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Evaluation of vitamin D level among patients with type 2 diabetes in Nineveh Governorate-Iraq

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ABSTRACT— The current study was conducted on patients with type 2 diabetes in the Nineveh Governorate, Iraq. The study included 60 blood samples. Blood samples were taken from 30 patients with type 2 diabetes (15 males and 15 females) and 30 healthy people (20 males and ten females). The mean age of patients was 55 ± 9.01, while the mean age of controls was 30 ± 14. 73. In the case group, females constituted 50% and males 50% of the case group, while in the control group, females were 33.3% and males were 66.6%. There was a significant difference in vitamin D levels among cases and controls (8.85 ± 5.95 VS 16.16±5.51 respectively, $p < 0.001$). Females had lower vitamin D levels than males (7.514± 3.124 VS 10.177± 7.422, P 0.05). The FSG, HbA1c, cholesterol, triglycerides, and blood urea were significantly increased (p 0.05) in patients compared to the control group. A significant negative correlation was noted between vitamin-D levels and BMI in T2DM (r= -0.56, p= 0.015). A negative significant correlation was noted between vitamin-D levels and HbA1C in T2DM (r= -0.523, p= 0.0237).

KEYWORDS: vitamin D, type 2 diabetes mellitus, HbA1c, BMI.

1. INTRODUCTION

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar. Hyperglycaemia, or raised blood sugar, is a common effect of uncontrolled Diabetes and, over time, leads to serious damage to many of the body's systems, especially the nerves and blood vessels.

In 2014, 8.5% of adults aged 18 years and older had Diabetes. In 2019, Diabetes was the direct cause of 1.5 million deaths, and 48% of all deaths due to Diabetes occurred before the age of 70 [18].

Type 2 diabetes mellitus (T2DM) is a chronic disease associated with acute and long-term complications [17].

Type 2 diabetes mellitus (T2DM) accounts for approximately 90% of diabetic patients [19]. The increasing prevalence of T2DM has become a major public health problem worldwide. In the past 20 years, advances in epidemiological research have increased our understanding of the pathogenesis of T2DM. The risk factors for T2DM are mainly summarized as genetic and environmental (e.g., unhealthy diet and lifestyle) aspects [20].

Vitamin D was once categorized solely as a vitamin, but it is now categorized as a hormone and has a role in various physiological processes. Vitamin D deficiency or insufficiency has been linked to various serious and often fatal diseases, including many cancers, infectious diseases, heart disease, autoimmune and metabolic diseases, and type 2 diabetes mellitus (t2DM). Vitamin D status is inversely related to future t2DM risks [16].

Vitamin D may influence metabolic syndrome and T2DM pathogenesis, such as reduced B-cell function and insulin resistance, either directly by activating vitamin D receptors or indirectly through calcium homeostasis control [21].

Vitamin D insufficiency is common in most regions of the globe; generally, individuals get vitamin D from the sun or food sources, including fish oil and nutritional supplements. Low vitamin D concentrations are linked to a higher risk of diabetic complications, such as cardiovascular disease, renal impairment, and peripheral arterial disease. Vitamin D stimulates insulin production, and low vitamin D concentrations are linked to a higher risk of diabetic complications, such as cardiovascular disease, renal impairment, and peripheral arterial disease [22].

Many factors contribute to VD insufficiency, including reduced sunshine exposure, dark skin, winter, the elderly, clothing that covers most of the body, feminine gender, and obesity [23]. [24] describe Type 2 diabetes as one of the most frequent non-communicable illnesses among the elderly and has become a major health concern for them [24].

2. OBJECTIVE

This study aims to look at vitamin D levels and the association between vitamin D levels, gender, age, and glycemic control in people with type 2 diabetes.

3. Material and method

From December 1, 2021, to January 30, 2022, researchers from AL-Wafa Center for Diabetes and Endocrine's Diabetic Center performed a case-control study. Sixty people from the Nineveh Governorate were involved in the study, 30 of whom had type 2 diabetes, and 30 did not.

Patients' group (B) includes 30 patients suffering from type 2 diabetes mellitus (15 males and 15 females).

The control group (A) consisted of 30 healthy people (20 male, ten female) who did not have Diabetes clinically or laboratory.

A questionnaire was given to the patients to ascertain their demographics, such as age, sex, domicile; diabetes duration; BMI; and the results of several biochemical tests. A random sample strategy was used to choose patients and healthy controls for the study. All of the participants gave their verbal consent. Each subject's BMI was determined. None of the females were expecting a child. The participants in the research had diabetes mellitus type 2 and were being treated with either diet alone or diet and oral anti-diabetic medications.

