Original Article

CORRELATION OF VITAMIN D LEVEL WITH THE TYPE 2 DIABETES MELLITUS IN MOSUL CITY

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ABSTRACT

Background: Vitamin D insufficiency and type 2 diabetes mellitus (T2DM) and the metabolic syndrome have been linked by epidemiological studies. It is unknown whether this association results from causation or confounding. **Aim of the study:** To examine the relationships between baselines vitamin D levels in Diabetic patients in Mosul and to compare its level between the controlled T2DM and the uncontrolled. **Patients and Methods:** In this hospital based cross-sectional study, the data were collected through direct interview with the patients. The diabetic patients were chosen and 143 patients were collected by a simple randomization technique at Mosul General Hospital during the period from 1st of October to 31st of December 2022. The data were collected by questionnaire form that includes sociodemographic characteristics as age, sex, occupations. Anthropometric measurements were calculated. The patients were sending for blood investigations that involved glucose level, HbA_{1c}, and vitamin D level. **Results:** The mean age of the study sample was 52.4±5.12 years and male to female ratio equal to 1:0.6. The mean level of the FBS among the current study sample was 234.51± 21.38 mg/dl, HbA1c was 7.92±1.94, and vitamin D was 19.25±2.96 ng/mL. According to educational levels and control status, 60.9% of uncontrolled DM and 33.9% of controlled DM among low educational level had low vitamin D level while 39.1% and 66.1% of uncontrolled and controlled DM with high education had low vitamin D level; the difference was statistically significant (p=0.002). The mean of vitamin D (Vitamin D insufficiency) among the uncontrolled DM (21.56±4.35) ng/mL was lower than that of the controlled DM (26.82±1.67) ng/mL in a statistically significant way (0.001). Moreover, the mean of vitamin D in the deficiency status among the uncontrolled DM (12.54±3.62) ng/mL was significantly (p=0.000) lower than that among the controlled DM (18.32±2.11) ng/mL. Correlation of vitamin D level with HbA1c showed an inverse good correlation coefficient (r= -0.856) which was statistically significant (p=0.000). **Conclusion:** In this study, there was a statistically significant difference in vitamin D level between uncontrolled and controlled type 2 DM patients. Moreover, the correlation between vitamin D levels and HbA1c levels among the study sample was significantly inversed.

KEYWORDS: Correlation, HbA1c, T2DM, Vitamin D.

INTRODUCTION

Middle East and North Africa (MENA) had the greatest global prevalence of diabetes in 2011 (12.5%), according to the International Diabetes Federation (IDF). By 2030, 14.3% of this is anticipated.[1] According to estimates, there were 35.4 million cases of DM in the MENA area in 2015, and by 2040, there are projections for 72.1 million cases.[2]

Vitamin D insufficiency and type 2 diabetes mellitus (T2DM) and the metabolic syndrome have been linked by epidemiological studies. It is unknown whether this association results from causation or confounding. Insulin sensitivity may be impacted by other routes by the active metabolite 1,25(OH)2D3, which influences pancreatic beta-cells and insulin secretion.[3] Vitamin D is a fat-soluble that also known as the "sunshine" vitamin and regarded as a prohormone steroid.[4] It is known that vitamin D plays a key part in maintaining calcium homeostasis and bone health as well as important roles in the endocrine, paracrine, and autocrine systems.[5,6]

Numerous randomized clinical trials based on vitamin D have been carried out to improve glycemic control in T2DM patients or slow the progression of prediabetes to

T2DM. Though frequently insignificant or clinically irrelevant, the findings of these investigations and Meta-analyses have confirmed these results.[3,7]

It is still unclear how vitamin D affects blood sugar levels and what function it plays. The most probable actions of vitamin D are inhibition of inflammation, increased uptake of peripheral and hepatic glucose, and control of insulin synthesis and secretion by pancreatic cells. Due to the existence of particular vitamin D receptors (VDR) and the expression of the 1-hydroxylase enzyme in pancreatic cells and peripheral tissues that are sensitive to insulin, such as muscle and fatty tissues, it is known that vitamin D plays a role in glucose metabolism.[8]

According to estimates, vitamin D deficiency affects about a billion individuals worldwide.[9,10] A dramatic increase in vitamin D deficiency has also been observed in the MENA area despite the region's abundant sunshine.[11,12]

The current study aimed to examine the relationships between baseline vitamin D levels in Diabetic patients in Mosul and to compare its level between the controlled T2DM and the uncontrolled.

