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Der Pharmacia Lettre, 2016, 8 (11):177-181
(http://scholarsresearchlibrary.com/archive.html)

Scholars Research Library
ISSN 0975-5071
USA CODEN: DPLEB4

Investigation of vitamin D serum level in patients with type 2 diabetes in comparison with control group

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ABSTRACT

Vitamin D deficiency is prevalent throughout the world. Some previous studies have shown that vitamin D deficiency accompanies type 2 diabetes but other researches have not confirmed that relationship. Evaluation of vitamin D deficiency in the patients with type 2 diabetes in comparison with the control group is the purpose of this study. This cross-sectional study was conducted on some patients with type 2 diabetes in Zahedan, southeast of Iran, in autumn and winter 2015. One hundred newly diagnosed type 2 diabetes patients were studied for their vitamin D serum level. Out of the general population, one hundred people having normal fasting plasma glucose were selected as the control group. The control group members were matched with the case group members based on sex, age (± one year), and body mass index (±1). Vitamin D serum level was measured by enzyme immunoassay method immunodiagnostic system [IDS (LTD), UK]. The results were compared using statistical t-test. The average of vitamin D serum level in the case group was 19.13±15.84 ng/ml and 22.50±15.66 ng/ml in the control group. No statistically significant difference was observed between the averages of vitamin D serum levels in the case and control groups (p=0.13). Vitamin D serum levels in patients with diabetes and control group were not significantly different which could be due to the high prevalence of vitamin D deficiency in the general population.

Key words: vitamin D, type 2 diabetes

INTRODUCTION

Industrialization, increased longevity, and change of people's lifestyles have resulted in prevalence of chronic diseases such as diabetes [1]. Type 2 diabetes is the prevalent type of diabetes in all over the world accounting for 90% of diabetes cases. An epidemic of diabetes is emerging in both developed and developing countries in all age groups particularly among the people older than 65. It is estimated that the population of 171 million people stricken with diabetes in 2000 will reach to 366 million in 2030 [2]. According to conducted studies, Iran is facing the increased prevalence of diabetes and that prevalence is 7% [3].

In addition to known risk factors for diabetes such as high calorie diet and sedentariness, some other factors such as vitamin D deficiency seem to account for the incidence of diabetes. Vitamin D is an essential nutritional component which has a unique metabolism in comparison with other vitamins and, in fact, it is better to be classified as a hormone [4]. In humans, two sources provide vitamin D: exogen (through diet) and endogen (produced in skin by sunlight). Type 2 diabetes is resulted from insulin resistance, reduction of beta cells function, and systematic inflammation and vitamin D affects all of these items. One of the roles of vitamin D in the function of beta cells could be described through the connection of 1, 25-Dihydroxy vitamin D to vitamin D receptors on beta cells. One alpha-Hydroxylase enzyme which exists in beta cells can change 25-Hydroxy vitamin D to its final and active form —1, 25-Dihydroxy vitamin D. Vitamin D can directly increase insulin sensitivity by simulation of insulin receptor

expression or activation of peroxisome proliferator-activated receptor (PPAR-δ) which is a factor accounting for regulating the metabolism of fatty acids in skeletal muscles and adipose tissues. Also, vitamin D can indirectly affect insulin secretion and insulin sensitivity and this effect is exerted by its role in extra cellular calcium regulation of beta cells and insulin target peripheral tissues [5,6]. Recently it has been shown that vitamin D activates zinc transporters by vitamin D receptor and zinc, in turn, plays a role in insulin synthesis, secretion, and function in both physiological and pathological status [7].

Considering the role of vitamin D in glucose metabolism and the contradictory results of previous studies showing accompaniment of vitamin D deficiency and type 2 diabetes, we investigate and compare vitamin D serum levels in type 2 diabetes patients and control group.

