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Prevalence of Zinc Deficiency in Obese Adults with Increased Appetite in Shiraz, Iran

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Abstract

Background: *Low serum zinc concentration is associated with obesity, and its deficiency has been linked to many pathogenesis aspects of obesity. The present study was designed to evaluate the prevalence of zinc deficiency in the obese adults with increased appetite in Shiraz, Fars province, south of Iran. Furthermore, we aimed to evaluate the serum zinc correlation with some demographic and anthropometric indices.*

Methods: *In this study, 260 adults with the ages ranged from 25 to 55 years old were selected for serum zinc concentration. Age, sex, job, education level, physical actively, weight, height, body mass index (BMI), waist circumference (WC), hip circumference (HC), and waist to hip ratio (WHR) were also recorded for each participants. Using calorimeter method, we considered the serum level of zinc less than 70µg/dL as deficient.*

Results: *Mean serum level of zinc was 96.37 ± 18.24 µg/dL. The prevalence rate of zinc deficiency was 8%, which was more prevalent among female participants than male ones with no significant difference (9.8% and 4.6%, respectively, Pvalue = 0.14). The participants' characteristics were not statistically different between normal and deficient groups, and serum zinc concentration had no correlation with age, sex, height, weight, BMI, WC, HC, and WHR.*

Conclusions: *Zinc deficiency in obese adults living in Shiraz is as prevalent as other population groups, and also other regions of Iran. Zinc deficiency is considered as a possible risk factor for obesity-related diseases, and requires more investigations.*

Keywords: Zinc, Deficiency, Prevalence, Obesity, Iran.
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Introduction

Obesity is recognized as a major public health problem, which has approached epidemic proportions globally. Obesity and excess abdominal fat are considered as the risk factors for a broad range of chronic diseases such as hypertension, type 2 diabetes mellitus, cardiovascular disease, and cancer, which all of them are considered as the major causes of mortality worldwide.[1-3] The burden of these diseases is now becoming a serious problem in developing countries, including the middle east countries.[4,5]

Recent evidence has revealed that obesity is associated with a state of zinc deficiency (ZD), and obese individuals appear to have lower serum zinc levels.[6,7] Zinc is an essential trace element playing a prominent role in human nutrition for normal growth and survival. Zinc is found in all parts of the human body, and is necessary for the function of many enzymes, cell division, proteins synthesis, wound healing, immune system, regulation of cytokines, and appetite.[8-10]

Different studies have shown a relation between lower serum zinc levels and a pathophysiological role in many diseases, due to catalytic, structural, and regulatory effects of this element. Estimation suggests that 46% of the Middle East population is under the risk of zinc deficiency.[11,12] Zinc deficiency is involved in the pathogenesis of obesity-related processes, and has been implicated in altered lipid markers, insulin resistance, oxidative stress, inflammatory markers, adiposity, serum leptin level, and hypertension6.[13,14]

To the best of our knowledge, despite these lines of evidence that emphasize on the importance of zinc nutritional status in obesity state, there is no information about the prevalence of zinc deficiency among obese people in Iranian population. Therefore, we aimed to evaluate the prevalence of zinc deficiency in obese or overweight individuals in Shiraz, Fars province, south of Iran.

Materials and Methods

This is an analytical cross-sectional study conducted from June to September 2018. According to the results of a previous study,[15] the sample size for estimating the mean serum zinc concentration was calculated to be 252 individuals. Inclusion criteria were the age ranged from 25 to 55 years old, body mass index (BMI) > 30 Kg/m^2, appetite questionnaire score of > 20, consuming no vitamin and mineral supplements over the past 2 months, using no weight loss products or diet, absence of liver, kidney, thyroid, diabetes, AIDS and other metabolic diseases, no using any lipid lowering, blood-thinning, and beta-blocker drugs. Exclusion criteria included failure to fill out the questionnaires and lack of willingness to donate the blood sample.

