Sudan Journal of Medical Sciences
Volume 18, Issue no. 4, DOI 10.18502/sjms.v18i4.14727
Production and Hosting by Knowledge E

Research Article

Assessment of Vitamin D Level and Its Relation to Glycemic Control Among Patients with Type 2 Diabetes Mellitus in Khartoum State

Ola Abdoalnasir Abdoalrasol Abdallah and Hafsa Ahmed Elrheima Ahmed*

Department of Chemical Pathology, Faculty of Medical Laboratory Science, University of Medical Science & Technology UMST, Khartoum, Sudan
ORCID:
Hafsa Ahmed Elrheima: https://orcid.org/0000-0003-3255-4529

Abstract

Background: Type II diabetes is a chronic hyperglycemic disorder. Vitamin D appears to be associated with chronic disease prevention and modulation of immunity. This study was designed to associate vitamin D levels with glycemic control among type 2 diabetes mellitus in Khartoum state.
Methods: This was a prospective case-control study conducted between June and November 2021 in Khartoum, Sudan. In total, 80 individuals were included in the study, of which 40 had type 2 diabetes mellitus, while the other 40 were normal, apparently healthy individuals. Vitamin D was measured by ELISA.
Results: SPSS was used for statistical analysis. Results showed that 20% of case group (patients with diabetes mellitus) had suboptimal vitamin D levels, whereas 80% had vitamin D deficiency. Vitamin D levels were significantly decreased among the case group when compared to the control group (P-value = 0.00). The glycated hemoglobin was negatively correlated with vitamin D level (P-value = 0.017, R = –0.376).
Conclusion: In this study, a significant decrease in vitamin D was seen among people with type 2 DM. There was a weak negative correlation between hemoglobin A1C and vitamin D level, and no significant difference in Vitamin D levels among gender and different types of treatment.

Keywords: diabetes mellitus, vitamin D, glycemic control

Corresponding Author: Hafsa Ahmed Elrheima Ahmed; email: hafsa.ahmed23@yahoo.com

Received 27 January 2023
Accepted 27 July 2023
Published 29 December 2023

Production and Hosting by Knowledge E

1. Introduction

Type II diabetes is a lifelong disease that keeps the body from using insulin as it should. People with type II Diabetes a are said to have insulin resistance [1].

Middle-aged or older people are most likely to get this kind of diabetes, which is why it was called adult-onset diabetes. However, type II diabetes affects kids and teens mainly because of childhood obesity [1].

Type II diabetes is the most common type of diabetes with about 29 million people affected in the US alone. While 84 million have pre-diabetes (high but not high enough to be diabetes yet) [2].

Vitamin D is a fat-soluble vitamin acquired from the diet and synthesized from direct sunlight exposure (cholecalciferol) [3]. This vitamin is hydroxylated as 25-hydroxyvitamin D (25OHD) in the liver and then converted into its final form, Calcitriol (1, 25 (O.H.) 2D), in the kidney cells. Vitamin D is associated with the prevention of chronic disease and modulation of immunity, regulation of cellular growth, and differentiation and induction of erythropoiesis in bone marrow cells [4].

Additional evidence has strongly suggested that vitamin D is vital in modifying the risk of type II diabetes. This effect is likely mediated by the effect of vitamin D on beta cell function, insulin sensitivity, and systemic inflammation. Vitamin D has both direct and indirect effects; the latter, via regulation of calcium, affects various mechanisms related to the path physiology of type II diabetes, including pancreatic beta cell dysfunction, impaired insulin action, and systemic inflammation [4].

The number and prevalence of people with diabetes mellitus (DM) are rapidly rising. Diabetes is a chronic progressive condition that results in significant morbidity, premature death, and economic burden to any healthcare system. This makes DM more lethal than the combined number of deaths [4].

Achieving A1C targets of <7% (53 mmol/mol) has been shown to reduce complications of type 1 and type 2 diabetes when instituted early in the course of disease [5], and it is suggested that a concentration of 60–80ng/ml of vitamin D in the body could keep blood glucose levels under control, which is vital for people with diabetes.