MATERIALS AND METHODS

Through case-control method, the present descriptive-analytical study was done on type 2 diabetes patients referred to Imam Ali Hospital of Zahedan in autumn and winter in 2015. The newly diagnosed type 2 diabetes patients with the minimum age of 30 participated continuously in the study. The patients' profiles, which were investigated and recorded, included age, sex, duration of diabetes, medications taken by them, history of suffering from different diseases, and body mass index. In case of fasting plasma glucose equal to or higher than 126 ml/dl (two times), oral glucose tolerance test levels equal to or higher than 200 ml/dl, glycosylated hemoglobin equal to or higher than 6.5, or random blood sugar levels higher than 200 ml/dl in the presence of the symptoms, diabetes was defined. Pregnant women and the patients suffering from liver, kidney, hyper or hypothyroidism, heart attack, stroke, and cancer, and thosee who took vitamin supplements were excluded from the study.

In this way, 100 type 2 diabetes patients were included in the study. The control group was formed by selecting some people out of healthy volunteer blood donors. Each person in the control group was matched with a member in the case group in terms of age (±1 year), sex, and BMI (±1). Fasting plasma glucose of the control group members was tested to diagnose diabetes and those whose fasting plasma glucose was less than 100 were included in the control group of the study. Body weight was measured without wearing shoes using a digital scale and height was measured in standing position using a stadiometer. Body mass index was defined base on the formula: body weight in kilograms divided by height in meters squared. All the blood samples were taken between 8 and 9 AM and after 8 hours of fasting. They were kept frozen in a temperature of −70 degrees until the test day.

Vitamin D (25-Hydroxy vitamin D) was measured using enzyme immunoassay method [enzyme immunoassay method immunodiagnostic system; (LTD), UK]. Blood sugar was measured by glucose oxidase method (Iran Pars Test).

Quantitative variables were defined in the form of average (and standard deviation) and qualitative variables were defined in terms of percentage. T-test and Mann-Whitney U-test were used to compare the quantitative variables. Chi-Square was used to compare the qualitative variables. Multivariate logistic regression analysis was done using diabetes as the dependent variable and age, body mass index, and vitamin D as independent variables. All analyses were done using STATA 12 software (Stata Corporation, College Station, TX). The necessary information was explained to all the participants in the study. The consent form was obtained from them. The ethics committee of Zahedan University of Medical Sciences confirmed the research (number of ethical code: IR.ZAUMS.REC.91.1673).

RESULTS

Totally, 200 subjects (100 patients with diabetes and 100 healthy people) in accordance with inclusive and exclusive criteria participated in the study. Gender distribution was equal in the both of groups, that is, the case and control groups each had 50 men and 50 women. Diabetes patients were the case group and healthy people were the control group.

As it is shown in table 1, the average age of participants is 48.76±12.10 years. The average age of case group members was 48.98±10.9 and it was 48.80±10.90 for the control group members. Using the statistical independent sample t-test, regarding age, no statistically significant difference was found between the two groups (p=0.8). The average of body mass index in the case group was 28.06±4.44 kg/m^2 and it was 28.13±4.45 kg/m^2 in the control group. Using independent sample t-test, no significant difference was seen between the two groups in terms of BMI (p=0.9).

As it is shown in table 2, the average of vitamin D serum level was 19.35±15.84 ng/ml in the case group and 22.50±15.66 ng/ml in the control group. No statistically significant difference was found in terms of the average of vitamin D serum level in the case and control groups of this study.

Out of all the diabetes patients, 91% suffered from vitamin D deficiency or insufficiency and only 9% had normal vitamin D level. This amount was not significantly different between the case and control groups (table 3). In regression analysis, vitamin D deficiency or normal vitamin D level did not have effects on the incidence of diabetes (table 4).

DISCUSSION

Two hundred subjects (100 diabetes patients and 100 healthy people) in accordance with the inclusive and exclusive criteria participated in this cross-sectional descriptive-analytical study. The averages of vitamin D serum level in the case and control groups were not significantly different.

