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Serum Zinc Levels in Patients with Type 2 diabetes mellitus compared with the control group

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ABSTRACT

Introduction and purpose: In addition to known risk factors, the role of different micronutrients such as zinc in incidence of diabetes has been proposed. Some previous studies have shown an association of zinc deficiency and diabetes type 2 while other studies have not confirmed such relationship. The aim of this study was to evaluate serum zinc level in patients with type 2 diabetes compared with the control group. Materials and Methods: This cross-sectional study was done on patients with type 2 diabetes in Zahedan, southeastern Iran. One hundred newly diagnosed type 2 diabetic patients were evaluated for serum zinc level. One hundred subjects from the general population who had normal fasting plasma glucose levels were selected as the control group. The control group subjects were matched with each of patients on the basis of sex, age (± one year), and body mass index (± 1). Serum zinc level was determined by spectrometry method. Results were compared using t-test. Results: The mean serum zinc level in patients was 86.45±7.94 mcg per dL and in control group was 103.20±9.68 mcg per dL. The mean serum zinc level was not significantly different between the two groups (P=0.12). Conclusion: Serum zinc levels in diabetic patients and the control group was not significantly different. Studies with larger sample size to evaluate serum zinc level in patients with diabetes and prospective studies along with zinc supplementation consumption and investigating its effect on incidence of diabetes are needed.

Key words: zinc, type 2 diabetes

INTRODUCTION

Diabetes mellitus is a common metabolic disease in the world. Type 2 diabetes accounts for about 90% of all diagnosed cases of diabetes. It is a debilitating and progressive disease characterized by insulin resistance in peripheral tissues including the skeletal muscle, adipose tissue and liver as well as loss of pancreatic beta cell function and relative insulin deficiency, and thus hyperglycemia. Diabetes damages multiple organ and cause serious complications such as coronary artery disease, kidney and ophthalmologic diseases, which can cause significant morbidity and mortality in diabetic patients [1,2]. According to the World Health Organization it is predicted that the total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030. According to studies, Iran is facing increasing prevalence of diabetes and the prevalence of disease in Iran population reaches to 7% [3]. The most important risk factors for type 2 diabetes are high calorie diet, aging, sedentary life style and obesity. In addition to known risk factors, the role of different micronutrients such as zinc in incidence of diabetes has been proposed [4,5]. Zinc is an essential trace element that plays a vital role in maintaining many biological processes and cell homeostasis. Zinc inefficient signaling is associated with some

chronic diseases such as diabetes. It also plays a key role in the synthesis, secretion and insulin action in both physiological and pathological situations. In addition, recent studies have highlighted zinc's dynamic role as a "cellular second messenger" in the control of insulin signaling and glucose homeostasis [6, 7]. Also there was some evidence which shows that zinc acts as an antioxidant. Under Zinc deficiency, free radicals are activated which is due to impaired antioxidant defense system and due to the imbalances in the production of free radicals and antioxidant defense system. High oxidative stress conditions are created this situation is involved in the pathogenesis of diabetes and its related complications [8-10]. Considering the important role of zinc in the metabolism of glucose, in this study, we examine the serum zinc level in patients with type 2 diabetes and Compare it with a control group.

MATERIALS AND METHODS

The present cross-sectional study was conducted on patients with type 2 diabetes who referred to Imam Ali Hospital in Zahedan, between October 2015 and February 2016. Patients with type 2 diabetes who were at least age 30 years were continuously enrolled in the study. Then, a form was completed for them which collected information about their age, gender, type of diabetes, duration of suffering from diabetes, type of diabetes treatment, incidence of other diseases, intake of medicine and body mass index. Diabetes is defined in the case of fasting plasma glucose ≥ 126 mg per deciliter (two times), oral glucose tolerance test ≥ 200 mg per dL, glycated hemoglobin ≥ 6.5 and random blood sugar > 200 mg per deciliter in the presence of symptoms. Pregnant patients as well as patients with liver disease, kidney disease, hyper or hypothyroidism, heart attack or stroke, cancer or patients who take supplements were excluded. Thus, 100 patients with type 2 diabetes were enrolled in the study. For each patient in case group one person who was matched in terms of age (± one year), sex and body mass index (± 1) was selected among healthy volunteers of blood donors referred to Zahedan Blood Transfusion Organization as a control group. In the control group, fasting plasma glucose was performed to rule out diabetes if their blood sugar was less than 100 they were enrolled as controls. Body weight without shoes using a digital scale and height in standing position was measured using a stadiometer. Body mass index was determined using this formula: weight in kilograms divided by the square of height in meters. All blood samples were collected between 8 and 9 am and after 8 hours fasting and stored frozen at -70 until examination. Zinc using spectrometry method [Graphite furnace atomic absorption spectrometry Varian, Australia (Spectr AA 240fs, 2009, USA)] and glucose was measured with glucose oxidase technique (Pars Iran test). Quantitative variables were expressed as mean (and standard deviation) and qualitative variables were expressed as a percentage. t -test and Mann-Whitney U-test were used to compare quantitative variables and Chi-Square was used to compare qualitative variables. Multivariate logistic regression analysis was done with diabetes as the dependent variable and age, body mass index, serum zinc level as independent variables. All the analysis were performed by software STATA version 12 (Stata Corporation, College Station, TX). All participants in the study were provided by necessary explanations about the study and the consent forms were collected from the subjects. The Research was approved on Ethics Committee of Medical Sciences (ethical code number: IR.ZAUMS.REC.1392.121).

