Zinc Deficiency in First Year Female Students of Tehran University of Medical Sciences

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Abstract

Objective: Zinc deficiency is an important health problem in developing countries. The aim of this study was diagnosis of zinc deficiency among young female students of Tehran University of Medical Sciences.

Materials and methods: This cross sectional study evaluated 420 medical and paramedical students of Tehran University in 2005. All of them were female and in the first year of their education. Serum concentrations of zinc were measured by enzymatic method students in whom had sufficient criteria to enroll in the study. Zinc concentration more than 85 µ/dl was considered as normal value. Concentration less than 50 µ/dl was defined as severe zinc deficiency. Mild and moderate deficiencies were described as zinc levels between 50 to 85 µ/dl. Analysis was performed by t-test, chi-square and ANOVA using SPSS software.

Results: Zinc deficiency was found in 7.1% of the participants. In women with body weights between 50.1-60 kg, zinc deficiency was less than patients with body weight of ≤ 50 Kg (p=0.04). In zinc deficient group acne was observed more frequently (p=0.01). Also anemic participants (Hb<12) had lower zinc level than non anemic women (Hb≥12) (p=0.001).

Conclusion: This study found severe and mild to moderate zinc deficiency in 1.4% and 5.7% of female students, respectively. Zinc deficiency is common in anemic students. Zinc supplementation is recommended in anemic patients and in cases of confirmed zinc deficiency.

Key Words: Zinc deficiency, Nutrition, Acne, BMI, Zinc

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Introduction

Zinc is a trace mineral with widespread roles to sustain human health. It is a component of many enzymes and is involved in cellular division (DNA and protein synthesis), insulin activation, metabolism of ovarian and testicular hormones, liver function, behavioral development, learning, wound healing, heavy metal (e.g. lead) poisoning protection, eye accommodation and regulation of taste sensation. Also it is important in energy production, protein, carbohydrate and fat metabolism. Zinc is found in almost all body fluids and tissues. Approximately every human being contains 2 grams of this element, distributing 60% in skeletal muscles and 30% (100-200 mg) in the bone mass. High concentrations are seen in retina (274 mg/gr) and prostatic fluid (300-500mg/l). Zinc is mainly excreted in the stool (0.5-3 mg/ day, depending on its intake) and in a lesser degree in the urine, skin, seminal fluid, menstrual blood, hair and nail (1, 2). There is not a specific organ for zinc reserve, so its daily intake is needed. Dietary fibers and phytates have inhibitory effect on zinc absorption (only 20% of the dietary zinc is absorbed), so its deficiency is more common in regions with high consumption of rice and unleavened bread (1, 2).

High levels of cadmium, phosphates and ethylene-diamine-tetra-acetic acid (EDTA) in fast foods could decrease zinc concentration in plasma (2). Dietary phytates, iron supplements, gastrointestinal disorders, cigarette smoking and chronic stress could decrease serum zinc concentration (2). Daily intake of 350 µg folate decreases zinc absorption (2, 3).

Clinical signs of zinc deficiency include reduced immune system activity, skin disorders, hair loss, diarrhea, fatigue, delayed wound healing, and decreased brain development in neonates, learning difficultties and infertility. Regular daily need for men and women is at least 15 mg and 12 mg, respectively. Severe zinc deficiency adversely affects the pregnancy outcome, and results in prolonged labor, intra uterine growth retardation and fetal demise (4-7). Severe zinc deficiency could result in growth retardation, delayed puberty and behavioral disturbances (8, 9). Serum zinc is a good determinant for predicting the zinc level of the body; it ranges from 10.7 µmole/l (70 µg/dl) to 15.3 µmole/l (150 µg/dl) in adults (10).

In some studies mild to moderate deficiencies are defined as 50-85 µg/dl (10-12). Due to high phytate diets in Iran zinc deficiency is expected to be high. According to a study conducted in Zahedan, zinc deficiency was 42.8% in teen girls and 49% in pregnant women (13). In a study in Tehran, its prevalence was 65% in high school students (14).

The present study aimed to evaluate zinc deficiency in female medical students as the future mothers in order to diagnose and treat the disorder as soon as possible.

