Mediterranean BioMedical Journals
Integrative Journal of Medical Sciences
2020, Volume 7, ID 215
DOI: 10.15342/ijms.7.251

CLINICAL STUDY

The Correlation between the Vitamin D Level and Glycemic Control Status among Diabetic Patients in Saudi Arabia: A Clinical Observational Study

Nasser Alqahtani [a], Eisa Ghazwani [a], Awad Alqahtani [a], Mohamed Helaly [b]

[a] Department of Family and Community Medicine, Faculty of Medicine, Najran University, KSA.
[b] Family Medicine, Najran University Hospital, KSA

ABSTRACT

Background: Vitamin D deficiency is widespread and coexisted with diabetes. However, the relation between Vitamin D level and glycemic control is not yet fully understood. This study examines the correlation between vitamin D level and glycemia indicators and diabetic microvascular complications.

Methods: The study is a cross-sectional study, had been done at the outpatient department in Najran university hospital, Saudi Arabia from May 2019 to February 2020. 220 patients recruited by simple random sampling.

Results: 60% of diabetes (n-130) had been using oral anti-glycemic medications, though most of them had uncontrolled glycemic status and had got microvascular complications. It is notable that among diabetes having a low vitamin D level; 55.5% had high FBS, 45.6% had high RBS and 65% had high HBA1C. Besides,17% have retinopathy, 16.6% have nephropathy, 26.2% have peripheral neuropathy and 1.9% have a diabetic foot.

Conclusion: The clinical and laboratory assessments are essential to control the glycemic state in diabetes. The study noted that an inverse relationship between the level of vitamin D with blood sugar levels and diabetic microvascular complications. To assure the feasibility of the prediction of vitamin D level in assessing the progress of diabetes further studies are needed.

KEYWORDS: Diabetes Mellitus; Vitamin D Level; Glycemic Control; Microvascular Complications

Correspondence: Dr Nasser Alqahtani, department of family and community medicine, faculty of medicine, Najran University, KSA. Email : drnasser1000@hotmail.com

INTRODUCTION

Diabetes mellitus is an impairment of insulin secretion that leads to raised blood glucose, impaired insulin action, or both. (1) Approximately 422 million people worldwide have diabetes in addition to one in two adults with diabetes is undiagnosed (212 million) (2). According to a recent review study, the estimated prevalence of diabetes in Saudi Arabia is around 33% (4). furthermore, diabetes continues to rise with a significant burden to the patients and health systems, and it is anticipated to reach 45.8% by 2030(3). In the management of diabetes, the optimum target is glycemic control to reduce the risk of diabetes sequelae (4).

Initially, vitamin D deficiency was known as the cause of rickets. Furthermore, it was reported that vitamin D deficiency or insufficiency is associated with other diseases (5). Vitamin D deficiency is defined when the level of 25-hydroxyvitamin D in serum less than 20 ng/mL (<50 nmol/l) (6). Vitamin D deficiency is a common health problem worldwide. (7). Recently in Saudi Arabia, some studies have estimated the prevalence of vitamin D deficiency among different populations (adults, children and adolescents, newborns, and pregnant/lactating women) is 81.0 % (8).

Many studies implicating vitamin D deficiency in various health problems like insulin resistance, allergic condition, multiple sclerosis, and cancers, and its possible role in the treatment of these conditions are in evolution and more research is needed to ascertain these findings (9). The glycemic control could be improved by vitamin D through stimulating insulin secretion; modifying systematic inflammation and immune responses, and reducing peripheral insulin resistance (10,11,12). Recent randomized controlled trials have not supported the notion that vitamin D supplementation can improve glycemic control in type 2 diabetes (13). Also, other studies have indicated negative results between vitamin D and glycemic state in populations of European descent (14, 15).

However, the association between vitamin D level and glycemic status is not yet well understood and due to the high prevalence of diabetes in our community and the heterogeneous etiology; a more research has needed to investigate the link between vitamin D deficiency and glycemic control. (16). Therefore, our study aimed to evaluate the relationship between vitamin D level and glycemic control status among diabetic patients at Najran university hospital. We hypothesis that vitamin D level might predict glycemic status in diabetes.

METHODS

The study was clinical observational; cross-sectional done from May 2019 to February 2020 at Najran university hospital in the Najran area in the Southern region of the Kingdom of Saudi Arabia. Najran university hospital has been serving all university staff, students, and their families. The hospital served 41048 patients in 2018. (17)

The study population consisted of all the patients with Diabetes Mellitus attending the outpatient department clinics (family medicine, internal medicine, and endocrine clinic), except those with gestational diabetes. The study subjects were 220 patients recruited by simple random sampling.

