Health Scope. 2017 February; 6(1):e18181. doi: 10.17795/jhealthscope-18181.

Published online 2016 November 8. **Research Article**

Reference Range for Zinc Level in Young Healthy Population in Southeast of Iran

Mohammad Ali Mashhadi,[1,*] Aliraza Bakhshipour,[2] Zahra Zakeri,[1] and Alireza Ansari- Moghadam[1]

[1]Health Promotion Research Center, Zahedan University of Medical Sciences, Zahedan, Iran
[2]Department of Internal Medicine, Ali Ebne Abitaleb Hospital, Zahedan University of Medical Sciences, Zahedan, Iran

[*]*Corresponding author*: Mohammad Ali Mashhadi, Health Promotion Research Center, Zahedan University of Medical Sciences, Zahedan, Iran. Tel: +98-9153411445, Fax: +98-5413411252, E-mail: dralimashhadi@yahoo.com

Received 2014 February 12; **Revised** 2016 July 27; **Accepted** 2016 October 13.

Abstract

Background: There are different controversial reports about Zinc status in healthy and normal population. The aim of this study is to evaluate Zinc status in normal and healthy population.
Methods: This cross-sectional study conducted on 320 subjects aged between 10 - 30 years without any underlying diseases or history of mineral therapy in Zahedan, south east of Iran. Zinc level was measured in all subjects after 12 hours fasting. All blood samples were centrifuged following 45 minutes spontaneous coagulation and then stored at -20°C. Zinc level was measured using graphite furnace atomic absorption spectrometry, Varian, Australia (spectr AA 240fs, 2009, USA).
Results: Of 355 cases, 320 were eligible for the study. Mean age was 15.5 $\pm$ 2.15 years and median age was 16. One hundred twenty cases were male and the others were female (200 cases). Mean BMI was 21.43 $\pm$ 4.15. Mean Zinc level was 100.1 $\pm$ 16 μg/dL. Overall, 2.1% of normal population had Zinc deficiency, 83.3% had normal Zinc status, and 14.6% had Zinc excess.
Conclusions: Our study showed minority of cases had Zinc deficiency, which is different from previous reported results, because the most subjects in this study had normal level of zinc. We recommend further studies on diet in our population. It seems the only reason for the obtained result in this part of Iran with low socioeconomic status may be related to the diets containing high levels of Zinc such as whole grains and dairy products.

Keywords: Zinc, Normal Population, South East, Iran

1. Background

Zinc is a micronutrient element, which has an important role in human growth and development. Zinc is a necessary element in the function of many enzymes, cell division, immune system, synthesis of multiple proteins, and DNA and RNA synthesis (1, 2). Zinc plays a major role in infectious diseases (3, 4). Considering the major role of zinc in growth, development, and immune system, daily usage is mandatory (5). High level of Zinc is found in Oysters, Red meat, poultry, beans, nuts, certain seafood, whole grains, fortified breakfast cereals, and dairy products. Low level of Zinc is found in vegetable, fruits, tea, coffee, rice, and bread (6). Zinc deficiency usually occurs in negative history of Zinc intake or any zinc-containing supplement intake and is commonly related to nutritional deficiency, but sometimes stems from malignant condition, diabetes mellitus, malabsorption, or other chronic illnesses (7, 8). Zinc deficiency is associated with growth retardation, decreased appetite, abnormal sexual function, abnormal wound healing, immune system dysfunction, neurologic abnormality, and predisposing to diseases such as diarrhea and pneumonia (9, 10). Age, gender, and geographic location have major effects on zinc status (11-14). Reference ranges is defined as 70 - 120 μg/dL, while the values lower than 70 μg/dL is defined as zinc deficiency (15). WHO has reported 800000 deaths per year due to Zinc deficiency (7). Zinc deficiency is known to adversely affect health and immunity; however, excessive quantities of zinc intake may lead to both acute and chronic toxicity (16). Countries vary in the rate at which their populations are exposed to zinc deficiency. The first aim of the present study is to evaluate Zinc status especially in terms of Zinc deficiency in south east of Iran with especial socioeconomic status. The second aim is to respond to this important question "how many populations and whom members need to zinc supplement?".

2. Methods

This cross sectional study was carried out on healthy population in 2011 - 2012 in Zahedan; south east of Iran. The study was approved by ethics committee of Zahedan University of medical sciences. We calculated sample size according to previous studies. Total eligible cases were 320 subjects aged 10 - 30 years. They were selected from 6 postal area of Zahedan city using probability sampling. First, we divided the city into six postal areas. Then, we selected two

zones from each area and a maximum of 30 people from each zone. Finally, we selected the subjects randomly from each zone using a list of names.