Materials and methods

In this cross sectional (descriptive analytic) study, which was performed in 2005, all newly entered female medical students of Tehran University of Medical Sciences (Tehran, Iran) were evaluated. All of them were in the first year of the education. Exclusion criteria were defined according to students´ positive answers to the following conditions: gastrointestinal and hepatic disorders, acrodermatitis entropatica, renal diseases, smoking, addiction, oral contraceptives(within three months ago), post operative period and severe burns.

From each student a 3 mL blood sample was collected and hemoglobin (Hb), hematocrit, and serum zinc concentration was measured. Serum zinc concentrate was measured by enzymatic method. This method has the same sensitivity and precision in comparison with atomic absorption(15).

Zinc concentrations more than 85 µ/dl were considered as normal values. Concentrations less than 50 µ/dl were defined as severe zinc deficiency. Mild and moderate deficiencies were described as zinc levels between 50 to 85 µ/dl (16-18). When zinc deficiency was detected, the patients were treated under supervision of chancellor of student affairs.

This project was approved by the ethical committee of chancellor for research of the university and was conducted after receiving the written consents of the students.

Analysis was performed by t-test, Chi-square, Pearson correlation coefficient. Spss 11 (Spss Inc. chicago IL.) software was used for statistical analysis and p-value less than 0.05 was considered as statistical significance.

Results

After interviewing and completion of the related questionnairs, 420 participitants entered the survey. The participants had mean and standard deviation of age 18.87±1.31 years, height 160.40±5.41 cm, weight 56.71±8.09 kg, body mass index (BMI) 21.93±3.37 kg/m^2, hemoglobin of 13.39±5.10 mg/dl, hematocrit

Table 1: Comparison of anthropometric variables between Zinc deficient and normal groups

	Zinc deficiency n (%)	Normal Zinc level n (%)	P-Value
Height (cm)			
≤156	10 (9.9)	91 (90.1)	
156.1-163	19 (10.1)	169 (89.9)	0.43
≥163.1	6 (5.8)	97 (94.2)	
Weight (kg)			
≤50	14 (12.6)	97 (87.4)	
50.1-60	8 (4.8)	158 (95.2)	0.04
≥60.1	13 (11.3)	102 (88.7)	
BMI (kg/m^2)			
≤20 (thin)	12 (10.3)	104 (89.7)	
20–25 (Normal)	17 (8.4)	186 (91.6)	0.94
25–30 (Over weight)	5 (9.3)	49 (90.7)	
≥30 (Obese)	1 (11.1)	8 (88.9)	

of 40.32±3.24%.

Mean and standard deviation of serum zinc level in participants were 104.69±18.07 µg/dl. In 24 cases (5.7%) zinc level was between 50-85 µg/dl and in 6 students (1.4%) was less than 50 µg/dl.

Hematocrit was not significantly different between the zinc deficient and normal groups (39.7±3.2 vs 40.2±3.4, respectively) (p=0.5). Also hemoglobin concentration was not significantly different between the zinc deficient and normal groups (13.3±2.5 vs 13.4±5.3, respectively) (p=0.9). Significant correlation was found between zinc level and hematocrit (p=0.024, r=0.11). Mean zinc concentration was 98.53±19.23 µg/dl in anemic students (Hb <12 mg/dl) and 105.24±18.4 µg/dl in students with normal Hb (Hb>12) (p=0.016).The mean weight (p=0.59), height (p=0.38) and BMI (p=0.31) were not significantly different between zinc deficient and normal groups.

According to height and BMI classification in zinc deficient and students with normal zinc level there was not significant difference between the two groups (p=0.43 and p=0.94, respectively). Although zinc deficiency was more common in BMI ≤ 20 kg/m^2 and >25 kg/m^2 (10.3% and 20.4%, respectively) (p=0.4). There was a significant relation between body weight and zinc deficiency (p=0.04) (Table 1).

Despite the significant relationship between acne and zinc deficiency (27.8% in zinc deficient and 12.7% in healthy students, p=0.01), there was not significant relation with irregular menses, menorraghia (heavy bleeding) and anorexia (Table 2).