The study participants were selected using voluntary sampling method from those people who were referred to the nutrition ward of Imam Reza clinic in Shiraz, Iran (associated to SUMS). According to the inclusion and exclusion criteria of the study, the eligibility of the participants was fully reviewed in an interview. After screening, 260 adults were found to be eligible for participating in this study.

All data were collected by trained researchers and all participants were provided with clear instructions. Measurements were performed on entry and 3 months after the intervention. Demographic information was collected through questionnaires. Height was measured to the nearest 0.5 cm, and weight to the nearest 0.1 kg, without shoes and light clothes. BMI was calculated as weight divided by the square of height. Waist circumference (WC) was measured at the level of the iliac crest, and hip circumference (HC) was measured as maximum circumference of the hip area. Also, Waist to hip ratio (WHR) was calculated as WC divided by the HC.

After 12 hours of fasting, blood samples (10 mL) were collected, separated by centrifugation at 3000 rpm for 10 minutes, and stored at -70ºC. Serum zinc concentration was estimated using atomic absorption spectrometry (calorimeter) (chem tech analytical, CTA 2000, English). Zinc concentration less than 70 µg/dL was considered as deficiency value.[16]

Data were analyzed using SPSS statistical analysis software (version 16:0, Shikagho.IL, USA), and in all analyses, significant level was set at 0.05. Quantitative data were stated as mean ± standard deviation (SD), and qualitative data were presented as frequency (percentage). The difference between the zinc deficient and normal groups was assessed using independent t-test. In addition, chi-square test was used to examine the differences among the qualitative variables in both groups. Pearson correlation coefficient was used to study the correlation of zinc with age, weight, BMI, WC, HC, and WHR.

The protocol of the study was approved by the ethics committee of Shiraz university of medical sciences (SUMS), and it was registered with the code of ethics of IR.SUMS.REC.1396.S918. After full explanation about the study objectives, a written informed consent was obtained from the participants. The principle of privacy and confidentiality was observed. Also, Participants could resign at each stage of the research.

Results

260 participants entered the survey (34.8% male and 65.2% female) with the age range of 40.02 ± 9.22 years old, and BMI of 32.9 ± 3.57 kg/m^2. The mean serum zinc concentration in all participants was 96.37 ± 18.24 µg/dl, ranging from 56 to 140 µg/dL. In male participants, this value was 97.18 ± 17.88 µg/dl, and in females was 95.94 ± 18.47 µg/dl. Regarding the gender, there was no significant difference in the serum zinc concentration (Pvalue = 0.61).

The prevalence rate of zinc deficiency was defined as serum zinc concentration less than 70 µg/dl, which was 8% in all participants. Zinc deficiency was observed among 4.6% of males and 9.8% of females, and no significant difference was seen between genders (Pvalue = 0.14). Tables 1 and 2 show the characteristics of the participants grouped according to their zinc status.

Table 1. Participants characteristics based on their zinc status

Variable	Normal (n= 240)	Deficient (n=20)	Pvalue
Sex (number) (%)			
−Female	(147) (58.8)	(4) (6.4)	0.14
−Male	(83) (33.2)	(16) (1.6)	
Age (years)	40.37 ± 9.00	36.70 ± 9.98	0.08
Weight (kg)	90.64 ± 13.83	90.93 ± 9.61	0.92
BMI (kg/m^2)	32.78 ± 3.50	34.01 ± 3.35	0.14
WC (cm)	112.54 ± 11.90	109.17 ± 14.99	0.25
HC (cm)	113.82 ± 13.56	114.97 ± 10.54	0.72
WHR	1.05 ± 0.81	0.94 ± 0.10	0.55
Serum zinc (µg/dl)	99.26 ±16.01	63.20 ± 3.44	<0.01

Abbreviations. BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio

Table 3 shows unadjusted Pearson's correlation coefficients of serum zinc with another variable. No significant correlation was observed between the serum zinc and anthropometrical indices.