Eight milliliters of venous blood were drawn from each study participant and divided into three portions; the first (two milliliters) was placed in an EDTA tube for HbA1C testing. The second portion (three ml) was put in a plain tube for routine biochemical tests. The third portion (three ml) was put in a plain tube and left to clot at room temperature for 2 hours, then centrifuged, and the serum was separated and stored at –20 C. It was assessed for vitamin D using an enzyme-linked immunosorbent assay (ELISA).

Initial consultation and examination involved the routine assessment of serum vitamin-D and glycaemic control (HbA1c) concentrations. The following laboratory parameters were also done: (fasting blood sugar, triglycerides, cholesterol, urea, and creatinine).

The enzyme-linked immunosorbent assay (ELISA) method was used to determine the vitamin D concentration in serum. A spectrophotometer measured HbA1c. Biochemical blood measurements were determined by a standard laboratory procedure using a biosystem kit.

Body Mass Index (BMI) is calculated by dividing weight in kilograms (Kg) by height in meters (M2).

BMI = weight / (height)2

Those with a BMI of 18.5–24.9 were considered normal, while those with a BMI of 25–29.9 were considered overweight, and those with a BMI of 30 were considered obese [25].

4. Statistical analysis

It was done using SPSS software ("Statistical Packages for Social Sciences") (version 16) and Microsoft Office Excel (2013). Data were analyzed using a One-Way Analysis of Variance (ANOVA) to determine the difference between the studied groups. A correlation test was applied to test the correlation between the tested parameters. The results were presented as mean, and standard deviation (mean ± SD). The statistical significances at the levels of (p 0.01) and (p 0.05) were considered.

5. Result and Discussion

Human and biochemical parameters for all participants were as shown in Table (1). The FSG, HbA1c, cholesterol, triglycerides, and blood urea were significantly increased (p< 0.05) in patients when equated with the control group, while there was a substantial reduction (p <001) in serum vitamin D when paralleled with the control group.

Table (1): Comparison between laboratory data of T2DM cases and controls

parameters	Control group	Diabetic group	p-value
no(M/F)	30(15/15)	30(20/10)	
Age	30 ±14.73	55±9. 01	
BMI(k/M^2)	26.34 ± 20.27	32.23 ± 4.79	0.123
FBS (mg/dl)	76 .23±8	175.2±32.79	<0.001
vitamin-D(ng/ml)	16.16±5.51	8.85 ± 5.95	<0.001
Urea (mmol/L)	3.2 ± 1.05	7.84 ± 2.27	<0.001
Cholesterol(mmol/L)	3.1± 0.98	5.68 ± 1.64	<0.001
triglycerides (mmol/L)	1.22 ± 0.97	3.22 ± 1.03	<0.001
HbA1C%	4.1±0.45	8.02±0.937	<0.001

Vitamin D level in males and females As shown in Table (2), it was observed that the level of vitamin D was higher in males than in females.

Table (2): level of vitamin D in male and female

Sex	Number	Mean of age	Mean of VD
Male	15	52.33± 8.55years	10.177 ± 7.422
Female	15	57.66 ± 8.39years	7.514 ± 3.124

Vitamin-D and age As shown in Table 3, low vitamin D levels were observed in older patients.

Table (3): Vitamin D level by age group

age	number	mean of age	mean of VD
40-55	15	47.13± 4.67 years	10.437±7.101
55-70	15	62.87± 3.38 years	7.25±3.604

A negative significant correlation was noted between vitamin-D levels and BMI in T2DM (r = -0.56, p = 0.015) as shown in table (4).and a negative significant correlation was noted between vitamin-D levels and HbA1C in T2DM (r = -0.523, p = 0.0237) as shown in table (4).

Table (4): Correlation of vitamin D with HbA1C and BMI in T2DM

Parameter	Vitamin-D	
	r	p-value
BMI	-0.56	0.015
HbA1C%	-0.523	0.0237

According to this study, there was a significantly significant difference in vitamin D concentrations between type 2DM and healthy controls. The results of this study agreed with a large number of studies, such as Salih et al., who conducted a study on patients with type 2 diabetes in the Dohuk governorate, and the results were similar to our study [7]. As well as the study agreed with (Zhang, J. et al.), where the results of their research indicated a low level of vitamin D in type 2 diabetes patients compared to healthy controls [8].