Discussion

This study showed severe and mild to moderate zinc deficiency in 1.4% and 5.7% of female students, respectively. Al-timimi reported the prevalence of this deficiency 2.7% for severe cases and 55.7% for Mild to moderate cases (12). Haralambie observed decreased plasma zinc was 23.3% in male athletes and 43% in female athletes (11). In Hettiarachchim´s research in serilanca 51.5% of boys and 58.3% of girls (aged 12-16 years old) had severe zinc deficiency (19). Zinc concentration less than 70 µ/dl was seen in 41.5% of nonpregnant females in Pathak´s study (20). Prevalence of zinc deficiency in 15-80 years old population was 0.53 percent in Kuwait, which implies sufficient zinc consumption in that region (21). In a review by Kaji, one of the important health problems in the world is various levels of zinc deficiency in children and female adults. He suggested that pregnant women have inadequate intake in 80 percent of cases (and 100% in developing countries) (22). Andriollo-Sanchez showed this deficiency was less than 5 percent in Europe (23).

Despite the high prevalence of zinc deficiency in the aforementioned studies, our study on newly entered medical students showed that 7.1% of them were zinc deficient. Although the students were from different regions of the country (and probably with better nutritional, socioeconomic, cultural situations to leave their homes in order to educate in the largest university of Iran), but it seems that they are not representative of the whole population.

Although mean hematocrit and hemoglobin concentrations were not significantly different between the zinc deficient and normal groups, but significant correlation was found between zinc level and hematocrit. Mean zinc concentration was lower in anemic students. Other studies confirm these results (24-27).

Table 2: Comparison of Clinical findings between Zinc deficient and normal groups

	Zinc deficiency n (%)	Normal Zinc level n (%)	P-Value
Acne			
No	26 (72.2)	317 (87.3)	0.01
Yes	10 (27.8)	46 (12.7)	
Irregular Menstrual Cycle			
No	28 (77.8)	290 (79.9)	0.45
Yes	8 (22.2)	73 (20.1)	
Menorrhagia			
No	30 (83.3)	331 (91.4)	0.16
Yes	6 (16.7)	31 (8.6)	

Regular Menstrual Cycle: Menstruation with 21-35 days interval
Menorrhagia: Menstrual bleeding more than eight days and bleeding with clot

Ai-Guoma described the relation of lowered plasma zinc and anemia (24), So he recommended that in iron deficiency anemia, zinc deficiency must be considered.

In this research, there was a significant relation between body weight and zinc deficiency (especially in $\leq$ 50 kg and $\geq$ 60 kg), which implies the possible role of malnutrition such as anorexia or bulimia. Gokbel showed lowered leptin levels in zinc deficient people (28). The study of Ghayour-Mobarhan showed lower serum zinc level in people with obesity (due to zinc role in catabolism). He described that in zinc deficiency, leptin is lowered and catabolism decreases (29, 30). Smidt described that the effect of zinc on fat metabolism, although subsequent regulation of leptin secretion is not well known (31). In some studies its role on decreasing appetite (1, 3, 31, 32) and in others its role on regulating the appetite is validated (1,3,21,27,33,34). In our research 13.9 % of zinc deficient students had anorexia. Some researchers believe that in menstruation periods decrease in hematocrit and hemoglobin concentrations results in lower zinc levels (3, 25, 26 and 35). Although in this study 16.7 % of zinc deficient students had menorrhagia. Significant relationship between acne and zinc deficiency (27.8% in zinc deficient and 12.7% in healthy students, p=0.01), was observed. Zinc deficiency is related to skin disorders (3, 4). Nigman described the relationship of this deficiency and psoriasis (10).

Zinc deficiency prevention is not only considered as an important issue for preventing maternal mortality, malaria and other diseases, but also nutritional state of developing countries is one of the third thousand targets (36,37). So evaluation of plasma zinc or its daily intake is indicated in order to schedule future interventional measures (38).

Future studies are recommended to explain the low prevalence in these students compared to general population. According to the effects of zinc deficiency on public health (especially maternal health), well designed studies are warranted to evaluate the true prevalence of this health problem in our community. It will also be interesting to repeat this survey, on the same sample of students just before completion of their education to compare the findings and explain any changes that might occur during the period of their education.

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