As presented in Table 4, a multiple regression analysis was run to predict the level of the serum zinc. These variables statistically significant predicted the serum zinc (F = 2.868, Pvalue = 0.002, R^2 = 0.137). A significant positive relationship was reported between the serum zinc with HC (Pvalue = 0.022); therefore, one centimeter elevated HC was related to increased 0.464 µg/dl of serum zinc (unstandardized β-coefficients = 0.464).

Table 2. Demographical characteristics of the patients based on their zinc status

Variable	Normal (n= 240)	Deficient (n=20)	Pvalue
Education status (number) (%)			
−Middle school	12.8%	1.2%	0.38
−Diploma	21.6%	1.6%	
−BA	12.4%	1.2%	
−BS	28.0%	1.6%	
−MSc	12.4%	2.4%	
−PhD	4.8%	0.0%	
Work status (number) (%)			
−Housekeeper	38.4%	2.4%	0.01
−Clerk	23.2%	3.2%	
−Self-employment	16.0%	0.4%	
−University Student	6.8%	2.0%	
−Retired	7.6%	0.0%	
PAL (number) (%)			
− Light	51.6%	3.2%	0.26
−Moderate	33.6%	4.4%	
−High	6.8%	0.4%	

Abbreviations. BMI, body mass index; BA, Bachelor of education; BS, Bachelor of science; MSc, master of science; PhD, doctor of philosophy; PAL, physical activity levels

Table 3. Correlation of serum zinc with age and anthropometrical indices

Variable		Age	Weight	WC	BMI	HC	WHR
Serum zinc (µg/dl)	r	0.077	-0.033	0.050	-0.094	0.051	-0.039
	Pvalue	0.25	0.60	0.43	0.15	0.42	0.54

Abbreviations. BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio

Table 4. Results of multiple linear regression for the relationship between patients' characteristics and serum zinc

Variables	Unstandardized β-coefficients	Standardized β-coefficients	Pvalue	R^2 for multiple model
SEX	-6.991	-0.185	0.08	
Age (years)	0.230	0.115	0.13	
Weight (kg)	0.857	0.504	0.62	
Height (cm)	-1.386	-0.705	0.46	
BMI (kg/m^2)	-4.728	-0.717	0.30	
WC (cm)	0.036	0.024	0.83	0.137
HC (cm)	0.464	0.356	0.02	
WHR	4.508	0.212	0.11	
Education	1.628	0.128	0.12	
Job	-1.679	-0.121	0.13	
Activity	-1.198	-0.041	0.55	

Abbreviations. BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio

Discussion

The findings of our study demonstrated that the mean serum zinc concentration was 96.37 ± 18.24 µg/dL. In different studies performed on Iranian population, serum zinc concentrations have been reported to be about 95.2 ± 177µg/dL in Tehran city,[17] and 87.7 ± 32µg/dL in Birjand city.[18] In the present study, serum zinc concentration was lower in females than in males with no statistically significant difference (Pvalue = 0.61). Mahmoodi et al. in their study, reported the same conclusion.[17] However, the results of another investigation are in contrast with those of our study.[19,20]

Various data has been reported about zinc deficiency prevalence in different studies in Iran; in the present study, the prevalence rate of zinc deficiency was 8%, and serum zinc concentration less than 70µg/dl was considered to be deficient.cutoff point less than 85 µg/dL. In another study conducted by Dabbaghmanesh et al. on a random sample of the adult population in Shiraz in 2011, approximately 42.5% of cases had zinc deficiency.[20] In the earlier mentioned study, zinc concentration under the 100 µg/dL in the serum was considered as deficient.

The cutoff point for serum zinc deficiency was ranged from 70 to100 µg/dL in different studies. As observed, different values for zinc deficiency are reported, and selecting different population, sampling method, geographical region, and cutoff points for determining the prevalence rate of zinc deficiency could be the reasons for this variation.

