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VITAMIN D SUPPLEMENTATION EFFECT ON HBA1C LEVEL-A CROSS SECTIONAL STUDY

Dr. Sonali Rode[1], Dr. Jyoti Shukla[2], Dr. Mahavir Mundra[3], Dr. Gaurav Gidwani[4]

[1]Professor and Head, Department of Pharmacology, Shri Balaji Institute of Medical Sciences, Raipur, Chhattisgarh, India

[2]Assistant Professor, Department of Biochemistry, SRVS Government Medical College, Shivpuri, Madhya Pradesh, India

[3]Assistant Professor, Department of Biochemistry, Government Medical College, Nagpur, Maharashtra, India

[4]Government Medical College, Gondia, Maharashtra, India

Corresponding Author:
Dr. Gaurav Gidwani
Email: garvhg11@gmail.com

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ABSTRACT

Background: Glycemic control is essential to halt the progression of diabetic complications. Diabetes is a metabolic disease that can affect nearly every organ system in the body. Recently, vitamin D has sparked wide spread interest in the pathogenesis and prevention of diabetes

Material and Methods: Total 100 individuals with type 2 diabetes, aged between 20- 85 years, who for diabetic checkup and satisfy our inclusion criteria were enrolled for this study. All patient socio demographic information was collected and relevant investigation was done. All patients received vitamin D supplementation for 12 weeks. HbA1c and vitamin D level was measured before and after supplementation. **Result**: Out of the total 100 patients, 69 patients had a deficient vitamin D level, 19 patients had a vitamin D level in the insufficiency range and rest had normal vitamin D levels. There was an inverse correlation between HbA1c and vitamin D levels which was also found to be statistically significant. HbA1c level (mean ± SD= 8.92 ± 0.72) improved significantly after vitamin D supplementation to the level of 7.83 ± 0.66 ($P<0.05$). There was a significant difference between groups of HbA1c level of (first tertile<7.5%, second tertile 7.6%-9.9%, third tertile ≥10%) after supplementation with vitamin D ($P <0.001$).

Conclusion: There is an inverse correlation between vitamin D levels and control of diabetes as measured by HbA1c. Vitamin D supplementation in type 2 diabetes patients, with vitamin D deficiency lead to significant improvement in glycemic control and reduced the HbA1C level

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Keywords: HbA1c, Type 2 Diabetes, Vitamin D, 25-hydroxyvitamin D.

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disorders distinguished by chronic high blood glucose levels (hyperglycemia) resulting from the impairment of insulin action, insulin secretion, or both. This disruption leads to abnormalities in proteins, lipids, and carbohydrates metabolism [1, 2]. Vitamin D deficiency is characterized by having a serum 25 hydroxy vitamin D (25(OH) D) level below 20 ng/mL (50 nmol/L), and moderate deficiency is indicated by 25(OH) D levels below 10 ng/mL (25 nmol/L) [3]. Earlier research has established a strong inverse correlation between serum vitamin D levels and glycemic control indicators, including fasting blood glucose (FBG) and glycated haemoglobin (HbA1c) levels [4]. Vitamin D improves glucose tolerance and prevents type 2 diabetes through its role as an efficient antioxidant. Additionally, the steroid hormone form of vitamin D promotes suppressor cell activity and inhibits the generation of cytotoxic (Tc), macrophages, delayed hypersensitivity type and natural killer (NK) cells. Vitamin D also mediates several non-calcemic functions. It is a regulator of cellular proliferation, differentiation and replication, and mediator of autoimmune reactions, in a variety of organs and biological systems [5-6]. Several epidemiological studies have suggested increased risks of diabetes or impaired glucose metabolism and cardiovascular diseases among persons with low vitamin D status [7-8]. There are also evidences regarding the association between vitamin D and IGF-1 level. It is suggested that vitamin D could increase the level of IGF-1 and improve the regulation of glucose homeostasis [9]. Earlier research has established a strong inverse correlation between serum vitamin D levels and glycemic control indicators, including fasting blood glucose (FBG) and glycated haemoglobin (HbA1c) levels [10-11]. Understanding the relationship between vitamin D levels and HbA1c in DM patients holds promise for enhanced therapeutic strategies and improved patient outcomes.

Aim:

MATERIAL AND METHODS

This was a cross-sectional, observational study was carried out in the Department of Biochemistry, in a tertiary care hospital, India. All the patients with type 2 diabetes mellitus who attended the outpatient clinics of our hospital during the study period were enrolled.