Inclusion criteria were healthy subjects without heart and liver diseases, gastrointestinal disease, diabetes mellitus, hemolytic anemia, malignancy, opium addiction, smoking, pregnancy, special diet, and supplement consumption during 6 months ago. Informed written consent was obtained from all participants and their parents. Briefly, weight was measured while participants wore light clothes without shoes, using digital scales, and recorded to the nearest 100 g. The height was measured in standing position without shoes, using a tape meter, while the shoulders were in normal state. BMI was calculated as weight (in kilograms) divided by height (in meters) squared. For ages lower than 18 years, Waterlow and Gomez indices were used (17, 18).

A blood sample was taken after 12 to 14 hours of overnight fasting. All blood analyses were stored at -20 degree of centigrade until measurement using graphite furnace atomic absorption spectrometry, Varian, Australia (spectr AA 240fs, 2009, USA) in Razavi hospital of Mashhad University of Medical Sciences. The normal range of serum Zinc level according to this instrument was 70 - 125 μg/dL. In this study, subjects with serum level lower than 70 μg/dL and higher than 125 μg/dL were defined as Zinc deficiency and Zinc excess, respectively.

Statistical analyses were conducted using SPSS 15.0. Continuous variables were presented as mean and standard deviation. An independent sample t-test, ANOVA or Mann-Whitney U-test were used to assess significance of differences for continuous variables. P-values (two-sided) < 0.05 were considered significant.

3. Results

All 355 cases over 10 years old with healthy condition entered the study. Totally, 320 cases were eligible and evaluated for Zinc status. The age of participants ranged between 10 and 30 years. Mean age was 15.5 $\pm$ 2.15 years and median age was 16. About 37.5 % (120 cases) of subjects were male and 62.5% (200 cases) were female. Mean BMI was 21.43 $\pm$ 4.15 kg/m^2 (ranged 13.69 - 33.75 kg/m^2). Mean Zinc level was 100.1 $\pm$ 16 μg/dL (ranged 62 - 155 μg/dL). In male and female subjects, mean of serum zinc level was 101.46 $\pm$ 16.8 μg/dL and 99.13 $\pm$ 15.77 μg/dL, respectively (P value = 0.213). In male cases, 1.6% (2 cases) showed zinc deficiency, 89.1% (107 cases) were in normal range, and 9.1% (11 cases) had zinc excess. In female group, 0.5% (1 case) had Zinc deficiency, 94% were in normal range, and 5.5% (11cases) had Zinc excess. Mean zinc status according to BMI was 100.01 $\pm$ 16.1 μg/dL with non-significant P-value (0.321). In this study, mean Zinc level did not show significant correlation with age, sex, and BMI (P value $>$ 0.05) (Tables 1 and 2).

Table 1. Zinc Status in Healthy Cases in Zahedan City in 2012 Based on Their Zinc Level, Gender, and BMI

Zinc status, μg/dL	Deficiency < 70	Normal, -12570	Excess, > 125
Mean Zinc level	65.4 $\pm$ 2.94	96.43 $\pm$ 6.5	132.3 $\pm$ 8.43
Sex, No. (%)			
Male	2 (1.6)	107 (89.3)	11 (9.1)
Female	1 (0.5)	188 (94)	11 (5.5)
Mean Zinc level			
Male	67.1 $\pm$ 1.1	89.1 $\pm$ 6.4	130.1 $\pm$ 5.5
Female	62 $\pm$ 0	87.7 $\pm$ 9.6	134.4 $\pm$ 10.4
Mean BMI	25.3 $\pm$ 2.68	21.5 $\pm$ 4.18	23.3 $\pm$ 5.02

4. Discussion

This cross sectional study conducted on 320 cases from normal population showed low prevalence (2.1%) of Zinc deficiency; the majority of cases had normal status of zinc, and the minority had zinc excess. literature review for Zinc level in normal population showed that many studies have reported different status for zinc from normal to severe deficiency (19-21).

In study of Hettiarachchi and coworkers (19), the prevalence of Zinc deficiency was much higher than that of our study. In their study in female and male groups, Zinc deficiency was 58.3% and 51.5%, respectively. In another study (20), the prevalence of Zinc deficiency was 38.2% with similar sex prevalence. In a study carried out in southwest of Iran (21), the prevalence of Zinc deficiency was higher than that of the present study, so that serum Zinc level was 68.4-205 μg/dl with the mean value of 103.60 μg/dL. Zinc deficiency rate in males and females was 57.7% and 57.4%, respectively. These values were not significantly different. Age, sex, and BMI did not show significant relationships with the prevalence rate.

