Article presented at 1st Int Conf Med Sci of North Technical University /Kirkuk, Iraq (1st ICMS 2023)

Original Article

Identifying the Effect of Vitamin D on the HbA1c in Patients of Type 2 Diabetes Mellitus in Mosul City

Azhar Adil Mohammad, Osamah Zaki Bakr[1], Ismail I. Daood[2]

Basic Science of Nursing Department, College of Nursing, Ninevah University, [1]Research and Development Department, General Company for Communications Equipment & Power, Ministry of Industry and Minerals, [2]Basic Science of Nursing Department, College of Nursing, Mosul University, Mosul, Iraq

Abstract

Background: Diabetes mellitus causes metabolic disturbances and defectiveness in most tissues and cells of the body, especially in the nerves, blood vessels, eyes, kidneys, and other body tissues. It is known that type 2 diabetes mellitus is one of the most prevalent diseases in the city of Mosul, due to several reasons, such as excessive carbohydrate intake, psychological disorders, obesity, and lack of exercise. Because of these and other reasons, there was a need to conduct scientific research to clarify the main reasons for diabetes, modify the method of treatment and change the lifestyle to avoid falling into these chronic diseases. **Objective:** Studying the effect of vitamin D deficiency on patients with type 2 diabetes mellitus for the population of Mosul city for the purpose of modifying the metabolism in the body. **Materials and Methods:** Fifty eight study subjects were collected from patients with type 2 diabetes mellitus (diagnosed by a specialist and HbA1c test results) with 20 control samples of approximately the same ages and body mass index. Thereafter, We have investigate the durations of improving vitamin D for more than one year and record all medical history of the patients. Eleven study subjects were excluded due to drug interactions. Forty nine subjects of a study comprised 33 females and 16 males who were included in the study after making sure that they did not take medication. None of them were pregnant or breastfeeding. Their mean age was (51.8 ± 0.2 years) and their mean BMI was (26.8 ± 0.5). The examination was carried out using immunofluorescence and dry chemistry using the I CHROMA TM II device with the materials of the device, which were provided by the manufacturer with all the materials for calibration and quality control. **Results:** Forty nine study subjects were examined by HbA1c and vitamin D level by immunofluorescence technique, and the mean results were (9.3 ± 0.1%) for HbA1c and (14.3 ± 1 ng/mL) for vitamin D. After treatment with vitamin D for 1 month. The results showed a good improvement in the results of the HbA1c examination, as their average results were (7.1 ± 0.1%), with an improvement in the results of the vitamin D examination by (48.8 ± 1 ng/mL). **Conclusions:** There was a clear improvement in the level of sugar in the blood of patients with type 2 diabetes mellitus after treatment with vitamin D and an improvement in its level in the blood.

Keywords: HbA1c, type 2 diabetes mellitus, vitamin D

Introduction

Type 2 diabetes mellitus is a long-term, non-contagious metabolic disease, and according to many global statistics, it is considered an epidemic in the 21st century.[1] The number of people infected with this disease began to double every year and the number of people with type 2 diabetes mellitus is estimated at more than 400 million patients. It is expected to rise to more than 650 million by 2040.[2] It is worth noting. Diabetes medications do not stop or eliminate the disease.[3] For these and many other reasons, scientists and researchers have sought to find true causes of this disease. Vitamin D plays a role in maintaining normal insulin secretion and reducing inflammation, the main process that causes insulin resistance. When vitamin D is deficient, many processes in the body begin to decline, paving the way for such diseases.[4] Research on diabetes in the UK indicates that vitamin D helps improve the body's sensitivity to insulin, the hormone responsible for regulating blood sugar.[5] Several studies have

Access this article online

Quick Response Code:

Website: https://journals.lww.com/mjby

DOI: 10.4103/MJBL.MJBL_362_22

Address for correspondence: Dr. Osamah Zaki Bakr, Research and Development Department, General Company for Communications Equipment and Power, Ministry of Industry and Minerals, Mosul, Iraq. E-mail: osamazaki.20102020@gmail.com

Submission: 30-Dec-2022 **Accepted:** 12-Jan-2023 **Published:** 29-Mar-2024

How to cite this article: Adil Mohammad A, Zaki Bakr O, Daood II. Identifying the effect of vitamin D on the HbA1c in patients of type 2 diabetes mellitus in Mosul city. Med J Babylon 2023;20:S1-5.

