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Correlation of Serum Vitamin D with HbA1c in Type 2 Diabetic Patients

Ameerah Abdulmunem Yaseen
Samarra University, Iraq

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ABSTRACT

Objective: *The present study aimed to investigate the correlation between the level of vitamin D and HbA1c in T2DM patients.* ***Method:*** *The samples were obtained from outpatient clinics in the city of Samarra between January 2025 and June 2025. The study comprised 45 patients with T2DM and 15 control.* ***Results:*** *The current investigation revealed an elevated HbA1c level in T2DM, with a p-value < 0.01. The study revealed a statistically significant reduction in level of vitamin D in T2DM patients, with a p-value of less than 0.01. The study demonstrated an inverse connection between the level of HbA1c and vitamin D in T2DM patients.* ***Novelty:*** *The inverse relationship between the level of HbA1c and vitamin D indicates that vitamin D insufficiency may correlate with inadequate glycemic management in individuals with T2DM.*

INTRODUCTION

Diabetes mellitus type 2, also known as T2DM, is a condition that is characterised by decreased insulin production and insulin activity. T2DM has long been a significant burden on the health of people all over the world. It is anticipated that the Middle East would have the highest prevalence of diabetes around the world by the year 2030 [1], [2].

Vitamin D, a lipophilic vitamin, is essential for equilibrium of calcium. It has also been associated with diabetes, and metabolic syndrome [3]. vitamin D is created by the synthesis that occurs in the skin when it is exposed to ultraviolet-B radiation from the sun [4]. It is believed that vitamin D, along with its receptors, plays a significant part in a number of cellular processes. These processes include the secretion of insulin by pancreatic beta-cells, the response of tissue to insulin, the regulation of glycemic levels, and the prevention of diabetic sequelae. There is evidence to show that vitamin D may alter glycemic control, insulin secretion, and insulin sensitivity through a number of different processes. For instance, beta-cells that produce insulin are the cells that express the vitamin D receptor, also known as the VDR. Beta-cells that produce insulin also possess the enzyme that is required for the conversion of 25(OH) D into 1, 25 dihydroxy vitamin D. Additionally, there is a possibility that vitamin D can improve glucose transport. In addition to this, the process of insulin production and secretion is also dependent on calcium, and as a result, it is possible for vitamin D, which is understood to be a regulator of plasma ionized-calcium levels, to exert an indirect influence on this process. Also, vitamin D was found to have a substantial impact on the reduction of an inflammatory process in individuals who were diagnosed with T2DM [5], [6], [7]

RESEARCH METHOD

Subjects

The research had a total of 60 samples, with 45 individuals presenting with T2DM, and 15 control. The age range of the participants was between 38 and 65 years, including both genders. Specimens were obtained from Sammara general hospital between September 2025 to February 2026.

Included criteria: T2DM, age (38-65).

Excluded criteria: Thyroid disorder, vitamin D supplemented

In order to prevent contamination, five millilitres of blood from the veins was collected in sterile polypropylene tubes that did not contain any anticoagulant. An attempt was made to enable the blood to coagulate in order to prevent the bursting of red blood cells. After being centrifuged, the serum that had been separated was then transferred to polypropylene tubes that were sterile, clean, and dry. The biochemical tests were carried out on the same day as the analysis.

Evaluated vitamin D

Serum concentrations were measured using ELISA. ELISA was used to test vitamin D levels. The plate was coated with human vitamin D antibodies. Sample includes vitamin D. Human vitamin D levels correlated positively with substrate solution colour. The process is stopped by adding an acidic stop solution and quantifying absorbance at 450 nm.

Assessment of HbA1c

Analytical solutions were utilised to test red blood cells that react with glycated haemoglobin to produce a 470 nm colour. American company Acon's On Call A1c HBA1c Analysis kit was used for this analysis.

Statistical analysis

P-values < P-0.01 were considered significant in SPSS programme (version 22) analysis. Results are presented as mean±SD. Data was normalised by the Shapiro-Wilk test. Pearson's correlation coefficient examined variable correlations. Statistically significant p values are below 0.05.

RESULT AND DISCUSSION

Result

The present study demonstrated increase level of the HbA1c in T2DM as compared with control (8.47±0.6, 3.9± 0.5) at p-value <0.001. As sown in Table (1).

Table 1. Level of HbA1c in T2DM and control

Parameters	Patients	Control
HbA1c %	8.47±0.6	3.9± 0.5
	0.001	

The present study demonstrated decrease level of Vitamin D in T2DM as compared with control(20.33 ± 4.7, 33.2± 5.01) at p-value <0.001. As sown in Table (2).

Table 2. Level of Vitamin D in T2DM and control

Parameters	Patients	Control
Vitamin D (ng/ml)	20.33 ± 4.7	33.2± 5.01
	0.001	

According to the findings of this research, there is a significant inverse relationship between the levels of serum vitamin D3 and HbA1c (r = -0.587, p = 0.021). As illustrated in Table 3 and Figure 1.