In our study, the mean serum zinc in males was higher than females without a significant difference, which is in agreement with the results of other studies (21-24). Only 2 studies reported higher mean zinc concentrations in female than male cases (25, 26). In other study, the prevalence of zinc deficiency was 31% (27). In study of Hashemi and coworkers, the prevalence of Zinc deficiency was 47.1% (24). In another study on female cases, the incidence of Zinc deficiency was reported as 7.1% (28). Dehghani (29) and coworkers reported the prevalence of zinc deficiency

Table 2. Association Between Age Distribution and Mean Zinc Level in Healthy Cases in Zahedan City in 2012

Age, y	10 - 14	15 - 19	20 - 30	P-Value
Number of cases	98	214	8	
Mean Zinc level, μg/dL	97.9 $\pm$ 16.17	102.09 $\pm$ 15.99	94.9 $\pm$ 16.52	0.22

much lower than the prevalence reported in other studies, although in comparison with our study, they revealed much more prevalence rate for zinc deficiency. In Dehghani et al. study, mean zinc level was 122.3 $\pm$ 55 μg/dL. Zinc status did not show statistical relation to BMI, sex, and age. Study of prevalence of Zinc deficiency in other parts of Iran has revealed different rates such as 28%, 30.1%, and 85.5% (27, 30, 31). One of the main reasons for different reported rates in all around the world may be related to zinc concentration in soil. Excessive supplement therapy, diet, and various cut-of point of zinc level could be other possible reasons. Consumption of large amount of phytate has had a relationship with high prevalence of zinc deficiency (32).

4.1. Conclusion

Serum Zinc in many studies has been in low levels, and also mild to moderate Zinc deficiency has been reported as the most common finding in healthy population. However, the present study showed approximately all cases of healthy population had normal Zinc status. This important finding is the clue of an important question about time and number of cases who need to Zinc supplement therapy. Our study showed that no Zinc supplement is required for the study population, although more studies are needed to recognize the role of diet in zinc status in this part of Iran.

Acknowledgments

This study was supported by research deputy of Zahedan University of Medical Sciences. We would like to thank the families who participated in this study.

References

1. Prasad AS. Zinc: an overview. *Nutrition.* 1995;**11**(1 Suppl):93–9. [PubMed: 7749260].
2. Malave I, Rodriguez J, Araujo Z, Rojas I. Effect of zinc on the proliferation response of human lymphocytes: mechanism of its mitogenic action. *Immunopharmacol.* 1990;**20**(1):1–10.
3. IZA . Zinc and human health recent scientific advances and implications for public health programs conclusions of the international conference Stockholm. 2009; .
4. Prasad AS. Zinc and immunity. *Mol Cell Biochem.* 1998;**188**:63–9. doi: 10.1023/A:1006868305749.
5. Rink L, Gabriel P. Zinc and the immune system. *Proc Nutr Soc.* 2000;**59**(4):541–52. [PubMed: 11115789].
6. Castillo-Duran C, Weisstaub G. Zinc supplementation and growth of the fetus and low birth weight infant. *J Nutrit.* 2003;**133**(5):1494S–7S.
7. IZA . Zinc for better health. 2009
8. Caulfield LE, Black RE. In: Comparative quantification of health risks: Global and regional burden of disease attributable to selected major risk factors. Ezzati M, Lopez AD, Rodgers A, Murray CJL, editors. World Health Organization; 2004.
9. Maret W, Sandstead HH. Zinc requirements and the risks and benefits of zinc supplementation. *J Trace Elem Med Biol.* 2006;**20**(1):3–18. doi: 10.1016/j.jtemb.2006.01.006. [PubMed: 16632171].
10. Radja N, Charles-Holmes R. Acrodermatitis enteropathica - lifelong follow-up and zinc monitoring. *Clin Exp Dermatol.* 2002;**27**(1):62–3. [PubMed: 11952674].
11. Hambidge M. Human Zinc deficiency. *J Nutrit.* 2000;**130**:1344–9.
12. Lachili B, Faure H, Arnaud J, Richard MJ, Benlatreche C, Favier A, et al. Blood micronutrients in Algeria, relationships with sex and age. *Int J Vitam Nutr Res.* 2001;**71**(2):111–6. doi: 10.1024/0300-9831.71.2.111. [PubMed: 11339107].
13. Bureau I, Anderson RA, Arnaud J, Raysiguier Y, Favier AE, Roussel AM. Trace mineral status in post menopausal women: impact of hormonal replacement therapy. *J Trace Elem Med Biol.* 2002;**16**(1):9–13. doi: 10.1016/S0946-672X(02)80003-7. [PubMed: 11878754].
14. Robberecht H, Deelstra H. Factors influencing blood selenium concentration values: a literature review. *J Trace Elem Electrolytes Health Dis.* 1994;**8**(3-4):129–43. [PubMed: 7599503].
15. Smith JC Jr, Butrimovitz GP, Purdy WC. Direct measurement of zinc in plasma by atomic absorption spectroscopy. *Clin Chem.* 1979;**25**(8):1487–91. [PubMed: 455691].
16. Fraga CG. Relevance, essentiality and toxicity of trace elements in human health. *Mol Aspects Med.* 2005;**26**(4-5):235–44. doi: 10.1016/j.mam.2005.07.013. [PubMed: 16125765].
17. Gomez F, Ramos Galvan R, Frenk S, Cravioto M, Chavez R. Mortality in second and third degree malnutrition. *Bull World Health Organ.* 1956;**78**.
18. Waterlow JC. Evolution of kwashiorkor and marasmus. *The Lancet.* 1974;**304**(7882):712.
19. Hettiarachchi M, Liyanage C, Wickremasinghe R, Hilmers DC, Abrahams SA. Prevalence and severity of micronutrient deficiency: a cross-sectional study among adolescents in Sri Lanka. *Asia Pac J Clin Nutr.* 2006;**15**(1):56–63. [PubMed: 16500879].
20. Liu J, Ai Y, Hanlon A, Shi Z, Dickerman B, Compher C. Micronutrients deficiency and associated sociodemographic factors in Chinese children. *World J Pediat.* 2011;**7**(3):217–23.
21. Dabbaghmanesh MH, Taheri Boshrooyeh H, Kalantarhormozi MR, Ranjbar Omrani GH. Assessment of zinc concentration in random samples of the adult population in shiraz, iran. *Iran Red Crescent Med J.* 2011;**13**(4):249–55. [PubMed: 22737474].
22. Diaz Romero C, Henriquez Sanchez P, Lopez Blanco F, Rodriguez Rodriguez E, Serra Majem L. Serum copper and zinc concentrations in a representative sample of the Canarian population. *J Trace Elem Med Biol.* 2002;**16**(2):75–81. [PubMed: 12195729].
23. de Mateo Silleras B, Perez Garcia A, Mijan de la Torre A. [The zinc status in a selected Spanish population. A multivariate analysis]. *Nutr Hosp.* 2000;**15**(1):32–41. [PubMed: 10740404].