The data was collected from the patient medical records by using a checklist. The checklist was prepared by the researchers and revised by three family medicine consultants to assure its appropriateness with the purpose of the study.

The study variables including serum vitamin D level as an independent variable, where the participants were classified into three groups; deficient if less than 20 ng/ml insufficient 21-29 ng /ml and normal >29 ng/ml. The dependent variables were the indicators of glycemic status, heamoglobineA1C (HbA1C), pre-prandial capillary plasma glucose, and postprandial capillary plasma glucose. According to the American Diabetes Association's (ADA) Standards of Care recommendation, participants were considered having controlled diabetes if their HbA1c was less than 7%, pre-prandial capillary plasma glucose 80–130mg/dL (4.4–7.2 mmol/L) and peak postprandial capillary plasma glucose<180mg/dL (10.0 mmol/L). (18)

The study included additional variables: demographic characteristics in form of age (<30/30-60/>60), gender (male/female), DM type (one-two), serving clinic (family medicine /internal medicine/endocrine) and treatment options (oral/mixed/injectable); coexisting health problems (hypertension, dyslipidemia, overweight/obesity, heart disease, and thyroid disease); diabetic microvascular complications (retinopathy, nephropathy, peripheral neuropathy, and diabetic foot).

Ethical approval was obtained from the ethical committee of the faculty of medicine at Najran university and issued from Najran university hospital administration. The researchers conducted the study based on their funds.

After checking for completeness of data, the coding had made to start the analysis. For statistical analysis, we used statistical package for social sciences (SPSS v. 23), from which we used: descriptive statistics to describe the basic features of the data in the study through frequencies and percentages with the graphical chart. Chi-square tests were performed to test the relations between variables in the study, which applied to determine any significant association between two categorical variables from a single population. The sample size was (N= 222), to minimize the bias associated with attrition and missing data, MCAR Test (Missing completely at random) was performed, the data found missing completely at random since p-value (> 0.05) was not significant at the 0.05 level.

RESULTS

Table 1 shows the frequencies and percent of the demographic data of the study sample. The highest percent of recruited patients were male (60.4%) about most of them, 62.9% were in middle age (30 - 60 years). Most of the recruited patients (n=196, 90.7%) had type 2 DM and around 60% on oral anti-glycemic medications.

Table 1: Basic characteristics of the study sample

Variables	Categories	N	%
Clinic	Family Medicine	69	31.2
	Internal Medicine	39	17.6
	Endocrine	113	51.1
Gender	Male	131	60.4
	Female	84	38.7
Age	<30	12	5.4
	30-60	139	62.9
	>60	70	31.7
DM type	Type 1	20	9.3
	Type 2	196	90.7
Treatment	Oral	130	59.6
	Mixed	61	28.0
	Injectable	27	12.4

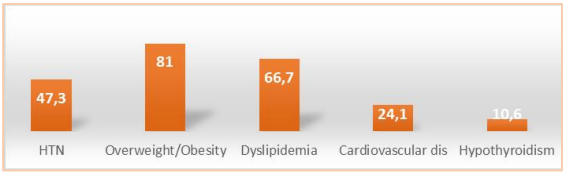

Figure 1 : Coexisting Health Problems

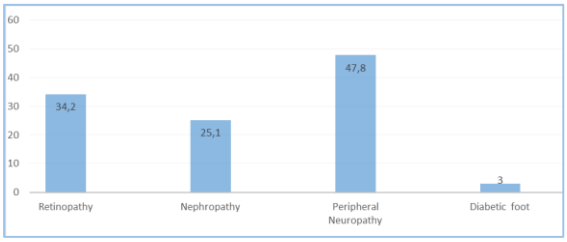

Figure 2 : DM complications

Table 2: Association between Vitamin D level and glycemic control

Glycemic control			Vitamin D			Chi-Square (P-value)
			Low	Normal	High	
FBs	Normal	N	32	30	3	1.495
		%	23.2%	21.7%	2.2%	(0.474)
	High	N	40	32	1	
		%	29.0%	23.2%	0.7%	
RBS	Low	N	1	2	0	
		%	0.8%	1.5%	0.0%	
	Normal	N	36	41	2	4.574
		%	27.3%	31.1%	1.5%	(0.334)
	High	N	31	17	2	
		%	23.5%	12.9%	1.5%	
HBA1c	Normal	N	29	38	3	
		%	17.2%	22.5%	1.8%	3.155
	High	N	54	43	2	(0.206)
		%	32.0%	25.4%	1.2%	