RESULTS

In this study, 200 subjects (100 with diabetes and 100 healthy people) who met the inclusion and exclusion criteria were enrolled. Gender distribution between two groups was equal and as 50 males and 50 females in each case and control group. The case group were diabetics and the control group were healthy subjects. The average age of the participants in the study was 45.43±10.13 years. The average age of study groups was 45.65±11.60 years in the case group and 45.50±11.90 years in the control group. Using Independent sample t-test there was no statistically significant difference between the two groups in terms of age (P=0.8). The mean BMI (body mass index) in case group was 27.03±3.24 kg/ m^2 and controls 27.13±3.15 kg/ m^2. Using independent sample t-test there was no statistically significant difference between BMI of both groups (P=0.9). As shown in Table 2, the mean serum zinc level in case group was 86.45±7.94 mcg per dL and in the control group was 103.20±9.68 mcg per dL. Mean serum zinc level in both case and control groups showed no significant difference (P=0.12). Of all people with diabetes, 34% were suffered from zinc deficiency that this amount in control group was 37% and there was no significant difference. In regression analysis the deficiency or lack of deficiency of Vitamin D had no effect on the incidence of diabetes (Table 3).

DISCUSSION

In this descriptive cross sectional study, a total of 200 patients (100 patients with type 2 diabetes and 100 healthy individuals) who met inclusion and exclusion criteria were enrolled. Mean serum zinc level in the both case and

control groups were not significantly different. Close relationship between zinc and insulin function was first approved by Scott in the early 1930s that showed that zinc is an essential component of insulin crystals [11]. Over the years, studies have shown that zinc ions play an important role in the biosynthesis, storage and insulin function [7]. Animal studies have shown that zinc like insulin can reduce hyperglycemia and increase lipogenesis [12]. How zinc could apply these effects is unknown, but some studies have suggested that improvements of insulin binding to its receptor and increased phosphorylation and tyrosine kinase can be involved in insulin signal transduction.On the other hand, zinc can act as an antioxidant. Zinc plays an important role in the antioxidant enzymes structure and thus could protect insulin and beta cells from free radical attack [13].

In a significant number of studies zinc serum levels in diabetic patients was statistically lower than control group [14, 15]. In a cross sectional study, subjects with pre-diabetes and diabetes had lower serum levels and increased serum zinc levels have been associated with decrease in insulin resistance [16]. Also the results of some studies show that zinc supplementation can reduce the incidence of diabetes and can be effective in the treatment of hyperglycemia in patients with diabetes and has helped to better glycemic control [17-19]. But in this study, mean serum zinc levels were not significantly different among the case and control groups that the findings are consistent with some previous studies. Also in a study in Iran which is done patients with type I diabetes, no significant statistical differences was observed in serum zinc level in patients with diabetes and control groups [20, 21]. Possible reasons for the difference in findings can be attributed to the difference in duration of diabetes, controlling glucose levels and zinc excretion in urine and also the amount of zinc in the diet in different areas [16].

Table 1. Characteristics of subjects in case and control group

Variable		Frequency		percentage	
		case	control	case	control
gender	Male	**50**	**50**	**50**	**50**
	Female	**50**	**50**	**50**	**50**
Age (yera)	<40	**20**	**20**	**20**	**20**
	40-60	**66**	**66**	**66**	**66**
	>60	**14**	**14**	**14**	**14**
BMI (kg/m2)	<18.5	**0**	**0**	**0**	**0**
	18.5-24.9	**29**	**29**	**29**	**29**
	25-29.9	**43**	**43**	**43**	**43**
	≥30	**28**	**28**	**28**	**28**

Table 2. Comparison of serum zinc level in case and control group

Variable	Group	Mean±SD	Range	p-value
Serum zinc levels (mcg per dL)	Case	86.45±7.94	65.30-108.22	
	control	103.20±9.68	83.35-129.12	**0.12**

SD: standard deviation

Table 3: Effective factors in diabetes

variable		Patients with diabetes (frequency)	Healthy subjects (Frequency)	Total (frequency)	OR	CI	p-value
Gender	Male	50	50	100	1	0.57-1.74	0.55
	Female	50	50	100			
Age (year)	<40	25	24	49	1.05	0.55-2.01	0.50
	<40	75	76	151			
BMI (Kg/m^2)	<25	24	24	48	1	0.52-1.91	0.56
	≥25	76	76	152			
Zinc Deficiency	Yes <60 µg/dl	34	37	71	1.55	0.85-2.71	0.58
	No >60 µg/dl	66	63	129			

OR:odds ratio***, CI:***confidence interval

In general, zinc deficiency is common worldwide and available data show that zinc deficiency in the diet causes deficiency of serum level of zinc in 15-20% of the world's population [22]. In our study 34% of patients with diabetes and 37% of the control group suffered from zinc deficiency. Not measuring the content of zinc in the diet and not measuring urinary zinc was limitations of this study. Another limitation of this study is its cross-sectional nature, which naturally cannot show the causal relationship. But the sample size is relatively acceptable and matching case and control groups based on gender, age and body mass index as pairs is of the strengths of this study. Considering results of this study suggested that studies do with larger sample size to evaluate the serum zinc levels in diabetic patients. On the other hand prospective studies and zinc supplementation and its effect on the incidence of diabetes, can be effective to more clarity of the role of this element in the incidence and pathogenesis of diabetes.

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Declaration of Conflicting Interests
The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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