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Original Article

Vitamin D status in diabetic patients (type 2) and its relation to glycemic control & diabetic nephropathy

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ABSTRACT

Background: Vitamin D deficiency appears to be lower in diabetic patients. Vitamin D may affect glycemic control & diabetic nephropathy.
Aim: To assess vitamin D level in type 2 diabetic patients and its relation to their glycemic control and development of nephropathy compared to healthy controls.
Design: and Setting: Case control study including 82 participants (41 cases and 41 controls) from Family Medicine Clinic, Cairo University Hospitals.
Method: Participants fulfilling the inclusion criteria were allocated into two groups, diabetes and control groups. History was taken, examination was done, and blood sample was withdrawn for analysis of Vitamin D levels and HBA1C. From the diabetic group only, serum creatinine was assessed and urine sample was collected for microalbuminuria. The results were analyzed using SPSS program version 21.
Results: Vitamin D level was lower in the diabetic group compared to control (65.5% and 56.1%). Vitamin D level was inversely proportionate to HbA1c levels in the diabetic patients (p value 0.000 & r −0.482), as well as to the A/C ratio (p value 0.01 & r −0.396).
Conclusion: Vitamin D level appeared to be lower in diabetic patients and is associated with poor glycemic control & microalbuminuria.

1. Introduction

Vitamin D deficiency is a worldwide health problem that is currently associated with chronic diseases, such as cardiovascular disease, diabetes mellitus and some cancers as prostate and colon cancer [1].

Vitamin D deficiency is affecting about one billion people worldwide mainly due to inadequate sunlight exposure [2]. Surprisingly most individuals suffering from vitamin D deficiency are living in sunny countries like Egypt [3].

Vitamin D is found to be deficient in patients with type 2 Diabetes mellitus [4]. It may affect insulin secretion in diabetic patients in multiple ways [5]. This may be explained by the role of Vitamin D in regulating the secretion of insulin from the pancreas [6] and the role of vitamin D deficiency in increased insulin resistance [7], and decreasing insulin sensitivity at target organs as skeletal muscles [8].

Vitamin D deficiency was found to be associated with diabetic nephropathy. There is increase in the prevalence of microalbuminuria with decreasing vitamin D level [9]. It was also found that treatment with vitamin D in patients with chronic kidney disease improves kidney functions, decreasing urinary albumin creatinine ratio (ACR) and improving estimated glomerular filtration rate (eGFR) [10].

2. Method

This is a cross-sectional case control study carried out at the family medicine outpatient clinic at Cairo University hospital. The participants were selected on 3 working days weekly from March to July 2017. A total sample size of 82 (41 in each group) was calculated using the G power program with power 80% and 5% significance level was sufficient to fulfill the study objectives.

The diabetic patients age ranged from 18 to 70 years old, were treated by diet with or without oral antidiabetic medications and not receiving vitamin D or calcium supplementation, however diabetic patients receiving insulin, obese (BMI >30), pregnant or lactating females and patients with advanced stages of diabetic nephropathy (A/C ratio >300) were excluded.

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Healthy persons aged 18–70 years who were not receiving vitamin D or calcium supplementation and have no history of diabetes or kidney problems and not obese were included as controls.

Participants fulfilling inclusion criteria were randomly selected and informed oral consent was taken from them.

Socio-economic status (SES) was evaluated by El-Gilany questionnaire; a scale includes 7 domains with a total score of 84, with a higher score indicating better SES. Full history, general examination including anthropometric measurements; (weight and height for calculating BMI) and systemic examination including cardiac, chest and abdominal examination were done.

Blood sample was then withdrawn from the study participants (cases & controls) to measure, glycosylated hemoglobin (HBA1C) and vitamin D (25(OH) D3) level, while form the diabetic group, in addition serum creatinine was measured and urine sample was collected to assess for albumin creatinine ration (A/C ratio).

HBA1C was considered controlled if $\leq 7\%$ [11], Normal vitamin D (>=30 mg/dl) [12], and microalbuminuria considered with A/C ratio >30 mg/dl [13].

2.1. Statistical analysis of data

Data were statistically described in terms of mean, standard deviation (SD), or frequencies (number of cases) and percentages when appropriate. For comparing categorical data, Chi-square [2] test was performed. P values less than 0.05 was considered statistically significant. All statistical calculations were done using computer program SPSS (Statistical Package for the Social Science) version 21.

3. Results

As shown in (Table 1) most of the diabetics were females, between 40 & 60 years old (49.6 ± 7), living at Urban areas and of moderate SE class, while the control group were younger than 40 years old (33.9 ± 9) and of high SE class. The discrepancy in the age between the two groups of the study may be explained by the more prevalence of type 2 diabetes among the middle aged adults while the control were younger being more willing to screen their vitamin D levels.

As demonstrated in (Fig. 1) vitamin D level was lower in diabetics (57.4%) compared to non diabetics (42.6%) with p-value 0.062). As seen in (Table 2) low vitamin D level is associated with uncontrolled blood glucose as well as nephropathy and this was statistically significant.

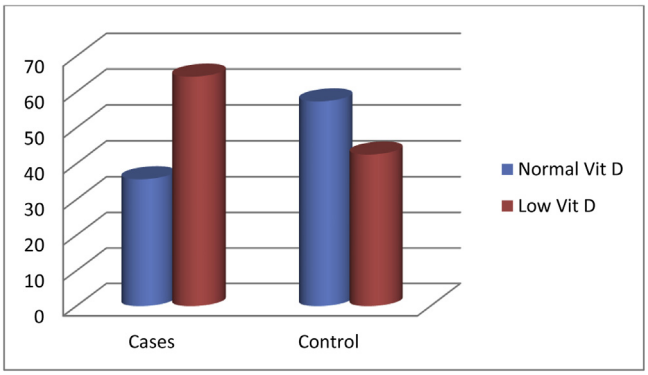

Fig. 1. Vitamin D status in the study participants.