Vitamin D is involved in various processes such as calcium metabolism, inflammation, glucose and blood pressure homeostasis [8-10]. The association of vitamin D deficiency with different diseases such as asthma, diabetes, cancer, and mental disorders have been reported [11,12]. Although vitamin D could be provided by fish oil, yolk, and dairy products fortified with vitamin D, its main source is the synthesis of 7-dehydrocholesterol in skin. Photochemical transportation of 7-dehydrocholesterol starting in skin and under the influence of ultraviolet radiation is the first step to produce active vitamin D. The product of this transformation is changed to 25-hydroxy vitamin D in the liver which then under the influence of 1-alpha-hydroxylase enzyme is transformed to 1,25-dihydroxivitamin D [13].

Different conducted studies have shown that vitamin D levels in diabetes patients are lower than in control groups and vitamin D deficiency has been more prevalent among diabetes patients [5, 14-17]. But in some other studies, no relationship has been found between vitamin D deficiency and type 2 diabetes and prescribing vitamin D supplements has not decreased the risk of diabetes incidence in the follow-up years [18,19].

In our study, the average of vitamin D serum level in diabetes patients was lower than in the control group but this difference was not statistically significant. The reason could be the high prevalence of vitamin D deficiency observed in the region. Shortage of food sources, nonfortifying foods with vitamin D, and skin pigmentation could be among the reasons for high prevalence of vitamin D deficiency in this region [20].

Cross sectional nature of our study is one of its limitations which can not indicate a causal relationship but the relatively acceptable sample size and pair matching of the control and case groups in terms of sex, age, and body mass index is a strength of the study. Regarding the result of this study and the contradictory results of previous studies, it is recommended that some other studies with larger sample size be done to investigate vitamin D serum level in diabetes patients. Also, conducting prospective studies and taking vitamin D supplements and investigating their effects on the incidence of diabetes can result in more clarification of the role of this vitamin in the incidence of diabetes and its pathogenesis.

Table 1. Characteristics of subjects in each group

Variable		Frequency		Percent	
		Case	Control	Case	Control
Sex	Male	50	50	50	50
	Female	50	50	50	50
Age (years)	<40	25	25	25	25
	40-60	61	61	61	61
	>60	14	14	14	14
BMI (kg/m^2)	<18.5	0	0	0	0
	18.5-24.9	24	24	24	24
	25-29.9	48	48	48	48
	≥ 30	28	28	28	28

Table 2. Comparing vitamin D serum levels of participants in the study in terms of group

Variable	Group	Average	Range	P value
Vitamin D serum level (ng/ml)	Case	19.13±15.84*	1.2-85	0.13
	Control	22.5±15.66	1.16-86-26	

**Mean ± standard deviation*

Table3. Frequency of vitamin D deficiency of participants in terms of groups under study

Vitamin D	Case group (percent)	Control group (percent)	P-value
Vitamin D deficiency (<20ng/ml)	75	70	0.07
Vitamin D insufficiency(20-30ng/ml)	16	21	
Normal Vitamin D level (≥ 30ng/ml)	9	9	

Table 4. Diabetes risk factors

Variable		Diabetes patients (frequency)	Healthy people (frequency)	Total (frequency)	OR	CI	P-value
Sex	Male	50	50	100	1	0.57-1.74	0.55
	Female	50	50	100			
Age group (years)	<40	25	24	49	1.05	0.55-2.01	0.5
	≥40	75	76	151			
BMI	<25	24	24	48	1	0.52-1.91	0.56
	≥25	76	76	125			
Vitamin D deficiency	Yes <20ng/ml	68	52	120	1.96	1.1-3.48	0.01
	No >20ng/ml	32	48	80			

Logistic regression analysis using diabetes as the dependent variable; BMI, and vitamin D deficiency as the independent variables. CI: confidence interval, OR: odds ratio

CONCLUSION

vitamin D serum levels in patients with diabetes and control group were not significantly different which could be due to the high prevalence of vitamin D deficiency in the general population

Acknowledgement
The authors would like to thank the patients who participated in the study. This study was supported by Zahedan University of Medical Sciences.

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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