The glycemic control results show in Table 2 that (52.9%) had high FBS, (37.9%) had high RBS, and (58.6%) had high HbA1c. Chi-Square results show that around (55.5%) of patients with low vitamin D level had high FBS, (45.6%) of patients with low vitamin D levels had high RBS and (65%) of patients with low vitamin D level had high HBA1C. However, no of these associations between vitamin D level and glycemic control in diabetes are statistically significant ($p > 0.05$).

Table 3: Percentage & frequencies of diabetic microvascular complications among diabetes with different levels of vitamin D

Diabetic microvascular complications			Vit. D			Total
			Low	Normal	High	
Retinopathy	Yes	Count	26	28	2	56
		% of Total	17.0%	18.3%	1.3%	36.6%
	No	Count	53	42	2	97
		% of Total	34.6%	27.5%	1.3%	63.4%
Nephropathy	Yes	Count	24	18	1	43
		% of Total	16.6%	12.4%	0.7%	29.7%
	No	Count	49	50	3	102
		% of Total	33.8%	34.5%	2.1%	70.3%
P. neuropathy	Yes	Count	43	36	1	80
		% of Total	26.2%	22.0%	0.6%	48.8%
	No	Count	37	43	4	84
		% of Total	22.6%	26.2%	2.4%	51.2%
D. foot	Yes	Count	3	3	0	6
		% of Total	1.9%	1.9%	0.0%	3.8%
	No	Count	75	75	4	154
		% of Total	46.9%	46.9%	2.5%	96.3%

Table 3 shows that among diabetic having low vitamin D level, 17% have retinopathy, 16.6% have nephropathy, 26.2% have p. neuropathy and 1.9% have a diabetic foot. Nevertheless, Chi-Square Tests show no significant association between vitamin D level and any diabetic micro-complications.

DISCUSSION

In the present study, more than 60% of the study sample (n=222) were male in middle age (30 - 60 years). Similar studies have found a higher prevalence of type 2 diabetes among men than women. Furthermore, visceral fat was generally the strongest predictor of diabetes. (19, 20) It was remarkable that 60% of diabetic patients (n-130) had been using oral anti-glycemic medications, even though most of the patients had uncontrolled glycemic status, high FBS, high RBS and high HbA1c with 52.9%,37.9% and 58.6%, respectively.

Cardiovascular disease is the leading cause of morbidity and mortality among individuals with diabetes which accounted for 68% of all diabetic death. (21) Despite that many cases are preventable; diabetes, obesity and dyslipidemia are known significant risk factors of cardiovascular disease (CVD) and stroke. The present study showed that 81% of diabetic patients were overweight and obese, while 66.7% had dyslipidemia and about half (47%) had hypertension. These findings were similar to the results of a study conducted in the gulf region revealed hypertension (83.40%), obesity (90.49%) and dyslipidemia (93.43%) among type 2 diabetes patients. (22) Likewise, several studies have found a link between overweight, dyslipidemia, hypertension and Vitamin D deficiency (VDD). (23) Furthermore, the present study found that diabetic patients are more likely to develop microvascular complications; peripheral neuropathy, retinopathy and nephropathy as follows: 48%, 34% and 25%, respectively.

Vitamin D deficiency (VDD) is reported to be higher up to 70.6% among people with diabetes. (24) This study found

that among diabetes having low vitamin D level; 55.5% had high FBS, 45.6% had high RBS and 65% had high HBA1C with no of these associations were statistically significant (p>0.05). The result is consistent with the results of previous studies that have reported that VDD is associated with poor glycemic control. (25) Moreover, it is in contrast with previous research that found that vitamin D is not associated with HbA1c. (26)

By looking at the correlation between the vitamin D and diabetic microvascular complications, despite statically no significance, we noted that among diabetes who have a low vitamin D level; 26.2% have peripheral neuropathy, 17% have retinopathy, 16.6% have nephropathy and 1.9% have a diabetic foot. These findings were in line with other studies that found there is a significant positive link between diabetic retinopathy and VDD in patients with T2DM. (27,28) The association between vitamin D deficiency and increase risk of diabetic peripheral neuropathy (DPN) in patients with type 2 diabetes was shown in the result of one meta-analysis (odds ratio [OR] 2.88; 95 % CI, 1.84–4.50; p < 0.00001). Another meta-analysis showed an independent association between vitamin D deficiency and increased risk of DPN in type 2 diabetes (OR 2.68; 95 % CI, 1.67–4.30; p < 0.0001). (29) A meta-analysis by Pittas et al. reported that vitamin D deficiency was common in diabetes, and diabetic complications could be delayed by vitamin D supplementation. (30).