Table 2
Vitamin D level in relation to glycemic control & diabetic nephropathy.

Normal Vitamin D	Low Vitamin D				P value
	No	%	No	%	
Glycemic control					
Controlled diabetic (n = 27)	10	37	17	63	0.009*
Uncontrolled (n = 14)	0	0	14	100	
Diabetic nephropathy					
No nephropathy (n = 16)	9	56.2	7	43.8	0.009*
With nephropathy (n = 25)	1	4	24	96	

Data in (Table 3) showed that there was inversed significant correlation with moderate strength between vitamin D levels and the participants' age, BMI, the HBA1C level and microalbuminuria. About the correlation between vitamin D and Socioeconomic Scale was direct highly significant of high strength.

Table 3
Correlation of Vitamin D Levels and different factors.

Vitamin D level	R	P
Age	−0.323	0.003*
SES	0.732	0.000*
BMI	−0.427	0.000*
HBA1C	−0.482	0.000*
A/C Ratio	−0.396	0.01

Table 1
Socio-demographic characteristics of the whole studied group.

Socio-demographic characteristics:	Study Sample						p value
	Cases No. = 41		Control No. = 41		Total No. = 82		
	No.	%	No.	%	No.	%	
Sex:							
Male	8	19.5	8	19.5	16	19.5	1.00
Female	33	80.5	33	80.5	66	80.5	
Age							
<40	2	4.9	29	70.7	31	37.8	0.000*
40-<60	35	85.4	12	29.3	47	57.3	
>=60	4	9.8	0	0.0	4	4.9	
Residency:							
Urban	30	73.2	34	83	64	78	0.000*
Rural	11	26.8	7	17	18	22	
SES (score 0–84)							
Low (=<42)	6	14.6	1	2.4	7	8.5	0.085
Moderate (43–63)	19	46.3	17	41.5	36	43.9	
High (64–84)	16	39.0	23	56.1	39	47.6	

4. Discussion

The prevalence of low serum 25-hydroxyvitamin D is more common in diabetics compared with non-diabetics. However this difference didn't reach statistical significance, due to the decrease in vitamin D levels in the controls as well. The study population was taken from the urban area of Cairo with limited exposure to sun & cultural overdressing. However [14], studied the prevalence of vitamin D levels among diabetic patients in Saudi Arabia and found that the prevalence of low serum 25-hydroxyvitamin D is more common in diabetics compared with non-diabetics 83% vs. 70% while [6], found a significant difference between diabetic cases and controls in vitamin D levels with p value < 0.0001, this reflects that vitamin D deficiency may be a risk factor for DM as it was found to be related to a higher risk for insulin resistance.

There was inverse correlation between vitamin D levels and age, Vitamin D levels significantly decreased with increasing age. This is expected, since the skin thickness decreases with age and thus, the production of 7-DHC is also compromised. Also, it could be due to the fact that with advancing age, a more sedentary and indoor lifestyle is adopted [15]. found that there was a significant inverse relationship between age and 25(OH) D levels. In the Southwest Region of Cameroon; A direct significant correlation between vitamin D levels and socioeconomic status (SES) was found, as did [16]. This may be due to the lack of awareness or proper attention to health matters, family structure and life style factors like in-door working or working in close environment with minimum sun exposure is also likely for high prevalence of vitamin D deficiency in our population.

BMI is a confounder that determines vitamin D concentrations and being diabetic made them to be vulnerable for more vitamin D deficiency [17]. found that in normal and overweight subjects serum 25 (OH) D levels decreased with increasing BMI. Increased BMI may be a risk factor for vitamin D deficiency as greater amounts of subcutaneous fat may sequester more of the vitamin and alter its release into the circulation; obesity is also linked to an unhealthier lifestyle, characterized by less physical activity, less sun exposure.

An inverse correlation between HbA1c and vitamin D was found, indicating that vitamin D levels may affect glucose control in diabetes mellitus type 2 through facilitating insulin secretion and stimulation of insulin receptors or the diabetes control may affect the vitamin D metabolism or that vitamin D metabolism is affected by the bad compliance to diabetes control. Further studies are needed to test the therapeutic effect of vitamin D replacement on the diabetes control.

There was a strong significant inverse correlation (p value 0.01 & r −0.396) between circulating vitamin D concentrations and the A/C ratio.

Study limitations: Small sample size.

5. Conclusion

Vitamin D deficiency is a common problem. Prevalence of vitamin D deficiency among diabetic patients was higher in diabetics than healthy controls, vitamin D levels is inversely correlated to glycemic control & vitamin D levels are lower in diabetic patients with nephropathy.

Funding

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Ethical approval

The study protocol was discussed by selected staff members of the Family Medicine Department, Faculty of Medicine, Cairo University, and was approved by its council held in April 2016. The Research Committee of the same faculty approved it in September 2016. The study protocol was also approved from the Research Ethical Committee of Faculty of medicine Cairo University in September 2016.

An informed consent was obtained from every patient before filling the questionnaires. They were reassured about the strict confidentiality of any obtained information, and that the study results would be used only for the purpose of research.

Conflicts of interest

Authors declare there is no conflict of interest regarding the publication of this paper.

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