating malnutrition. Zinc deficiency is also a serious public health problem, affecting mostly young children and pregnant women. Growth retardation linked to zinc deficiency in childhood leads to 6-8% loss of productivity in adulthood. The first 2 years of life are very important in the development of children and 60-70% of all childhood deaths are associated to malnutrition [12]. Malnutrition diminishes motivation and development, consequently impairing mental and cognitive abilities. Poverty, one of the causes of malnutrition, is also a consequence, as malnutrition blunts intellects and saps the productivity and potential of entire societies. Zinc is an essential trace element for the optimal health and growth of humans and is required for the activity of over 200 enzymes involved in major metabolic pathways. Elements such as zinc and copper are vital for growth, reproduction and development. They are components of some cellular enzyme; in several immune processes they play an important role in the resistance to free radical damage by stabilizing the cellular membrane. Low serum levels of copper and zinc could cause impairment in cellular and enzymatic functions. Zinc is an element which cannot be stored in the body and therefore it can easily decline in infective diseases. Serum zinc levels were lower during protozoan infections. In addition, elevations of serum copper levels are observed in most of the acute and chronic parasitic infections. In several studies conducted regarding trace elements in Giardiasis has shown a significant decrease in zinc levels while there was an obvious increase in copper levels. In addition, there was a significant increase in copper levels in 59.1% of *Giardia* positive group [13-15]. As it was mentioned above zinc cannot be stored in the body, therefore it could be easily declined in the serum. However, 90% of serum copper is stored in the blood. Copper is essential for the production of red blood cells, hemoglobin formation and absorption of iron, and for the activity of various enzymes. Copper is essential for the production of red blood cells, hemoglobin formation and absorption of iron, and for the activity of various enzymes. However, the association between trace elements and giardiasis has rarely been investigated [16, 17]. Many studies proved the association between Giardiasis zinc and copper levels in human hosts. A consistent change in level of zinc and copper in the blood of children infected with *GL* has been noted by some investigators who have also reported decreased serum levels during Giardiasis.

Conclusion

Our findings indicated that Giardiasis elevated the serum copper levels, while it decreased the serum zinc.

Conflict of Interest

The authors declare that they have no conflict of interest.

Acknowledgements

The authors would like to thank Mrs. Marziyeh Beigom Modares Sanavi for her kind support and assistance.

References

[1]. Markell EK. Examinations of stool specimens. In: Medical Parasitology. Eds, Markell EK and Voge M. Saunders 9th ed. Missouri; 2006.

[2]. Kappus KD, Lundgren RG, Jr, Juranek DD, Roberts JM, Spencer HC. Intestinal parasitism in the United States: update on a continuing problem. Am J Trop medical hygiene. 1994; 50(6):705-13.

[3]. CDC. Giardiasis surveillance - United States, 2006-2008. MMWR Morb Mortal Wkly Rep. 2010; 59(SS06):15-25.

[4]. Gibson RS. Zinc: the missing link in combating micronutrient malnutrition in Developing countries. Proc Nutr Soc. 2006; 65:51–60.

[5]. Welch RM, Graham RD. A new paradigm for world agriculture: meeting human Needs—productive, sustainable, nutritious. Field Crops Res. 1999; 60:1–2.

[6]. Hoddinott J, Maluccio JA, Behrman JR, Flores R, Martorell R. Effect of a nutrition Intervention during early childhood on economic productivity in Guatemalan Adults. Lancet 2008;371:411–16.

[7]. UNICEF. The state of the world's children: focus on nutrition. Oxford; 1998.

[8]. Arbabi M, Esmaili N, Parastouei K, Hooshyar H, Rasti S. Levels of Zinc, Copper, Magnesium Elements, and Vitamin B12, in Sera of Schoolchildren with Giardiasis and Entrobiosis in Kashan, Iran, Zahedan. J Res Med Sci. 2015;15:29-32.

[9]. Culha G, Sangun MK .Serum levels, copper, iron, cobalt, magnesium and selenium elements in children diagnosed with giardia intestinalis and enterobiosis vermicularis in Hatay, Turkey. Biol Trace Elem Res. 2007;118(1):21-6.

[10]. Kilic E, Yazar S, Saraymen R. Responsiveness of total content changes of magnesium and zinc status in patients infected with Giardia intestinalis. Biol Trace Elem Res. 2003; 96(1-3): 153-58.

[11]. Jendrezko A, Sodowska H. Zinc deficiency in children infected with Giardia lamblia. WiadLek 1993; 46(1-2): 32-35.

[12]. WHO. Cameroon nutrition profile; 2010. Available from:URL:http://www.childinfo.org/files/nutrition/DI%20Profile%20-%20Cameroon.pdf

[13]. Olivers JL, Fernandez R, FletaJ, Ruiz MY Clavel A. Vitamin B12 and folic acid in children with intestinal parasitic infection. J Am Coll Nutr. 2002;21(2):109-13.

[14]. Ertan P, Ysereli K, Kurt O, Balcioğlu IC, Onağ A. Serological levels of zinc, copper and iron elements among Giardia lamblia infected children in Turkey. PediatrInt 2002;44(3):286-88.

[15]. Kana Sop MM1, Gouado I, Mananga MJ, Djeukeu Asongni W, Amvam Zollo PH, Oberleas D, et al. Trace elements in foods of children from Cameroon: A focus on zinc and phytate content. J Trace Elem Med Bio 2012; 26(2-3):201-204.

[16]. Iñigo -Figueroa G, Méndez-Estrada RO, Quihui-Cota L, Velásquez-Contreras CA, Garibay-Escobar A, Canett-Romero R, et al. Effects of dietary zinc manipulation on growth performance, zinc status and immune response during Giardia lamblia infection: a study in CD-1 mice. Nutrients. 2013;5(9): 3447-60.

[17]. Azza S. El-Ghareeb, Raniyah H M Shake, Ashraf M.S. Shahin, Neveen T. Abed , Ghada El Bathyony, Zinc Deficiency and Gastrointestinal Parasitic Infections Among Children, Int J Med Health Sci. 2015;(4)1:47-54.