Our goal in the treatment of diabetes is to control the blood sugar level and delay the onset of complications. To achieve this goal, a range of non-pharmacological measures are needed in addition to drug interventions and to monitor the progress regularly. Assessment through the clinical and laboratory measurements is essential in every visit. As part of scientific explanations that examine the relationship between vitamin D level, blood sugar levels , and diabetes complications; it has been noted that vitamin D is high in diabetics, as well as an inverse relationship between the level of vitamin D in the blood with blood sugar levels and the diabetic complications. Although considering the limitations of observational study design to generalize the findings, the context of studies in the feasibility of the prediction of vitamin D levels in assessing the progress of diabetes calls for further observation, analysis, and linking of results.

AUTHORS' CONTRIBUTIONS

The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors. Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

COMPETING INTERESTS

The authors declare no competing interests.

FUNDING SOURCES

None.

REFERENCES

[1] Punthakee Z, Goldenberg R, Katz P. Definition, classification and diagnosis of diabetes, prediabetes and metabolic syndrome. Can J Diabetes. 2018;42:S10–5. doi: 10.1016/j.jcjd.2017.10.003.

[2] International Diabetes Federation: IDF Diabetes Atlas, 2019 [article online]. Available from www.diabetesatlas.org

[3] Meo SA. Prevalence and future prediction of type 2 diabetes Mellitus in the Kingdom of Saudi Arabia: a systematic review of published studies. J Pak Med Assoc. 2016;66(6):722–725.

[4] American Diabetes Association. 6. Glycemic targets: standards of medical care in diabetes—2018. Diabetes Care. 2018;41((Supplement 1)):S55–64.

[5] Recognition and Management of Vitamin D Deficiency;PAULA BORDELON, DO; MARIA V. GHETU, MD; and ROBERT LANGAN, MD, St. Luke's Family Medicine Residency Program, Bethlehem, Pennsylvania,Am Fam Physician. 2009 Oct 15;80(8):841-846.

[6] Simsek Y, Kucukler FK, Arduc A, Guler S. Is there an association between vitamin D level and microvascular complications of type 2 diabetes mellitus? West Indian Med J Open. 2015;2(3): 138–14

[7] M.F. Holick, T.C. Chen, Vitamin D deficiency: a worldwide problem with health consequences, Am. J. Clin. Nutr. 87 (4) (2008) 1080S–1086S

[8] Nasser M. Al-Daghri. Vitamin D in Saudi Arabia: Prevalence, distribution and disease associations. Journal of Steroid Biochemistry & Molecular Biology 175 (2018) 102–107

[9] Hart PH. Vitamin D supplementation, moderate sun exposure, and control of immune Diseases. Discov Med. 2012;13:397–404.

[10] Gysemans C.A., Cardozo A.K., Callewaert H., Giulietti A., Hulshagen L., Bouillon R., Eizirik D.L., Mathieu C. 1,25-Dihydroxyvitamin D3 modulates expression of chemokines and cytokines in pancreatic islets: implications for prevention of diabetes in nonobese diabetic mice. Endocrinology. 2005;146:1956–1964. doi: 10.1210/en.2004-1322.

[11] Park S., Kim D.S., Kang S. Vitamin D deficiency impairs glucose-stimulated insulin secretion and increases insulin resistance by reducing PPAR-gamma expression in nonobese Type 2 diabetic rats. J. Nutr. Biochem. 2016;27:257–265. doi: 10.1016/j.jnutbio.2015.09.013.

[12] Zhou Q.G., Hou F.F., Guo Z.J., Liang M., Wang G.B., Zhang X. 1,25-Dihydroxyvitamin D improved the free fatty-acid-induced insulin resistance in cultured C2C12 cells. Diabetes Metab. Res. Rev. 2008;24:459–464. doi: 10.1002/dmrr.873.