PATIENTS AND METHODS

In this hospital based cross-sectional study, the data were collected through direct interview with the patients. The diabetic patients were chosen and 143 patients were collected by a simple randomization technique at Mosul General Hospital during the period from 1st of October to 31st of December 2022. After a short brief explanation for the research purposes and taking the oral consent from the patient, detailed information were taken by special questionnaire form that include sociodemographic characteristics as age, sex, occupations. Anthropometric measurements were calculated. The patients were sending for blood investigations that involved glucose level, HbA$_{1c}$, and vitamin D level.

The value of serum vitamin D level was further divided in following category: sufficient = 30- 100ng/ml, insufficient=20-29ng/ml, deficiency = less than 20ng/ml. the study sample was divided into uncontrolled and controlled DM according to American Diabetes Association[13] (Standards of Medical Care recognizes as targets of well-controlled diabetes: HbA1c of 7%, preprandial capillary plasma glucose between 80-130mg/dL and peak postprandial capillary plasma glucose of 180mg/dL). The appropriate statistical tests were used for analysis.

RESULTS

One hundred forty three patients those diagnosed with Diabetic Mellitus were included in the current study. The mean age was 52.4±5.12 years and male to female ratio equal to 1:0.6. The distribution of the study sample according to the age groups and gender was demonstrated in figure (1) which showed a female predominance in all age groups, with the high frequency of ≥60 age group over the others.
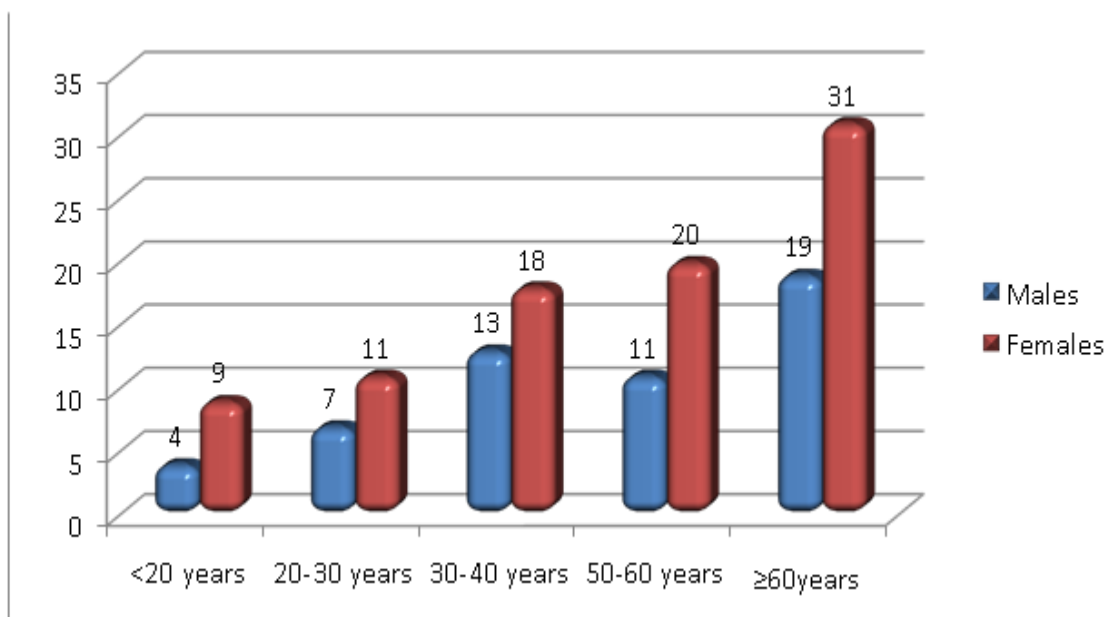
Figure (1): The distribution of the study sample according to the age groups and gender.

The distribution of the study sample according to BMI was illustrated in figure (2) and showed around half of the study sample (48.3%) had overweight, the obesity was found in 30.0%. Normal BMI constituted 21.7%.
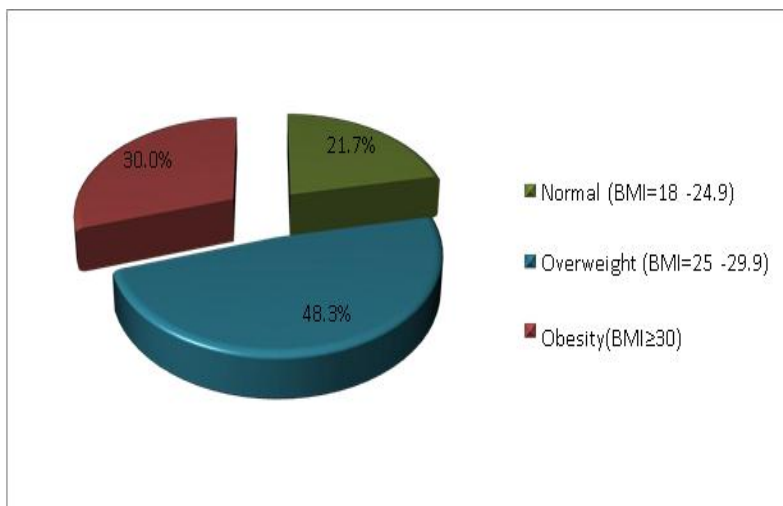
Figure 2: The distribution of the study sample according to BMI.