linked vitamin D deficiency to diabetes. The only way to make sure that one's vitamin D level is at the correct level is to have a blood test for 25(OH)D. The ideal blood level should be 40 ng/mL. Many researchers have begun to study the effect of vitamin D on the course of diabetes, and it was found that vitamin D supports the level of glucose in the blood and is inversely proportional to the level of HbA1c.[6,7] And there is research showing a link to a decrease in the development of gestational diabetes with vitamin D intake.[4,8,9] It should be noted that the activity of vitamin D is directly related to many physiological processes in living organisms, especially liver and intestinal functions, lipid metabolism, and vitamin E intake. Vitamin D is very important for general health, sexual health, the functioning of the immune and reproductive systems, and blood levels.[10-12]

This study was conducted to find out the effect of vitamin D deficiency on patients with Type 2 diabetes mellitus in the city of Mosul, and based on the HbA1c test to reach the extent of improvement in the disease.

Materials and Methods

Samples were collected from 58 patients with type 2 diabetes mellitus diagnosed by an endocrinologist. We started to record the subject, since first week of June 2021 till August of 2022. The medical history of each patient (age, BMI, gender, marital status, smoking, taking medications, and having medical problems in the heart, liver, kidneys, or endocrine glands, etc.). A total of nine patients were excluded from the study due to drug interactions and some health problems. The studied samples had 49 patients including 33 women and 16 men who were aged 41–68 years, with mean ages 51.8 ± 0.2 years and $P < 0.01$. Mean BMI was 26.8 ± 0.5 ($P < 0.01$). It was confirmed that not all of the studied samples took medications, nor were pregnant or breast-feeding women, and there were four male smokers. Control samples (20) were healthy subjects of approximately the same age, sex, and BMI. All assays were performed using the immunofluorescence and dry chemistry I CHROMA TM II + ® kit. All quality control checks for the materials used and calibration of the equipment are confirmed by Boditech's Supply Company, Republic of Korea.

Statistical Analysis

All statistics, tabulation, and calculations were carried out using the statistical program Minitab version 17, Excel, and ANOVA program, under the supervision of specialists in statistics and computer sciences from the University of Mosul, Mosul, Iraq.

Ethical approval

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with the patients' verbal and analytical approval before sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to the document number 433 (including the number and the date in 04/06/2021) to get this approval.

All subjects in the research (control subjects and patients) agreed to take the results of their analyses for the purpose of the study. It should be noted that all research procedures do not have any physical, health, moral, or social impact on the research participants.

Gratitude and appreciation

We extend our sincere thanks and appreciation to the staff of (KLPA) Al Kawthar Laboratory for Pathological Analysis, which is one of the most important private laboratories licensed by the Nineveh Health Department in Mosul, who provided us with all the assistance and facilities to complete the practical aspect of the research.

Results

The control group was first examined, numbering 20 people. It was confirmed that they had normal levels of vitamin D and that they did not have type 2 diabetes mellitus. Their age and BMI were at the same level as the studied samples. The mean for the vitamin D test was

Table 1: The values for control cases

No.	HbA1c (%)	Vit. D (ng/mL)	No.	HbA1c (%)	Vit. D (ng/mL)
1	5.4	42	12	4.6	52
2	4.8	40	13	5.1	64
3	5.5	48	14	5.3	67
4	4.1	44	15	4.7	63
5	4.7	45	16	4.4	58
6	5.0	62	17	5.1	71
7	4.4	73	18	5.3	60
8	5.1	55	19	4.6	59
9	5.7	47	20	5.1	58
10	5.6	50	Total	99.7	1124
11	5.2	66	Average	4.985	56.2

Table 2: Results of tests for the level of vitamin D in the blood and HbA1c for the studied samples before and after treatment with the arithmetic mean