[13] Nigil haroon n, anton a, john j, mittal m , Effect of vitamin D supplementation on glycemic control in patients with type 2 diabetes: a systematic review of interventional studies . J Diabetes Metab Disord. 2015 Feb 12;14:3. doi: 10.1186/s40200-015-0130-9. eCollection 2015. https://www.ncbi.nlm.nih.gov/pubmed/25722966

[14] Afzal S, Brondum-Jacobsen P, Bojesen SE, Nordestgaard BG (2014) Vitamin D concentration, obesity, and risk of diabetes: a mendelian randomisation study. Lancet Diabetes Endocrinol 2(4):298–306. https://doi.org/10.1016/S2213-8587(13)70200-6

[15] Ye Z, Sharp SJ, Burgess S, Scott RA, Imamura F, InterAct C, Langenberg C, Wareham NJ, Forouhi NG (2015) Association between circulating 25-hydroxyvitamin D and incident type 2 diabetes: a mendelian randomisation study. Lancet Diabetes Endocrinol 3(1):35–42. https://doi.org/10.1016/S2213-8587(14)70184-6

[16] Almetwazi MS, Noor AO, Almasri DM, et al. The association of vitamin D deficiency and glucose control among diabetic patients. Saudi Pharm J. 2017;25(8):1179–1183. doi:10.1016/j.jsps.2016.09.002

[17] Najran hospital annual report 2018

[18] American Diabetes Association, "6. Glycemic Targets: Standards of Medical Care in Diabetes," 2019) Diabetes

Care 2019;42(Suppl. 1):S61–S70 https://doi.org/10.2337/dc19-S006

[19] Nordström et a, Higher Prevalence of Type 2 Diabetes in Men Than in Women Is Associated with Differences in Visceral Fat Mass, J Clin Endocrinol Metab, October 2016, 101(10):3740–3746

[20] Kautzky-Willer A, Harreiter J, Pacini G. Sex and Gender Differences in Risk, Pathophysiology and Complications of Type 2 Diabetes Mellitus. Endocr Rev. 2016;37(3):278–316. doi:10.1210/er.2015-1137

[21] Bhupathiraju SN, Hu FB. Epidemiology of Obesity and Diabetes and Their Cardiovascular Complications. Circ Res. 2016;118(11):1723–1735. doi:10.1161/CIRCRESAHA.115.306825

[22] Jelinek HF, Osman WM, Khandoker AH, et al, Clinical profiles, comorbidities and complications of type 2 diabetes mellitus in patients from United Arab Emirates. BMJ Open Diabetes Research and Care 2017;5:e000427. doi: 10.1136/bmjdrc-2017-000427

[23] Rolim MC, Santos BM, Conceição G, Rocha PN. Relationship between vitamin D status, glycemic control and cardiovascular risk factors in Brazilians with type 2 diabetes mellitus. Diabetol Metab Syndr. 2016;8(1):77.

[24] Suzuki A, Kotake M, Ono Y, Kato T, Oda N, Hayakawa N, et al. Hypovitaminosis D in type 2 diabetes mellitus: Association with microvascular complications and type of treatment. Endocr J. 2006;53:503–10.

[25] Hussain Darraj, Mohammed Badedi, Kirsten R Poore 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: 853–862.

[26] Sheth JJ, Shah A, Sheth FJ, Trivedi S, Lele M, Shah N, Thakor P, Vaidya R. Does vitamin D play a significant role in type 2 diabetes? BMC Endocr Disord. 2015 Feb 26;15:5.

[27] Ahmadieh H, Azar ST, Lakkis N, Arabi A. Hypovitaminosis D in patients with type 2 diabetes mellitus: a relation to disease control and complications. ISRN Endocrinol. 2013;2013:641098.

[28] Suzuki A, Kotake M, Ono Y, et al. Hypovitaminosis D in type 2 diabetes mellitus: association with microvascular complications and type of treatment. Endocr J. 2006;53(4):503–510.

[29] Lv WS, Zhao WJ, Gong SL, Fang DD, Wang B, Fu ZJ, et al. Serum 25-hydroxyvitamin D levels and peripheral neuropathy in patients with type 2 diabetes: a systematic review and meta-analysis. J Endocrinol Invest 2014, Dec 21. [Epub ahead of print]

[30] Pittas AG, Lau J, Hu FB, Dawson-Hughes B. The role of vitamin D and calcium in type 2 diabetes. A systematic review and meta-analysis. J Clin Endocrinol Metab. 2007;92:2017–29.