In the present study, there was no significant relationship between sex and serum zinc level; however, zinc deficiency was slightly more prevalent among female participants (9.8% compared to 4.6% in males) (Pvalue = 0.14). This is not compatible to what Arvanitidon et al. in Greece and Ohtake et al. in Japan reported.[21,22] Differences in serum zinc levels in different regions of the world can be attributed to the soil zinc concentrations; however, Qin et al. in 2009 found that the prevalence of zinc deficiency was not significantly correlated with the low soil zinc concentrations.[23] Another conceivable contributor to this disparity in findings can be considered to be the differences in dietary intake, supplementation with zinc in some areas along with different soil zinc levels, and cutoff point of serum zinc level considered as deficient. Moreover, different intakes of phytate relative to zinc between males and females, have been suggested as an explanation for this dissimilarity in zinc deficiency.[24]

In our study, no significant correlation was found between the serum zinc and age, weight, WC, BMI, HC, and WHR. Costa et al. in Brazil, reported no significant correlation between zinc, weight or BMI.[25] Such a finding (no significant correlation between the values of anthropometrical measurements and zinc concentrations) is similar to that of some studies in this field,[19,26] and also in contrast with that of another study.[27]

The results of this study provided evidence for the existence of zinc deficiency among obese adults in Shiraz city, and we concluded that zinc deficiency in those obese adults living in Shiraz is as prevalent as other population groups and regions of Iran, as well zinc deficiency is not correlated with anthropometric indices in this area. Zinc, as a trace element, plays an important role in human health, and its deficiency results in undesirable effects in clinical outcomes. Thus, it seems that using the methods like food fortification with a high level of absorbable zinc, is recommended for eliminating zinc deficiency. Furthermore, it seems that designing comprehensive studies are required to determine a precise cutoff point for estimation of zinc deficiency prevalence among obese people.

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Conflict of Interest

The author declares that she has no conflicting interest.

References

1. Wadden TA, Bray GA. Handbook of obesity treatment. 2nd ed. Guilford Publications. New York London; 2018.
2. Hall ME, Wang Z, do Carmo J, Kamimura D, Hall JE. Obesity and metabolic syndrome hypertension. Disorders of Blood Pressure Regulation: Springer; 2018. p. 705-22.
3. Upadhyay J, Farr O, Perakakis N, Ghaly W, Mantzoros C. Obesity as a disease. Medical Clinics 2018;102:13-33.
4. Poobalan A, Aucott L. Obesity among young adults in developing countries: a systematic overview. Current obesity reports 2016;5:2-13.
5. Seidell JC, Halberstadt J. The global burden of obesity and the challenges of prevention. Ann Nutr Metab 2015;66:7-12. doi:10.1159/000375143
6. Liu MJ, Bao S, Bolin ER, Burris DL, Xu X, Sun Q, et al. Zinc deficiency augments leptin production and exacerbates macrophage infiltration into

adipose tissue in mice fed a high-fat diet. J Nutr 2013;143:1036-45. doi:10.3945/jn.113.175158

7. Herter-Aeberli I, Thankachan P, Bose B, Kurpad AV. Increased risk of iron deficiency and reduced iron absorption but no difference in zinc, vitamin A or B-vitamin status in obese women in India. Eur J Nutr 2016;55:2411-21. doi:10.1007/s00394-015-1048-1

8. Sallé A, Demarsy D, Poirier AL, Lelièvre B, Topart P, Guilloteau G, et al. Zinc deficiency: a frequent and underestimated complication after bariatric surgery. Obes Surg 2010;20:1660-70. doi:10.1007/s11695-010-0237-5

9. Xanthakos SA. Nutritional deficiencies in obesity and after bariatric surgery. Pediatr Clin North Am 2009;56:1105-21. doi:10.1016/j.pcl.2009.07.002