Therefore, this study was performed to associate vitamin D levels with glycemic control in type 2 DM.

2. Methods

2.1. Study design

This was a prospective case-control, hospital-based study.

2.2. Study area and study population

The study was conducted in Khartoum state (Yastabshiron hospital) between June and October 2022.

The study comprised 80 people who were divided into two groups: 40 healthy nondiabetic individuals as the control group and 40 individuals with type 2 diabetes as the case group.

2.3. Inclusion criteria

Patients with type 2 DM were enrolled in this study as case group.

2.4. Exclusion criteria

Individuals with renal disorder, liver disorder, history of drug intake, alcohol intake, bone disorder, vitamin D deficiency, hypoparathyroidism, hyperparathyroidism, malabsorption syndrome and those who didn't agree to participate were excluded from this study.

2.5. Sampling technique and sample size estimation

Sample size was estimated by the formula:

$n = z^2 pq(deff)/d^2$,

where n is the sample size, z is the standard normal variable (corresponding to the 95% level of significance = 1.96), p is the expected prevalence = 0.5% as determined by a preliminary study, and d is the precision corresponding to the effect size = 0.05. Based on the above data, n = (1.96)2 × P (P–1)/ (0.05)2 = 384.

However, due to a limited budget and the time factor, this equation was not used. Instead, 80 individuals were selected through convenience sampling technique.

2.6. Data collection, management, and statistical analysis

Venus blood was collected in a heparin container after cleaning the skin with 70% alcohol. Then, drawn specimens were poured slowly into a heparin container and separated by centrifugation at 3000 RPM for 3 min. Samples were saved in the refrigerator till the time of analysis.

Vitamin D level was measured using the ELISA method, and HbA1c was recorded.

Data were entered and organized into Microsoft Office Excel 2010 data sheet, then for the analysis, Statistical for Science software, version 22.0 (IBM SPSS Inc.) wase used. Initially, all information was gathered via questionnaire was coded into variables. Normality of data was tested using Kolmogorov–Smirnov test. Both descriptive and inferential statistics involving independent *t*-test, one-way ANOVA, and Pearson's correlations were used to present results. For each test, a *P*-value of <0.05 was considered statistically significant.

3. Result

Eighty participants were included in this study (40 in the case diabetic group and 40 in the healthy control individual).

The minimum age of the population was 18, while the maximum age was 43 years, with a mean age of 29.1 years for the case group and 26.5 years for the control group (Table 1).

Moreover, 62% of the population was male, whereas 38% were female; 18% of the population were smokers, while the rest 82% were non-smokers.

The minimum vitamin D level among the case group was 12.8 ng/ml, whereas the maximum level recorded was 25.6 ng/ml, with the mean being = 18.6 ng/ml.

TABLE 1: Mean difference of vitamin D levels and age among case and control group, Independent *t*-test, n = 80.

Study group		**N**	**Mean**	**SD**	**P-value**
Vitamin D	Case	40	18.6	3.2	0.000
	Control	40	29.2	8.0	
Age (yr)	Case	40	29.1	7.4	
	Control	40	26.5	6.7	

Vitamin D level is significantly decreased in the case group when compared to the control group (*P*-value ≤ 0.05 is considered significant).

TABLE 2: Distribution of the case group according to treatment, n = 40.

Variables	**Frequency**
Insulin	16
Other medications	34

Of the total population, 40% (16 individuals) use insulin as treatment, while 60% (34 individuals) are under oral hypoglycemic drugs.

In terms of the vitamin D levels, 20% of the patients (case group) had suboptimal vitamin D levels, whereas 80% had vitamin D deficiency.

While there was a weak moderate correlation between vitamin D level and HA1C, whereas no significant correlation was seen between vitamin D level and the age of patients.

