STUDY SERUM LEVELS OF COPPER AND IRON IN THE DIET OF PEOPLE WITH TYPE 2 DIABETES COMPARED WITH NON-DIABETICS

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ABSTRACT

Diet and some minerals inside it can contribute on diabetes. In this study levels of iron and copper in diet of non-diabetics and diabetics people have studied.

For this purpose, 50 healthy person and 50 persons with type 2 diabetes were selected accidently from those people who were refer to diabetes center of Valiasr hospital and Bouali laboratory in Zanjan. Information about age, sex, weight and height were registered. Levels of copper and iron in serum of studied people were measured. All collected dates were evaluated by SPSS software.

BMI in diabetic's people were significantly higher than in non-diabetic people (p: 0.001). But there was no extreme analytical difference between the levels of iron and copper received from diets in both groups. However iron concentration of serum in diabetic people was a bit lower than non-diabetic people. Therefore there was no significant difference. Also Copper concentration of serum in diabetic people was lower than non-diabetic people, but this difference was significant between two groups (p: 0.008).

In diabetic people there was a reverse solidarity between level of iron and copper serum and there was a revers solidarity between nutritional iron and copper in the serum (r: - 0.339, p: 0.016).

Reduction in copper level of serum in diabetic people was not related to diet, the reason should be search in other factors Nevertheless, evaluation of dietary mineral and effects of that on sugar, iron and copper serum of diabetic people needs more investigation.

Keywords: Diabetic type 2, Diet, Copper and Iron

INTRODUCTION

Diabetes is the most prevalent disease throughout the world whose prevalence is different from country to country. Diabetes type 2 is a chronic diseases and glucose metabolism disorder with reduction in tissues ability to respond to insulin (insulin resistance) which chronically leads to increase of glucose resulted from serum vessels and hurts nerve cells and leads to micro-vascular diseases and increases the risk of cardiovascular diseases as well as posing additional costs all over the world particularly in industrialized countries. There are reports indicating that diabetes is a global health issue and in 2011 there were 366 million individuals with diabetes and it is expected that in 2-30 it would reach 552 million ones [1]. The level of diabetes type 2 prevalence in Iran is 4-4.5% and in people older than 30 years it is 14%. International diabetes federation reported the prevalence of diabetes type 2 between Iranian aged in range of 20-79 years in 2010 about 9.3%. Also, with age the diabetes prevalence increases such that in individual younger than 50 years, it is about 9.8% and among older than 50 years it is 33.3%. Its prevalence in Yazd, Boshehr is more than other provinces (16.3% and 13.6% respectively) which is more likely due to difference of genetic and climate conditions [2, 3]. In Iran, prevalence of diabetes among females is more than males which in USA, Turkey and some Arab countries is true, too and based on the reports in 2011, over 4 million Iranian have got diabetes increase of which during 7 past years was by 35% [3-5]. Based on the Diabetes atlas IDF, Middle East and North Africa have the most diabetes prevalence [5]. Moreover, urbanization and economic statue are influential in diabetes pattern such that its prevalence in urban and rural population in Iran are 17.7% and 10.5%, respectively in Iran and people living in cities are 1.7% times more susceptible than rural residents to diabetes and in developed countries majority of the patients with diabetes are older than 60 years while in developing ones they are in range of 40-60 years and it is predicted that by 2030, urbanization and change of lifestyle would lead to increase of patients with diabetes by 54% [6, 7]. According to studies conducted in 2009 in Iran, the annual direct costs of diabetes is over $590 million estimated [8]. Clinical researches indicate that rare elements' hemostasis by diabetes is disordered by diabetes and the lack of primary balance for rare particular elements plays an important role in insulin and glucose metabolism disorder. Evidence indicate that deficiency of elements such as magnesium, zinc and chromium can make the person glucose

intolerable and begin to make him/her susceptible to diabetes and the deficiency of these elements related to chronic diseases occur with problems in iron absorption [9-15]. According to available reports, change of iron hemostasis in human and animals contributes to diabetes and iron, by producing different types of reactive oxygen leads to diabetic nephropathy [15]. Considering these facts this was necessary to investigate the concentrations of some rare elements in biologic samples of people with diabetes and their stability as well as their effect on personal health was evaluated. In present article, Smell's variables of copper and iron level of serum and diet for diabetic patients was evaluated in both gender and the results were compared with non-diabetic persons in the same age and gender. In addition, there was not seen any similar literatures and articles in Zanjan journal, but there are studies conducted on other elements such as zinc and cobalt.