10. Sánchez A, Rojas P, Basfi-fer K, Carrasco F, Inostroza J, Codoceo J, et al. Micronutrient deficiencies in morbidly obese women prior to bariatric surgery. Obes Surg 2016;26:361-8. doi:10.1007/s11695-015-1773-9

11. Wessells KR, Brown KH. Estimating the global prevalence of zinc deficiency: results based on zinc availability in national food supplies and the prevalence of stunting. PLoS One 2012;7:e50568. doi:10.1371/journal.pone.0050568

12. Hwalla N, Al Dhaheri AS, Radwan H, Alfawaz HA, Mona A, Fouda M, et al. The prevalence of micronutrient deficiencies and inadequacies in the middle east and approaches to interventions. Nutrients 2017;9:229. doi:10.3390/nu9030229

13. Maares M, Haase H. Zinc and immunity: An essential interrelation. Arch Biochem Biophys 2016;611:58-65. doi:10.1016/j.abb.2016.03.022

14. Bonaventura P, Benedetti G, Albarède F, Miossec P. Zinc and its role in immunity and inflammation. Autoimmunity reviews 2015;14:277-85. doi:10.1016/j.autrev.2014.11.008

15. Farsani GM, Zabetian Targhi F, Pishgahroudsari M, Mokhber S, Pazouki A. High prevalence of zinc deficiency in Iranian morbid obese patients undergoing bariatric surgery. Journal of Minimally Invasive Surgical Sciences 2015;4:e33347. doi:10.17795/minsurgery-33347

16. Mashhadi MA, Bakhshipour A, Zakeri Z, Ansari-Moghadam A. Reference range for zinc level in young healthy population in southeast of Iran. Health Scope 2016;6. doi:10.17795/jhealthscope-18181

17. Mahmoodi MR, Kimiagar SM. Prevalence of zinc deficiency in junior high school students of Tehran City. Biol Trace Elem Res 2001;81:93-103. doi:10.1385/BTER:81:2:093

18. Fesharakinia A, Zarban A, Sharifzadeh GR. Prevalence of zinc deficiency in elementary school children of South Khorasan Province (East Iran). Iranian Journal of Pediatrics 2009;19:249-54.

19. 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 Journal of Medical Sciences 2006;12:173-82.

20. 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;13:249-55.

21. Arvanitidou V, Voskaki I, Tripsianis G, Athanasopoulou H, Tsalkidis A, Filippidis S, et al. Serum copper and zinc concentrations in healthy children aged 3–14 years in Greece. Biol Trace Elem Res 2007;115:1-12. doi:10.1385/BTER:115:1:1

22. Ohtake M, Tamura T. Serum zinc and copper levels in healthy Japanese children. Tohoku J Exp Med 1976;120:99-103. doi:10.1620/tjem.120.99

23. Qin Y, Melse-Boonstra A, Zhao J, Wu M, Hu X, Kok FJ. Stunting and zinc deficiency among primary school children in rural areas with low soil zinc concentrations in Jiangsu province, China. Asia Pac J Clin Nutr 2009;18:15-21.

24. 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;123:1487-96. doi:10.1093/jn/123.9.1487

25. da Costa GA, do Nascimento Marreiro D, Eulálio JM, Neto JM, Amorim AC, Nogueira AM, et al. Erythrocytary zinc and the infant growth profile in northeast Brazil. Biol Trace Elem Res 2008;126:S15-20. doi:10.1007/s12011-008-8213-9

26. Abiaka C, Olusi S, Al-Awadhi A. Reference ranges of copper and zinc and the prevalence of their deficiencies in an Arab population aged 15-80 years. Biol Trace Elem Res 2003;91:33-43. doi:10.1385/BTER:91:1:33

27. Sánchez C, López-Jurado M, Planells E, Llopis J, Aranda P. Assessment of iron and zinc intake and related biochemical parameters in an adult Mediterranean population from southern Spain: influence of lifestyle factors. J Nutr Biochem 2009;20:125-31. doi:10.1016/j.jnutbio.2007.12.008