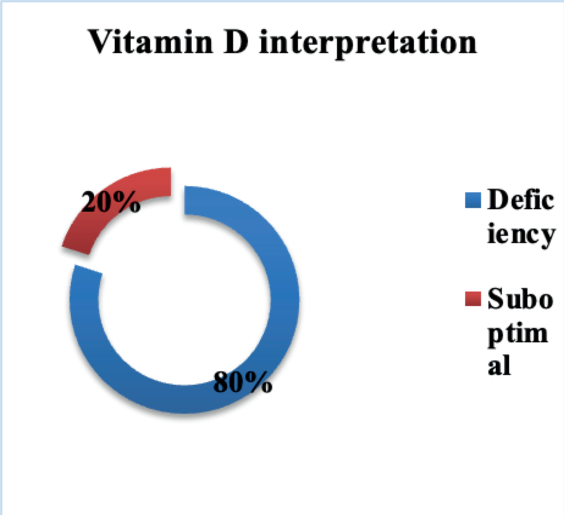

Figure 1: Distribution of the case group by Vitamin D interpretation, n = 40.

TABLE 3: Correlations between vitamin D levels and HA1C and age, Pearson's correlation, n = 40.

Correlation		HA1c	Age (yr)
Vitamin D	**N**	40	40
	R	–0.376	–0.224
	P-value	**0.017***	0.164
	Strength	Weak	Weak
	Direction	Negative	Negative

TABLE 4: Mean differences between vitamin D levels among gender, smoking status, insulin, and other medications, Independent t-test, n = 40.

Vitamin D		N	Mean	SD	P-value
Gender	Male	24	18.7	3.2	**0.956**
	Female	16	18.6	3.2	
Smoking	No	33	18.3	3.1	**0.158**
	Yes	7	20.4	3.3	
Insulin	No	34	18.4	3	**0.358**
	Yes	6	20.1	4.0	
Other medication	No	20	18.4	3.1	**0.657**
	Yes	20	18.9	3.3	

There was no significant difference in Vitamin D level among gender, smoking status, and type of treatment.

4. Discussion

The number and prevalence of people with DM are rapidly rising. Diabetes is a chronic progressive condition that results in significant morbidity, premature death, and economic burden to any healthcare system. This makes DM more lethal than the combined number of deaths [4].

This study aimed to associate vitamin D levels and glycemic control in type II DM.

The study showed a significant decrease in vitamin D level in the case when compared to the control group (*P*-value = 0.00; mean = 18.6 $\pm$ 3.2) (29.2 $\pm$ 8.0).

These findings agree with a study performed in 2021 by Jan Papaioannou I *et al.* Vitamin D deficiency is related to severe retinopathy, diabetic peripheral neuropathy, and poor cognition performance. At the same time, there is consensus about the beneficial effect of vitamin D on peripheral artery disease, foot ulceration prevention, and wound healing. Vitamin D plays a vital role on indexes of insulin and lipid profile through its impact on activating insulin receptor expression [6].

In addition, these findings agree with a study performed in 2020 by Dall'Agnol Canceler *et al*. [7].

Furthermore, the current study revealed no significant difference between vitamin D levels among gender (*P*-value = 0.956).

This result agrees with a study conducted by Mari-Anne Gall in 2010 [8], however, it disagrees with a study conducted by Anyanwu AC *et al*. [9].

In addition, the study under discussion reflected that there is no significant difference between vitamin D levels among smoking and different types of treatment, with *P*-values being equal (*P*-value = 0.158 and 0.657, respectively). This finding corresponds with a study by Silvano Adam *et al.* [10].

Moreover, this study showed an intermediate negative correlation between vitamin D level and HbA1c (*P*-value = 0.017; *R*-value = –0.376).

This result matches a study by Badurudeen Mahmood *et al.* in 2017 [11].

5. Conclusion

There was a significant decrease in vitamin D levels among patients with type 2 DM and a weak negative correlation between vitamin D level and HbA1C.

6. Impact

Patients with type II DM would benefit from vitamin D supplements to avoid the complication of DM. Also, further studies are required to measure the different forms of vitamin D.

Study Limitations

Sample size equation was not applied due to the high budget of the study with the absence of funds and short duration, only 80 participants were included.