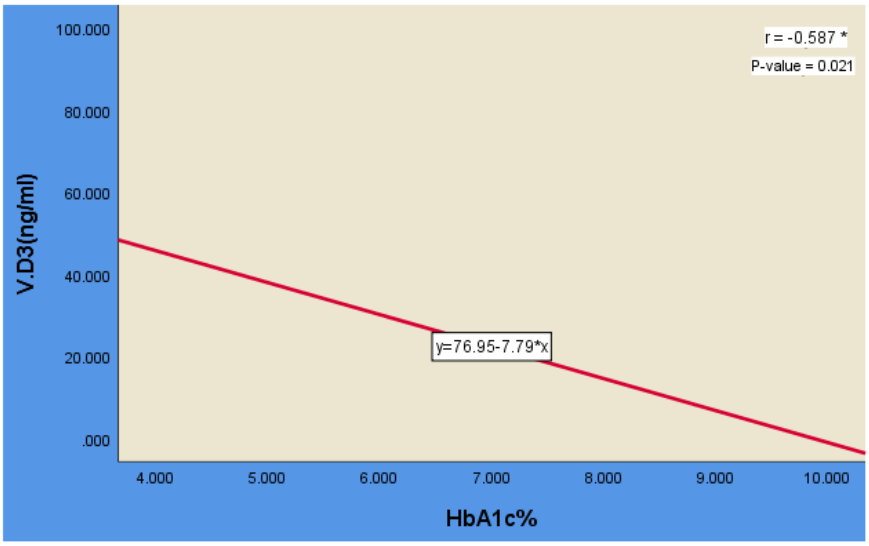

Figure 1. The correlation between VD3 and HbA1c in T2DM patients

Discussion

A study by[8] demonstrates that VD3 supplementation elevated level of 25(OH)D, which enhanced glycaemic management in the T2DM patients, evidenced by substantial decreases in FBG, HbA1c.

In a study by[9]demonstrated that the VD3 intake had no significant effect on fasting blood glucose, while HbA1c became less than 0.2% [9]. Another study by [10] demonstrated the administration of VD3 to T2DM patients showed a significant alteration in the level of HbA1c [10]. VD3 regulates diabetes via two mechanisms: its direct activation of insulin receptors and its indirect modulation of calcium flux and extracellular calcium. Calcium is essential for functions in insulin-sensitive tissues,thus, vitamin D3 enhances pancreatic β-cell activity and ameliorates insulin resistance [11].

Vitamin D modulates insulin production and release via many pathways. The active form of vitamin D, interacts with VDR to facilitate glucose transport and to promote insulin production from pancreatic β cells [12]. The anti-inflammatory effects of vitamin D may inhibit the production of nuclear factor kappa B, hence mitigating islet dysfunction and improving glucose metabolism [13]

A deficiency in vitamin D is a risk factor for diabetes that is independent upon itself. There have been other investigations that have identified a correlation between a lack of vitamin D and the reduction of the glucose-mediated production of insulin in rat

pancreatic β-cells[14]. Vitamin D administration appears to restore the glucose-mediated production of insulin, which is the opposite of what was previously observed[15]. Vitamin D has been shown to be a possible regulator of insulin secretion and Ca2+ influx, as well as a modulator of pancreatic β-cell survival, according to the findings of preclinical research [40]. When it comes to pancreatic β-cells, VDR is expressed. The action of VD3 on pancreatic β-cells is achieved by the binding to VDR [16]. Over the course of several experimental experiments, it was discovered that mice without a functional VDR exhibited a reduction in insulin production following glucose loading [5,] [17]. It has been found that the VDR response element is present in the promoter of the insulin gene in β-cells, which indicates that calcitriol increases the release of insulin [18], [19]. Vitamin D insufficiency was shown to be associated with impaired insulin production from β-cells in rats, as demonstrated by [20]. Each of these studies was conducted in rats. It has been demonstrated that increasing insulin secretion by the use of vitamin D or its active derivative can yield positive results [21], [22]. The lower levels of vitamin D were linked to higher levels of fasting blood glucose and HbA1c [23].

CONCLUSION

Fundamental Finding: The fundamental finding of this study is that patients with type 2 diabetes mellitus had much lower levels of vitamin D and significantly higher HbA1c levels compared with healthy controls. **Implication:** This finding implies that vitamin D deficiency may be associated with poor glycemic control in patients with type 2 diabetes mellitus, as indicated by the inverse correlation between vitamin D levels and HbA1c. **Limitation:** The limitation of this statement is that it does not explain the specific factors that may influence vitamin D levels and HbA1c, such as diet, sunlight exposure, medication use, duration of diabetes, or lifestyle factors. **Future Research:** Future research should involve a larger sample size and consider additional clinical and lifestyle factors to better understand the relationship between vitamin D deficiency and glycemic control in patients with type 2 diabetes mellitus.

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* **Ameerah Abdulmunem Yaseen (Corresponding Author)**
Samarra University, Iraq
Email: ameerah@uosamarra.edu.iq