The statistical characteristics of the study sample regarding FBS, HbA$_{1c}$, and Vitamin D were shown in table (1) and demonstrated that the mean level of the FBS among the current study sample was 234.51± 21.38 mg/dl, HbA1c was 7.92±1.94, and vitamin D was 19.25±2.96 ng/mL.

Table 1: Statistical characteristics of the study parameters.

Study parameters	Mean	Standard deviation	Minimum Value	Maximum value
FBS	234.51	21.38	101.67	335.65
HbA1c	7.92	1.94	5.2	10.6
Vitamin D	19.25	2.96	12.0	29.1

The distribution of the study sample according to the educational levels and illustrated that 60.9% of uncontrolled DM and 33.9% of controlled DM among low educational level had low vitamin D level while 39.1% and 66.1% of uncontrolled and controlled DM with high education had low vitamin D level; the difference was statistically significant (p=0.002).

Table 2: The distribution of the low vitamin D level according to the control status and the educational levels.

Educational level	Uncontrolled DM (n=87)	Controlled DM (n=56)	p-value*
Low education	53(60.9)	19(33.9)	0.002
High education	34(39.1)	37(66.1)	
	*Chi square test		

Comparison of Vitamin D insufficiency and deficiency between uncontrolled and controlled DM was demonstrated in table (3) and revealed that the mean of vitamin D (Vitamin D insufficiency) among the uncontrolled DM (21.56±4.35) ng/mL was lower than that of the controlled DM (26.82±1.67) ng/mL in a statistically significant way (0.001). Moreover, the mean of vitamin D in the deficiency status among the uncontrolled DM (12.54±3.62) ng/mL was significantly (p=0.000) lower than that among the controlled DM (18.32±2.11) ng/mL.

Table 3: Comparison of Vitamin D insufficiency and deficiency between uncontrolled and controlled DM.

| Vitamin D status	Uncontrolled DM (n=87)	Controlled DM (n=56)	p-value*
Vitamin D insufficiency (<30-20) ng/mL	21.56±4.35	26.82±1.67	**0.001**
Vitamin D deficiency (≤20) ng/mL	12.54±3.62	18.32±2.11	**0.000**
*t-test for independent two means			

The correlation of vitamin D level with HbA1c was showed in table (3) and revealed an inverse good correlation coefficient (r= -0.856) which was statistically significant (p=0.000), and the association was illustrated in figure (1).

Table 3: The correlation of vitamin D level with HbA1c.

Pearson's R correlation of Vitamin D with HbA_{1c}	Value of correlation coefficient (r)	Asymp. Std. Error[a]	Approx. T[b]	p-value
	-0.856	0.035	-19.679	0.000[c]
a. Not assuming the null hypothesis.				

b.   Using the asymptotic standard error assuming the null hypothesis.
c.   Based on normal approximation.
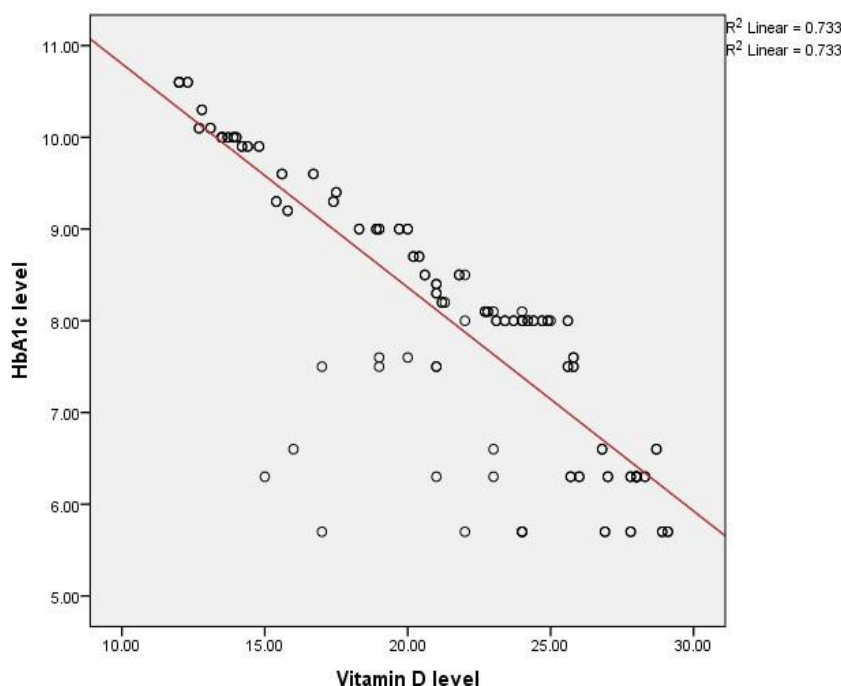
Figure 1: The correlation of vitamin D level with HbA1c.