Inclusion criteria:

- Patients aged 18 years or above with both gender
- Type 1 & 2 diabetes mellitus without any complication
- Patients who provided written informed consent for the study

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Exclusion criteria:

- Patients <18 years of age
- Non-diabetic patients or Type 2 diabetics with microvascular complications
- Patients on vitamin D and calcium supplements
- Patients who not provide consent for the study

Participants were classifying according to their plasma vitamin D levels:
Vitamin D deficiency: concentration of serum vitamin d was <20ng/ml
Vitamin D insufficiency: concentration of serum vitamin d was 20-30ng/ml
Normal Vitamin D: concentration of serum vitamin d was >30ng/ml)
HbA1c levels were divided into three categories: first tertile (HbA1c<7.5%), second tertile (HbA1c:7.6%-9.9%), and third tertile (HbA1c ≥ 10%) [12].

Demographic information (like name, age, sex, BMI, socio-economic status and dietary status) was obtained. Complete history, clinical examination and investigations were done for all the patients.
FBS was measured as a morning sample after overnight fasting of minimum of 8 hours and PPBS was measured 2 hours after a major meal. Total vitamin D assay was estimated by ECLIA method HbA1c was measured using ion exchange High performance liquid chromatography method.
Recruited patients were assigned to receive vitamin D according to the safe upper limit dose recommended by the American Diabetic Association 4,000 IU/day for adults [13]. Then after 12 weeks from starting the supplementation, vitamin D level and HbA1c were measured again. They were compared with the initial readings to evaluate the effect of vitamin D supplementation on HbA1c level.

Statistical analysis: Data was compiled and analysis was done using Statistical Package for the Social Sciences (SPSS) 22.0. Percentage, mean, standard deviation, chi square test and pearsons' coefficient correlation was used. P value <0.05 was considered as statistically significant.

RESULTS

A total of 100 diabetic patients enrolled for the study, out of which 54 were males and 46 were females. The age groups of the patients were 20-85 years; with mean age of the study population was 53.4 ± 10.7. The mean HbA1c level in males and females was 8.57± 0.85 and 8.13± 0.41 respectively. Majority of the patients (61%) were urban residence and 63% were overweight.
Duration of diabetes was 5-10 years in 49% of patients, >10 years in 38% and <5 years were in 23% of patients. Details description shown in table: 1.

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Table 1: Baseline Characteristics of the Study Participants

Baseline Variables		No (%)	25 (OH) D (Mean ± SD)	HbA1c (Mean ± SD)	P value
Age (years), mean (SD)		53.4 ± 10.7	16.6±2.44	8.35 ± 0.48	0.343
Gender	Male	54 (54%)	15.57 ± 2.49	8.57 ± 0.85	0.247
	Female	46 (46%)	10.21 ± 2.11	8.13 ± 0.41	
Residency	Urban	61 (61%)	11.73 ± 2.16	8.52 ± 0.84	0.117
	Rural	39 (39%)	14.27 ± 3.80	9.14 ± 0.97	
BMI (kg/m2)	Normal	37 (37%)	17.131 ± 3.92	7.49 ± 0.52	0.525
	Overweight	63 (63%)	13.14 ± 2.55	8.26 ± 0.95	
Duration of diabetes	< 5 years	23 (23%)	15.37 ± 2.82	9.42 ± 1.24	0.438
	5-10 years	49 (49%)	12.19 ± 2.22	8.67 ± 0.81	
	>10 years	38 (38%)	10.24 ± 1.75	8.54 ± 0.78	

Out of the total 100 patients, 69 patients had a deficient vitamin D level that is vitamin D level less than 20, 19 patients had a vitamin D level in the insufficiency range that is between 20 to 29 while the rest 12 patients had sufficient vitamin D levels.

The HbA1c level was <7% in 20%, 7-9.9% in 30% and HbA1c ≥ 10% in 50% of patients. Correlation of vitamin D and HbA1c was shown in Figure 1.