24. Hashemi F, Jalilvand A, Hakimi SM, Nourmohammadi I. Assessment of zinc levels in serum samples from personnel of Firouzgar hospital by atomic absorption spectrometry (AAS). *Razi J Med Sci.* 2006;**12**(49):173–82.
25. Schuhmacher M, Domingo JL, Corbella J. Zinc and copper levels in serum and urine: relationship to biological, habitual and environmental factors. *Sci Total Environment.* 1994;**148**(1):67–72.
26. Boonsiri P, Pooart J, Tangrassameeprasert R, Hongsprabhas P, Khampitak T, Yongvanit P. Serum vitamin A and zinc levels of healthy people in northeast Thailand. *Clin Chim Acta.* 2006;**373**(1-2):132–8. doi: 10.1016/j.cca.2006.05.020. [PubMed: 16806137].
27. Mahmoodi MR, Kimiagar SM. Prevalence of zinc deficiency in junior high school students of Tehran City. *Biol Trace Elem Res.* 2001;**81**(2):93–103. doi: 10.1385/BTER:81:2:093. [PubMed: 11554399].
28. Haghollahi F, Ramezanzadeh F, Norouzi M, Shariat M, Mahdavi A, Foroshani A, et al. Zinc deficiency in first year female students of Tehran university of medical sciences. *J Family Reproduct Health.* 2008;**2**(2):81–6.
29. Dehghani SM, Katibeh P, Haghighat M, Moravej H, Asadi S. Prevalence of zinc deficiency in 3-18 years old children in shiraz-iran. *Iran Red Crescent Med J.* 2011;**13**(1):4–8. [PubMed: 22946012].
30. Shrifi F, Hedayati SM, Mirmiran P. Serum level of zinc, copper and iron in the high school children of 23 provinces of Iran. 1999
31. Bekheirnia M, Shamshirsaz A, Kamgar M, Bouzari N, Erfanzadeh G, Pourzahedgilani N, et al. Serum zinc and its relation to bone mineral density in β-thalassemic adolescents. *Biol Trace Element Res.* 2004;**97**(3):215–24.
32. Ferguson EL, Gibson RS, Opare-Obisaw C, Ounpuu S, Thompson LU, Lehrfeld J. The zinc nutriture of preschool children living in two African countries. *J Nutr.* 1993;**123**(9):1487–96. [PubMed: 8395593].