METHODOLOGY

This research is an analytic one of control type. The sample is selected among the patients with diabetes type 2 who went to the diabetes center of Vali ASR hospital and Zanjan private laboratory who were confirmed as diabetic patients by fellowship of glands and the control group were selected as their non-diabetic families. The

sampling is randomized and both the sample and control groups were selected in the same age and gender. After written consent received from all participant in this research, all participants' weight was measured using an accurate scale and their height also was measured when they are standing without shoes using strip meter. The Body Mass Index (BMI) for everyone was measured from the weight (kg) on square of height (m^2). 24-hours and 3-days diet planning questionnaires were filled in order to determine the iron and copper intake amount. In order to measure the level of diet copper and iron the Food Processor software was used. Then, participants were taken vascular serum of 10 ml after 12 hours breakfast (based on American Diabetes Association criterion) and after centrifuge, the samples taken were maintained in condition with $-70°c$ until the time of experiments. After sample collection using Pars Azmoon kits, the glucose measurement of the serum and the iron were performed by spectrophotometry device, model HITACHI and measurement of the copper of the serum was done using spectrometry of atomic absorption device, model PERKIN ELMER 110. It is necessary to note that hyperglycemia is confirmed in diagnosis of diabetes using WHO criteria. Information analysis using the frequency distribution table and central and dispersion indices

were conducted in SPSS, version 12, using statistical T-TEST. The investigation of linear relationship between variables of copper and iron of serum and diet, BMI and age was performed using Pearson's correlation method. This research plan was free for participants and the results obtained would be privatized. In addition, the criteria for inclusion in patients' group was to have diabetes type 2 and for control group was to be non-diabetic and both groups were asked about lack of effective diseases on copper and iron level of serum as well as lack of making use of supplements containing these elements and then confirmed.

FINDINGS

Table 1 presents the results of descriptive statistics of data. As it is observed from the table, the level of serum glucose were $102/22 \pm 17/8$ mg and $148/66 \pm 62/7 \, \text{mg}$ for non-diabetic and diabetic groups, respectively. The level of serum iron and copper for non-diabetic group were $106/44 \pm 42/5 \, \mu g$ and $114/36 \pm 20/5 \, \mu g$ and in diabetic group $100/66 \pm 32/4 \, \mu g$ and $103/22 \pm 20/7 \, \mu g$, respectively. Considering the serum glucose limitations of diabetic and non-diabetic individuals, these 2 groups are differentiated based on ADA definition. In table 1 the T-TEST results indicate that the mean difference of concentration of serum iron and copper of

both groups is not significant (p=0.4), whereas the mean difference of concentration of serum copper and weight are significant for both groups and the p is 0.008 and 0.08, respectively. Mean weight in non-diabetic group was 68.34 kg and for diabetic one was 73 kg and the mean concentration of serum copper were $114/36 \pm 22/5 \mu g$ and $103/22 \pm 20/7 \mu g$ for non-diabetic and diabetic groups, respectively. This table also indicates that there is no significant difference between diet copper and iron level for both groups (p=0.00). Also the statistical results of BMI analysis are presented. Mean BMI for diabetic group was 7% more than the control group and its difference was significant (P=0.00). In tables 2 and 3 (correlation between data in both diabetic and non-diabetic groups) are presented. The highest correlation coefficient between serum iron and diet iron (0.53) obtained in a completely significant level (p=0.01) and correlation coefficient between iron and copper in serum and diet and serum glucose were meaningful. In tables 4 and 5 the results of correlation in control group are presented. In these tables only the correlation between serum glucose and copper was negative and the remaining results were positive correlations, but none of them were in significant level. In this

group also the correlation between diet and serum iron was positive significant (0.62).

DISCUSSION

Rare elements for chemical reactions in human body are essential. The interaction between diabetes and these elements has been discovered. In 2007 Leo et al. (V) indicated that increase of the iron leads to oxidative damages and insulin resistance. This research conducted on 455 patients with diabetes and proved that diet iron intake particularly iron is in direct relation with increasing the risk of diabetes type 2. As outlined in results, the correlation between serum iron and glucose in diabetic group is negative and meaningful with P=0.03; i.e. as iron increases the serum glucose decreases whose reason is unknown and needs to be more investigated., but this is not true in control group. The other point observed in analysis of results related to iron and copper of patients with diabetes is the negative correlation between serum copper and iron which is a negative significant correlation (p=0.005). This can explain the fact that absorption of an element inhibits the other's absorption or increases the ejection of other elements in body which causes its reduction in serum. This negative correlation is not significant in control group. The other point obtained in this research in target group (diabetic) is then negative correlation between serum copper and diet iron (p=0.001) and can explain that as iron in diet increases, the serum copper decreases. Considering that in both analyses in target and control group, the positive significant correlations were obtained between serum and diet iron, the results indicated that as diet iron increases, serum iron increases, too and diet iron increase leads to serum copper reduction. In this research, mean concentration of serum iron for diabetic group was less than control one, but the difference was not significant. But results of copper demonstrates that copper in diabetic group reduced significantly more than non-diabetic group (p=0.008). it appears that copper metabolism in patients with diabetes changes and for different reasons such as low diet copper absorption or increase of copper ejection, its level decreases in serum or maybe its required level is more than non-diabetic groups. Since copper is a very important and essential element in action of enzymes it is recommended that patients with diabetes intake sufficient copper level in their diets. It is noteworthy to say that the opinions are different in literatures on the concentration of serum copper. Some of them reported reduction, some reported increase and in some literatures it is reported as unchanged. About the level of micro-nourishing of serum for diabetic and non-diabetic people there are many