The relationship of vitamin D with type 2 diabetes is through the effect of this vitamin on insulin secretion, as well as on insulin effectiveness, insulin resistance, calcium activity, and cytokines, in addition to its role in the development of Diabetes and its complications [1].

The relationship between vitamin D and type 2 diabetes is as follows: Central insulin resistance in pancreatic beta cells activates gluconeogenesis in pancreatic alpha cells, resulting in increased glucose synthesis by the liver in the baseline state and impaired glucose utilization in peripheral organs. This process affects insulin receptors in muscle, brain, and fatty tissues, resulting in decreased glucose absorption for energy requirements in peripheral tissue, increased adipose tissue lipolysis, increased gastrointestinal deficiency, and increased glucose adsorption in the kidney in impaired glucose tolerance. [2].

Vitamin D has an anti-inflammatory effect by reducing the generation of cytokines, which helps decrease the chronic low-grade inflammation seen in DM II [12]. Vitamin D improves insulin action by increasing the expression of the human insulin receptor gene, which gives instructions for the production of a protein called insulin receptor. The insulin receptor protein is found in many types of cells' outer membranes and connects to the insulin molecule. Insulin receptor protein is found in many types of cells' outer membranes and connects to the insulin molecule insulin in the bloodstream [13]. This also aids in the transcription of the human insulin gene, which results in the production of insulin hormone [14]. It also influences fatty acid oxidation by raising the expression of the peroxisome proliferator-activated receptor delta (PPAR-) gene [14].

Calbindin, a calcium-binding protein present in pancreatic beta-cells, is regulated by the active form of vitamin D (1.25 (OH) 2D3). Vitamin D will serve as a depolarization modulator of the beta-cells of the pancreas, allowing enough insulin to be secreted [3].

Insulin resistance is influenced indirectly by vitamin D deficiency via the aldosterone renin-angiotensin pathway. Angiotensin inhibits insulin in the vasculature, causing glucose absorption to be restricted and energy demand to be lowered [2].

The active form of Vitamin D, calcitriol, speeds up the conversion of pro- insulin to insulin. And the discovery of vitamin D receptors (VDR) and vitamin D binding protein (DBP) in beta-cells supports the role of vitamin D in insulin secretion. Hu and colleagues (2019).

According to studies, the frequency of vitamin D insufficiency rises with age. In general, older adults are more vulnerable to vitamin D insufficiency for a variety of reasons, including decreased solar exposure, lower nutritional intake, poor intestinal absorption, and decreased hydroxylation in the liver and kidneys. [5].

This result was agreed with [5]. There was no correlation between VD and disease duration.

Our findings suggest that female patients with low vitamin D levels (insufficient and deficient) were significantly more likely to be female. This could be due to social behaviors or religious requirements that require women to cover their entire body with clothes and wear a hijab when they go outside. Sun exposure, and hence Vitamin-D production and status, are hampered by clothing. Even if they reside in a sunny area, sun exposure to unprotected faces and hands, as shown in hijab-clad females, is insufficient for vitamin D production. This discovery was in line with the findings of several other researchers [6].

We also found a negative correlation between vitamin-D levels and HbA1c in diabetic type 2 patients. And this result was agreed with [7]. But this result did not agree with ALkharashi, who found no correlation between vitamin D and HbA1C (ALkharash et al).

Many studies have assessed the link between vitamin D and the physiological function of the pancreatic β cell as β cells express VDRs, and 1a-hydroxylase is assessed in pancreatic tissue, equivalent to the expression of insulin [12]. Insulin secretion depends on calcium level, and it has been noted that vitamin D deficiency prevents glucose-facilitated insulin secretion [15].

We also found a negative correlation between vitamin-D levels and BMI in diabetic type 2 patients. And this result was supported by [8]. But this result did not agree with Baradaran et al., who found no correlation between vitamin D and BMI [9].

Low dietary intake of VD, decreased outdoor physical activity with poorer skin exposure to sunlight, impaired hydroxylation in adipose tissue, VD accumulation in fat, and alterations in VD receptors in patients with body fat excess have all been proposed as pathophysiological mechanisms to explain the associations between fat body mass excess and hypovitaminosis D. [10], [11].

6. Conclusion

Hypovitaminosis D is high among patients with type-2 diabetes, particularly those with poor glycemic control and obesity. Vitamin-D deficiency is more prevalent in females and older patients.

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