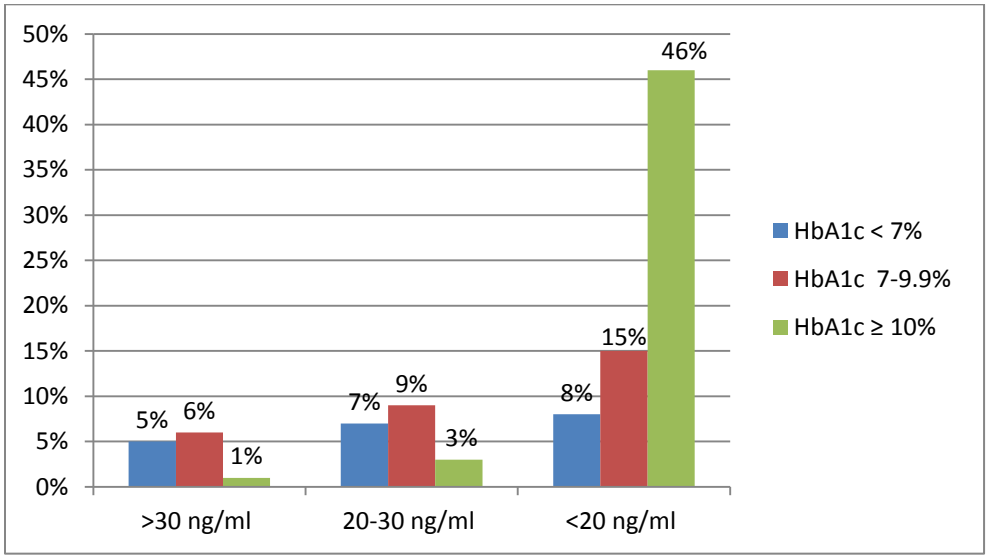

Figure 1: Association of Vitamin D levels with HbA1c values among study participants

The mean dose of vitamin D supplementation was 3860 ± 995 IU/day. The difference in the mean HbA1c level before (8.92 ± 0.72) and after (7.83 ± 0.66) vitamin D supplementation was statistically significant (P<0.05). Also, the percentage of patients' glycemic control groups was statistically significant after vitamin D supplementation (P <0.001), as shown in Table 2.

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Table 2: HbA1c level before and after vitamin D supplementation

HbA1c level	Before supplementation	After supplementation	**P value**
HbA1c < 7%	20 (20%)	30 (40%)	**<0.001**
HbA1c 7-9.9%	30 (30%)	65 (65%)	
HbA1c ≥ 10%	50 (50%)	5 (5%)	
Pre-HbA1c* (Mean ± SD)	8.92 ± 0.72		**0.022**
Post- HbA1c* (Mean ± SD)	7.83 ± 0.66		

DISCUSSION

In Type II diabetes mellitus, significant improvements in HbA1c are obtained with enhanced Vitamin D supplementation as part of drug regimen over time. Investigation provides the first known evidence of a relationship between enhanced Vitamin D supplementation as part of a pre-existing medical regimen taken over long term and determinants of Type II diabetes mellitus in a group of overweight and obese patients with Type II diabetes mellitus [14].

Current study reported that prevalence of vitamin D deficiency was very higher (69%) in diabetic patients, concordance with the Mehta N et al [15].

Our study showed that approximately 50% of the studied patients exhibited HbA1c levels ≥10%, indicating poor glycemic control in this subgroup, in agreement with the Alshahri BK, et al [16] and Mamo Y, et al [17].

In the present study HbA1c levels in the vitamin D deficiency group were significantly higher than those in the no vitamin D deficiency group for all subjects, similar findings observed by many other researchers: Zhao et al [18] and Farahmand et al [19], this indicates that the increase in HbA1c is negatively associated with a decrease in vitamin D levels. There was an inverse correlation between HbA1c and vitamin D levels which was also found to be statistically significant.

In our study Serum 25(OH) D was lower among females (10.21 ± 2.11) ng/mL than males (15.57 ± 2.49) ng/m, but statistically not significant (P >0.05), consistent finding reported by Zanco J. et al [20] and Al-Agha, et al [21].

In the present study, socio-demographic and clinical factors did not find any significant association effect on initial Serum 25 (OH) D and HbA1c level among study participants, accordance with the other studies [22-23].

Our results showed that mean pre intervention HbA1c level improved significantly after supplementation of vitamin D, our result was comparable with the Mohammadian, et al [24] and

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Madar AA, et al [25].

Current study showed improvement in patients number and percent in all glycemic groups (first tertile <7.5%, second tertile 7.6%-9.9%, third tertile ≥10%) after vitamin D supplementation, similar finding also observed by F A Randhawa et al [26].

CONCLUSION

There was an inverse correlation between vitamin D levels and HbA1c in diabetic patients. Supplementing vitamin D to diabetic patients with vitamin D deficiency or insufficiency leads to significant improvement in glycemic control and significantly reduced HbA1c level.

Conflicts of interest: none
Source of funding: none

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