researchers conducted. In an article by Loan et.al [17] in 2008 in china the researchers concluded that increase in diet iron increases the risk of diabetes, but iron has this effect in other forms, too and eating vegetable foods can reduce the risk of diabetes. The other research by Kazi et al. [18] in 2008 on complete serum, urine and head hair of 257 patients with diabetes type 2 indicated that the mean level of serum copper and iron are higher than non-diabetic groups. Based on the research by Abu-Saif et al. [19] there were many differences in level between rare elements due to age and gender and people are more susceptible to increase or decrease of these elements with age and the metabolism of some rare elements would change during diabetes and these elements play key role in the disease pathogenesis. Tomas el al. [20] indicated that increase of iron plays a role in diabetes pathogenesis and free iron as a catalyst is effective on oxidation of proteins and lipids and formation of reactive oxygen types and the iron is in relationship with obesity and insulin resistance. If the serum glucose increase and inflammation occur, iron plays its role in growth and oxidative damage development and affects the glucose control, negatively. In another research by Cary et.al [18] in Turkey it was indicated that the main reason for anemia in old patients with diabetes is due to deficient of iron resulted from lack of appetite or decrease of iron intake and absorption. In patients with diabetes the copper and iron hemostasis changes and iron affects negatively the glucose control. Based on the researches by Victoriana et al. [21] glycolic hemoglobin is in positive correlation with level of serum copper and copper/zinc ratio and copper metabolism disorder plays a key role in development of diabetes type 2. In a research by Flores et al. [22] it was detected that serum zinc and copper concentrations increases in patients with diabetes and these elements has a particular role in diabetes pathogenesis.

CONCLUSION

It is concluded that disorders of rare elements metabolism plays a role in diabetes type 2 pathogenesis and development. Reduction of copper and iron in serum biopsies of diabetic patients plays a key role in insulin secretion or performance. Reduction of iron and copper in these patients stops the anti-oxidation actions and leads to peroxidation of lipids a reduction of vascular diseases in patients with diabetes.

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Table 1: Mean and SD of studied variables in both target and control groups

Variables	Diabetic group (mean ± SD)	Non-diabetic group (mean ± SD)	P – Value
Age (year)	$50/28 \pm 7/8$	$48/58 \pm 8/6$	0.3
Glucose (mg / 100)	$148/66 \pm 62/7$	$102/22 \pm 17/8$	0.0
Serum iron $(\mu g/100)$	$100/66 \pm 32/4$	$106/44 \pm 42/5$	0.4
Serum copper $(\mu g/100)$	$103/22 \pm 20/7$	$114/36 \pm 20/5$	0.008
Height (cm)	$163/50 \pm 6/3$	$163/34 \pm 7/0$	0.869
Weight (kg)	$73 \pm 7/5$	$68/34 \pm 8/6$	0.005
Diet copper (mg)	$0/77 \pm 0/41$	$0/82 \pm 0/38$	0.507
Diet iron (mg)	$11/26 \pm 5/1$	$9/72 \pm 4/3$	0.108
(kg/m^2) BMI	$27/26 \pm 1/6$	$25/61 \pm 2/6$	0.00

Table 2: Correlation between serum copper and other variables studied for diabetic patients

Variables	Correlation coefficient	P – Value
Age (year)	-0.005	0.97
Glucose (mg / 100)	-0.072	0.62
Serum iron $(\mu g/100)$	-0.0388	0.005
Serum copper $(\mu g/100)$	1	—
Diet copper (mg)	0.039	0.79
Diet iron (mg)	-0.339	0.016
(kg/m^2) BMI	-0/036	0/80

Table 3: Correlation between serum iron and other variables studied for diabetic patients

P – Value	Correlation coefficient	Variables
0.92	-0.014	Age (year)
0.62	-0.134	Glucose (mg / 100)
—	1	Serum iron $(\mu g/100)$
0.005	-0.388	Serum copper $(\mu g/100)$
0.36	-0.133	Diet copper (mg)
0.01	0.535	Diet iron (mg)
0.73	-0.050	(kg/m^2) BMI

Table 4: Correlation between serum copper and other variables studied for non-diabetic group

Variables	Correlation coefficient	P – Value
Age (year)	-0.159	0.29
Glucose (mg / 100)	-0.119	0.18
Serum iron $(\mu g/100)$	-0.240	0.09
Serum copper	1	—

$(\mu g/100)$		
Diet copper (mg)	-0.122	0.40
Diet iron (mg)	-0.182	0.21
(kg/m^2) BMI	-0.204	0.16

Table 5: Correlation between serum iron and other variables studied for non-diabetic group

Variables	Correlation coefficient	P – Value
Age (year)	0.026	0.86
Glucose (mg / 100)	0.226	0.11
Serum iron $(\mu g/100)$	1	—
Serum copper $(\mu g/100)$	-0.24	0.09
Diet copper (mg)	-0.073	0.61
Diet iron (mg)	0.625	0.00
(kg/m^2) BMI	0.017	0.91

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