No.	Before		After		No.	Before		After	
	HbA1c (%)	Vit. D3 (ng/mL)	HbA1c (%)	Vit. D3 (ng/mL)		HbA1c (%)	Vit. D3 (ng/mL)	HbA1c (%)	Vit. D3 (ng/mL)
1	8.2	8	6.9	36	27	8.9	21	7.3	49
2	8.7	10	7.1	41	28	8.7	14	6.3	50
3	8.9	12	6.8	48	29	8.9	13	6.9	54
4	8.6	7	6.4	38	30	9.3	9	7.2	39
5	9.1	12	7.3	44	31	9.1	12	7.1	43
6	9.5	14	7	40	32	10.4	14	8.7	48
7	9.3	10	7.2	47	33	10.7	16	7.4	42
8	8.8	18	6.8	51	34	9.8	13	7.7	49
9	9.2	17	7.3	45	35	9.4	14	7.1	53
10	9	15	7.1	43	36	9.1	21	7.3	48
11	8.8	17	6.3	49	37	8.7	12	6.2	53
12	9.4	21	7	54	38	8.5	10	6.8	54
13	9.7	9	6.9	49	39	9.3	9	7	51
14	10.4	10	7.3	51	40	9.4	13	6.9	54
15	9.9	8	7.7	42	41	9.9	17	7.6	48
16	9.3	13	7.4	48	42	10.1	19	8.1	55
17	10.1	14	7.8	52	43	10.9	18	7.8	47
18	8.7	14	6.5	49	44	8.7	11	6.1	46
19	8.9	18	7.1	67	45	8.5	16	7.1	39
20	9.8	11	7.3	52	46	8.9	15	7	42
21	9.3	12	7.4	49	47	9.2	12	6.9	59
22	10.4	17	8.1	56	48	9.9	19	6.9	64
23	10.8	20	8.8	64	49	8.1	28	6.2	48
24	9.7	19	7.4	63	Total	455.7	703	349.8	2394
25	8.1	14	6.2	42	Average	9.3	14.3	7.13	48.8
26	8.7	17	7.1	39					

56.2 ± 1 ng/mL ($P < 0.01$), and the mean for the HbA1c test was $4.98 \pm 0.1\%$ ($P < 0.01$) [Table 1].

Vitamin D level test and HbA1c test were performed for the studied samples (49 subjects). The mean vitamin D test was 14.3 ± 1 ng/mL ($P < 0.01$) and the mean of the HbA1c test was $9.3 \pm 0.1\%$ ($P < 0.01$) [Table 2]. After this, the patient was sent to specialist of the endocrinologist and treated with vitamin D at a dose of 2,000 units per day for two months, all patients were retested for HbA1c and tested. The mean HbA1c test was $7.1 \pm 0.1\%$ ($P < 0.01$), and the mean vitamin D test was 48.8 ± 1 ng/mL ($P < 0.01$). While the results show the enhance of HbA1c for all the patients in [Table 2] and Figure 1. Explaining the difference between HbA1c test results before and after treatment with vitamin D. Figure 2, also shows the extent of improvement in the HbA1c values. The values were determined using a set of modern statistical software. In Table 3 display the result of *P*-value samples are significant studies. Figure 2 shows the extent of improvement in the HbA1c values. The values were determined using a set of modern statistical software.

Discussion

Vitamin D is one of the few vitamins that a human body can produce on its own. And it needs a little help from the sun—which is why it is often referred to as the sunshine vitamin. You can also get vitamin D through the diet. Owing to the lack of exposure to the sun, the poor diet of many residents of the city of Mosul, or the presence of hormonal disorders, there will be a deficiency in the level of vitamin D in the body's systems.[13,14] Many researchers concluded that the lack of vitamins in the body is a major indicator of many diseases, especially chronic ones. Its persistent deficiency may lead to osteoporosis in adults, rickets in children, and adverse outcomes in pregnant women. It may also be linked to heart disease, diabetes, cancer, kidney disease, and high bad lipids—though more study is needed on this topic.[15-17] This disease leads to numerous and continuous complications in both Type 1 and Type 2 patients, and it may cause risks of death. And treatment through cholecalciferol drugs is the most common solution in many countries.[16,18,19] It is important for the absorption of calcium and phosphorous from the stomach, and for the work of calcium in the body.[14] There are many conclusions that indicated that treatment

Table 3: The *P*-value of the studied samples

Source of variation	SS	df	MS	*F*	*P*-value	*F* crit
Between groups	56083.49	3	18694.5	1094.192	2E–120	2.65164
Within groups	3280.358	192	17.0852			
Total	59363.85	195				

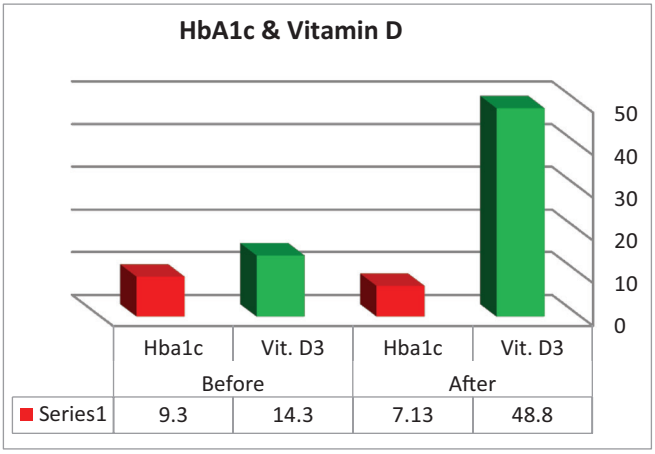

Figure 1: Arithmetic mean of HbA1c and vitamin D values before and after treatment with vitamin D