DISCUSSION

Various studies done in different geographical region and cultural background have shown varied range of prevalence of vitamin D deficiency in diabetic group ranging from 67%- 98.8%.[14,15]

The mean age of the sample included in current study was 52.4±5.12 years, 50 patients out of 143 studied patients were older than 60 years. Talukder _et al.,_[16] study showed that from 156 study people, 58(37.18%) were in the range of 40-50 while those above 60 years represented 26(16.67%). The present study found that there were more females with type 2 DM patients than males with male to female ratio was equal to 1:0.6. This finding was in accordance with a study by Brunner and Suddart[17] in 2002 which showed that females suffered from diabetes more than males due to the higher percentage of body fat deposits found in females than males. Body fat deposits were one of the factors with the ability to reduce sensitivity to the activity of 13 insulin in

the muscles and liver. Other studies in accordance with the results of Riskesdas 2013[18] also showed that the prevalence of type 2 DM was higher 4 in females (2.3%) compared to males (2.0%).

The vitamin D level among those with higher education in this study was found significantly higher in comparison with those with lower educational levels. The same observation has been noted in a number of previous studies.[19] Bani-Issa _et al.,_ concluded that the less-educated, employed Emirati's participants had a significantly higher percentage of vitamin D deficiency than the higher-educated participants.[20] This is probably because higher education people are more aware and knowledgeable about the benefits and importance of vitamin D by obtaining it either from the food, health supplements, or sunlight exposure. Moreover, the education level is influenced by the differences in the income amount of people. Regarding the differences in the dietary habits between the T2DM group and the non-diabetic group, this phase of the present trial has

observed that there is a highly significant difference between the diabetic and non-diabetic groups in the consumption of fortified food. This finding might be attributed to the diabetic patients'fearthatthefortifiedfoodordrinksmightcontainaddedsugarthatcould increase their blood glucose levels.

By comparing the level of vitamin D between those with uncontrolled and controlled DM, the current study found a significant statistical lower level among the uncontrolled DM at the insufficient and the deficient levels. This was corresponding with the result of Azlin *et al.,*[21] study; there was no significant difference of vitamin D levels between controlled and uncontrolled type 2 DM patients. Vitamin D levels in controlled type 2 DM were (22.94±6.18) higher than uncontrolled type 2 DM (20.99±6.47) patients with p-value of 0.310. Other studies[22] also reported that there was no significant difference between HbA1c and Vitamin D levels, and normal vitamin D levels were not initially affected by increases or decreases 14 of HbA1C levels in type 2 diabetes mellitus patients. To date, it is still questionable whether vitamin D has an important role in type 2 DM although some previous research data showed that there

Vitamin D level among the current study sample was inversely correlated in a significant way with the HbA1c. Similar finding was reported by Salih *et al.,*[23] study in which an inverse association between 25(OH) D and HbA1c in diabetes mellitus type 2 patients noted. Moreover, Krul-Poel *et al.,*[24] performed a doubleblinded RCT on 275 T2DM adult patients in Netherlands in 2015 to evaluate the impact of vitamin D on the blood glucose control in T2DM patients. The authors have observed that for every 25 nmol/L (or 10 ng/mL) decrease in calcidiol level, type 2 diabetes mellitus risk was 1.01 (95% CI 0.75–1.36; P = 0.94). They have also stated that vitamin D deficiency was highly prevalent in this population. While in contrary to the present finding, Luo *et al.,*[25] reported that there was no correlation between low vitamin D levels, metabolic syndrome and glycemia in type 2 DM. The clinical impact on metabolic control in type 2 DM and correction of vitamin D deficiency will not have great clinical benefit as a therapeutic agent in diabetic patient. Also, Kumar *et al.,*[26] had evaluated the correlation between serum vitamin D levels and markers of glycemic control in Indian patients with type 2 diabetes mellitus. They found that vitamin D deficiency was observed in 52.5% of the studied cohort and vitamin D levels did not correlate with insulin resistance or glycemic control markers.

CONCLUSION

In this study, there was a statistically significant difference in vitamin D level between uncontrolled and controlled type 2 DM patients. Moreover, the correlation between vitamin D levels and HbA1c levels among the study sample was significantly inversed.

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