Acknowledgements

The authors are highly grateful to Mr. Ahmed Khalid H. for his valuable assistance in data analysis.

Ethical Considerations

Approval from the ethical committee of UMST was taken. Also, the medical director's office granted approval from the hospital administration to get their permission. Furthermore, participants were verbally approved to, and samples were disposed of according to the instruction of the Ministry of Health. The results were returned to the attending physician

Competing Interests

The authors have no conflicts of interest to declare.

Availability of Data and Material

Data are available upon request through the contact person Hafsa Ahmed upon request.

Funding

None.

References

[1] Holick, M. F. (2007, July 19). Vitamin D deficiency. *The New England Journal of Medicine, 357*(3), 266–281. https://doi.org/10.1056/NEJMra070553

[2] Zoppini, G., Galletti, A., Targher, G., Brangani, C., Pichiri, I., Negri, C., Stoico, V., Cacciatori, V., & Bonora, E. (2013). Glycated haemoglobin is inversely related to serum vitamin D levels in type 2 diabetic patients. *PLoS One, 8*(12), e82733. https://doi.org/10.1371/journal.pone.0082733

[3] Papaioannou, I., Pantazidou, G., Kokkalis, Z., Georgopoulos, N., & Jelastopulu, E. (2021). Vitamin D deficiency in elderly with diabetes mellitus type 2: A review. *Cureus, 13*(1), e12506. https://doi.org/10.7759/cureus.12506

[4] Zakhary, C. M., Rushdi, H., Hamdan, J. A., Youssef, K. N., Khan, A., Abdalla, M. A., & Khan, S. (2021, August 20). Protective role of vitamin D therapy in diabetes mellitus type II. *Cureus, 13*(8), e17317. https://doi.org/10.7759/cureus.17317

[5] American Diabetes Association Professional Practice Committee. (2022). Diabetes technology: Standards of medical care in diabetes—2022. *Diabetes Care, 45*(Suppl 1), S97–S112. https://doi.org/10.2337/dc22-S007

[6] Chai, X., Jin, Y., Wei, Y., & Yang, R. (2022). The effect of vitamin D supplementation on glycemic status and C-reactive protein levels in type 2 diabetic patients with ischemic heart disease: A protocol for systematic review and meta-analysis. *Medicine*, *101* (49), e32245.

[7] Higgins, T. (2013). HbA1c for screening and diagnosis of diabetes mellitus. *Endocrine*, *43*(2), 266–273.

[8] Mari, A., GALL, A Schemes, Joergensen G and et al. (2010, October). Vitamin D level and mortality in type II diabetes. *Diabetes Care, 33*(10).

[9] Joergensen, C., Gall, M. A., Schmedes, A., Tarnow, L., Parving, H. H., & Rossing, P. (2010). Vitamin D levels and mortality in type 2 diabetes. *Diabetes Care, 33*(10), 2238–2243. https://doi.org/10.2337/dc10-0582

[10] Anyanwu, A. C., Fasanmade, O. A., Odeniyi, I. A., Iwuala, S., Coker, H. B., & Ohwovoriole, A. E. (2016). Effect of vitamin D supplementation on glycemic control in type 2 diabetes subjects in Lagos, Nigeria. *Indian Journal of Endocrinology and Metabolism, 20*(2), 189–194. https://doi.org/10.4103/2230-8210.176345

[11] Adami, S., Viapiana, O., Gatti, D., Idolazzi, L., & Rossini, M. (2008, February). Relationship between serum parathyroid hormone, vitamin D sufficiency, age, and calcium intake. *Bone, 42*(2), 267–270. https://doi.org/10.1016/j.bone.2007.10.003

[12] Buhary, B. M., Almohareb, O., Aljohani, N., Alrajhi, S., Elkaissi, S., Sherbeeni, S., Almaghamsi, A., Khan, S. A., & Almalki, M. H. (2017). Association of glycosylated hemoglobin levels with vitamin D status. *Journal of Clinical Medicine Research, 9*(12), 1013–1018. https://doi.org/10.14740/jocmr3227w