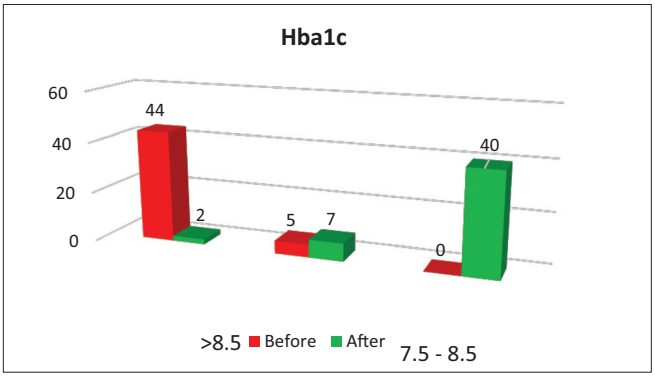

Figure 2: Change in the values of the HbA1c after treatment with vitamin D

with vitamin D has a significant effect on bone mineral density for patients with osteoporosis after menopause. The body needs daily vitamin D between 400 and 800 international units.[20] Vitamin D treatment with a dose of 2000 units per day is the best, according to many recent studies.[10,21,22] And whether in the case of type 1 or type 2 diabetes, vitamin D has an effective role in regulating and controlling blood sugar, and a group of studies showed that diabetes arises from inflammation in the body, and this inflammation affects the beta cells that secrete insulin in the pancreas. These studies have found that vitamin D may help protect these cells and improve their function, thus helping them to produce insulin more effectively.[23] It also contributes to regulating blood sugar levels by improving the response of the body's cells to insulin, so the cells get the glucose they need, which maintains the stability of blood sugar levels, and this would prevent type 2 diabetes mellitus.[24,25] Therefore, in this study, we recommend maintaining the percentage of vitamin D in the body and following up on its natural ratio in the body to maintain health in general and not to cause the body to fall into chronic diseases or other metabolic or hormonal diseases. We also recommend doing a vitamin D analysis and knowing its percentage, when the possibility of falling into type 2 diabetes mellitus, especially in its first year, to avoid chronic disease with this disease.

Conclusion

Certainly, the main objective of the research is to get rid of diabetes and modify the therapeutic pattern to get rid of it and its symptoms and complications by adjusting the levels of vitamin D in the body to obtain the functional regularity of all body systems. Where the study showed a clear improvement in blood sugar after adjusting the level of vitamin D, especially at the beginning of the disease. For a good observation, patients should have a test of vitamin D once has symptoms of type-2 diabetes mellitus appear to determine the main cause of the disease. Thus, symptoms of type-2 diabetes mellitus are highest diseases in Mosul city/Iraq.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Schleicher E, Gerdes C, Petersmann A, Müller-Wieland D, Müller UA, Freckmann G, *et al.* Definition, classification and diagnosis of diabetes mellitus. Exp Clin Endocrinol Diabetes 2022;122:384-6.
2. Forouhi NG, Wareham NJ. Epidemiology of diabetes. Medicine (Baltimore) 2019;47:22-7.
3. Alkasabera A, Onyali CB, Anim-Koranteng C, Shah HE, Ethirajulu A, Bhawnani N, *et al.* The effect of type-2 diabetes on cognitive status and the role of anti-diabetes medications. Cureus 2021;13:e19176.
4. Darraj H, Badedi M, Poore KR, Hummadi A, Khawaji A, Solan Y, *et al.* Vitamin D deficiency and glycemic control among patients with type 2 diabetes mellitus in Jazan City, Saudi Arabia. Diabetes Metab Syndr Obes 2019;12:853.
5. Wang M, Zhou T, Li X, Ma H, Liang Z, Fonseca VA, *et al.* Baseline vitamin D status, sleep patterns, and the risk of incident type 2 diabetes in data from the UK Biobank study. Diabetes Care 2020;43:2776-84.

6. Minieri M, Leoni BD, Bellincampi L, Bajo D, Agnoli A, De Angelis AM, *et al*. Serum iPTH range in a reference population: From an integrated approach to vitamin D prevalence impact evaluation. Clin Chim Acta 2021;521:1-8.
7. Zhao H, Zhen Y, Wang Z, Qi L, Li Y, Ren L, *et al*. The relationship between vitamin D deficiency and glycated hemoglobin levels in patients with type 2 diabetes mellitus. Diabetes Metab Syndr Obes 2020;13:3899.
8. Pasyechko N, Kulchinska V, Radetska L, Naumova L, Smachylo I, Bob A, *et al*. Vitamin D and diabetes mellitus type 2. Int J Med Med Res 2016;2:10-3.
9. Shao B, Mo M, Xin X, Jiang W, Wu J, Huang M, *et al*. The interaction between prepregnancy BMI and gestational vitamin D deficiency on the risk of gestational diabetes mellitus subtypes with elevated fasting blood glucose. Clin Nutr 2020;39:2265-73.
10. Chang SW, Lee HC. Vitamin D and health—The missing vitamin in humans. Pediatr Neonatol 2019;60:237-44.
11. Muñoz-Garach A, García-Fontana B, Muñoz-Torres M. Vitamin D status, calcium intake and risk of developing type 2 diabetes: An unresolved issue. Nutrients 2019;11:642.
12. Ren Z, Zhe D, Li Z, Sun X-P, Yang K, Lin L. Study on the correlation and predictive value of serum pregnancy-associated plasma protein A, triglyceride and serum 25-hydroxyvitamin D levels with gestational diabetes mellitus. World J Clin Cases 2020;8:864-73.
13. McCullough PJ, McCullough WP, Lehrer D, Travers JB, Repas SJ. Oral and topical vitamin D, sunshine, and UVB phototherapy safely control psoriasis in patients with normal pretreatment serum 25-hydroxyvitamin D concentrations: A literature review and discussion of health implications. Nutrients 2021;13:1511.
14. Alia E, Kerr PE. Vitamin D: Skin, sunshine, and beyond. Clin Dermatol 2021;39:840-6.
15. Abed TA, Chabuck ZAG. The interrelationship between diabetes mellitus and COVID-19. Med J Babylon 2022;19:1.
16. Balachandar R, Pullakhandam R, Kulkarni B, Sachdev HS. Relative efficacy of vitamin D2 and vitamin D3 in improving vitamin D status: Systematic review and meta-Analysis. Nutrients 2021;13:3328.
17. Abdullah WH, Kadhum AJ, Baghdadi GA. Diabetic nephropathy in children with type 1 diabetes mellitus with vitamin D deficiency and dyslipidemia as associated risk factors. Med J Babylon 2022;19:294.
18. Sosa Henríquez M, Gómez de Tejada Romero MJ. Cholecalciferol or calcifediol in the management of vitamin D deficiency. Nutrients 2020;12:1617.
19. PérezCastrillón JL, DueñasLaita A, Brandi ML, Jódar E, Pino-Montes J, QuesadaGómez JM, *et al*. Calcifediol is superior to cholecalciferol in improving vitamin D status in postmenopausal women: A randomized trial. J Bone Miner Res 2021;36:1967-78.
20. Orces C. The association between body mass index and vitamin D supplement use among adults in the United States. Cureus 2019;11:7-8.
21. Grübler MR, Gängler S, Egli A, BischoffFerrari HA. Effects of vitamin D3 on glucose metabolism in patients with severe osteoarthritis: A randomized doubleblind trial comparing daily 2000 with 800 IU vitamin D3. Diabetes Obes Metab 2021;23:1011-9.
22. Kojecky V, Matous J, Kianicka B, Dite P, Zadorova Z, Kubovy J, *et al*. Vitamin D levels in IBD: A randomised trial of weight-based versus fixed dose vitamin D supplementation. Scand J Gastroenterol 2020;55:671-6.
23. Perez SIA, Senior PA, Field CJ, Jindal K, Mager DR. Frailty, health-related quality of life, cognition, depression, vitamin D and health-care utilization in an ambulatory adult population with type 1 or type 2 diabetes mellitus and chronic kidney disease: A cross-sectional analysis. Can J Diabetes 2019;43:90-7.
24. Moharir G, Naikawdi A, Urmila S, Patil BS, Krishnamurthy K, Bharatha A. Effect of vitamin D on blood glucose and lipid profile in streptozotocin-induced diabetic rats. 2022:3401-3402.
25. Szymczak-Pajor I, Śliwińska A. Analysis of association between vitamin D deficiency and insulin resistance. Nutrients 2019;11:794.