International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

*Original Research Article*

# Association of Vitamin D and HbA1c in Type II Diabetes Mellitus Patients

**Dr Ayesha Juhi**

Associate Professor, Department of Physiology, Apollo Institute of Medical Science and Research, Hyderabad.

## ABSTRACT

Diabetes mellitus being a metabolic disorder is characterized by chronic hyperglycemia due to impaired insulin secretion, peripheral insulin resistance, or both. Vitamin D serves several hormonal functions on various cell types that express vitamin D receptors (VDRs) on them. Vitamin D deficiency may play a key role in the development of impaired glucose tolerance, type II diabetes mellitus and metabolic syndrome. The main aim of this study is to see the association of vitamin D and HbA1c levels in diabetes mellitus type II patients. Material and methods: This is a cross sectional study, conducted on 63 Diabetes mellitus type II patients in the age group of 30-70 years. HbA1c levels were correlated with their serum 25(OH) VITAMIN D3 levels. Pearson correlation statistical test was chosen to see the relation between HbA1c levels and serum25 (OH) VITAMIN D3 levels. Results: Pearson's correlation r value obtained was r= -0.3 which shows an inverse relationship between the two variables. P value obtained for correlation was 0.013 which showed a significant negative correlation. Conclusion: By the results obtained in the study, vitamin D levels were deficient than optimal levels among diabetic type II patients .These inadequate levels of vitamin D among them could one be the cause for their hyperglycemic state. And also the poor gylcemic control in them could also lead to deficient Vitamin D levels among them. Based on these results it would be physiologically correct to recommend vitamin D supplementation to improve glucose control in type 2 diabetes mellitus patients.

***Keywords:*** 25(OH) Vitamin D3, HbA1c (glycosylated hemoglobin), Diabetes mellitus type II

## INTRODUCTION

In the present scenario, Diabetes mellitus type II contributes to the vast burden of morbidity and mortality worldwide and yet is largely preventable and managed by a healthy lifestyle and dietary modifications. [(1)]

In 2018, there were more than 500 million prevalent cases of type II diabetes mellitus, the incidence increasing at an alarming rate worldwide. Presently, India has 32 million diabetic individuals and predicted to increase to 80 million by the year 2030. [(2)]

Diabetes mellitus being a metabolic disorder is characterized by chronic hyperglycemia due to impaired insulin secretion, peripheral insulin resistance, or both. [(3)]

To prevent long-term micro- and macro-vascular complications, patients with DM are required to maintain adequate glycemic control, which is routinely assessed by measuring glycosylated

hemoglobin (HbA1c) and fasting blood glucose (FBG) levels. [4]

Despite being classified as a micronutrient, vitamin D has also been noted to serve several hormonal functions that are proposed to result from its action on vitamin D receptors (VDRs), which are widely expressed on various cell types. [3] Vitamin D deficiency can aggravate many diseases and is also linked to predisposition of diabetes and may play a role in the development of diabetes. [5]

Vitamin D deficiency is highly prevalent in India even though we live in the temperate zone. About 70% of adults in both rural and urban areas were found showing manifestations of vitamin D deficiency. [4] Indians outstands in the prevalence of both diabetes and Vitamin D deficiency.

According to a study, vitamin D levels having been found to be inversely related to glycosylated hemoglobin levels in gestational diabetes mellitus. [6]

In animal studies, mice lacking functional VDRs exhibited impaired insulin secretion. [7] Furthermore, vitamin D supplementation was able to induce insulin biosynthesis in the pancreatic islets of rats. [8]

Vitamin D may serve a role in peripheral insulin sensitivity through its action on VDRs expressed on human skeletal muscle and adipose tissue cells. [9] These cells are involved in determining peripheral insulin sensitivity as they are responsible for glucose uptake in response to insulin secretion. [9]

The present study was taken up with the aim to study the association between serum 25(OH) vitamin D3 concentration and glycosylated hemoglobin (HbA1c) levels in patients with type II Diabetes mellitus.

## MATERIAL AND METHODS

This is a cross sectional study, conducted on 63 Diabetes mellitus type II patients in the age group of 30-70 years. They were selected on the basis of the inclusion criteria: Diabetes mellitus type II not more than 5 years, taking treatment only in the form of oral hypoglycemic drugs and not on vitamin D supplements.

**Exclusion criteria:** Diabetics more than 5 years, diabetic patients on treatment with insulin, vitamin D supplements, having diabetic complications, hypertensive, smoker, alcoholic, autoimmune disorder, thyroid disorders, bone disorders, menopause and any disease which alter glucose homeostasis in body.

The patients were selected randomly from the various diabetic camps conducted; whose fasting blood glucose level was more than 125 mg/dl were included in the study. Ethical clearance was taken from the ethics committee of the institute before the study was conducted. Written consent was taken from the patients after the purpose of the study was explained to them in detail.

The patients were asked to refrain from heavy physical activity for 24 hours and from consumption of alcohol and caffeinated beverages for 12 hours prior to the measurements. Baseline and anthropometric parameters were recorded before blood collection.5ml blood was collected by venipuncture technique to estimate 25(OH) Vitamin D3 and HbA1c levels.

25(OH) Vitamin D3 was measured by Fully Automated Chemi Luminescent Imunno Assay analyzed on Siemens ADVIA centura. Serum 25(OH) D3 level is a better indicator of vitamin D status than 1,25(OH)2D3, since the former has a slower rate of clearance than the latter. [10] Glycosylated hemoglobin (HbA1c) was measured using FULLY AUTOMATED H.P.L.C. using Biorad variant Turbo.

## STATISTICAL ANALYSIS

It was performed using the licensed SPSS version 24.The parameters obtained were entered using Microsoft excel version 10.Pearson correlation statistical test was chosen to see the relation between Glycosylated hemoglobin( HbA1c) and serum 25(OH) vitamin D3 levels.

**Table no.1 Descriptives of the data obtained from the diabetes mellitus type II patients**

| | N | Minimum | Maximum | Mean | Std. Deviation | Skewness | | Kurtosis | |
|---|---|---|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| AGE (years) | 63 | 34 | 59 | 47.11 | 6.328 | -.010 | .285 | -.845 | .563 |
| 25 (OH)Vitamin D3 (ng/ml) | 63 | 6 | 19 | 12.27 | 3.214 | .248 | .302 | -.505 | .595 |
| HbA1c (%) | 63 | 6.20 | 8.90 | 7.2349 | .71531 | .813 | .302 | -.040 | .595 |

**Table no. 2 shows the Pearson Correlation(r)between 25 (OH)Vitamin D & HbA1C levels**

| | | 25 (OH)VITAMIN D3 ng/ml | HbA1c% |
|---|---|---|---|
| 25 (OH)VITAMIN D3 ng/ml | Pearson Correlation | 1 | -.311* |
| | Sig. (2-tailed) | | .013 |
| | N | 63 | 63 |
| HbA1c % | Pearson Correlation | -.311* | 1 |
| | Sig. (2-tailed) | .013 | |
| | N | 63 | 63 |
| * Correlation is significant at the 0.05 level (2-tailed). | | | |

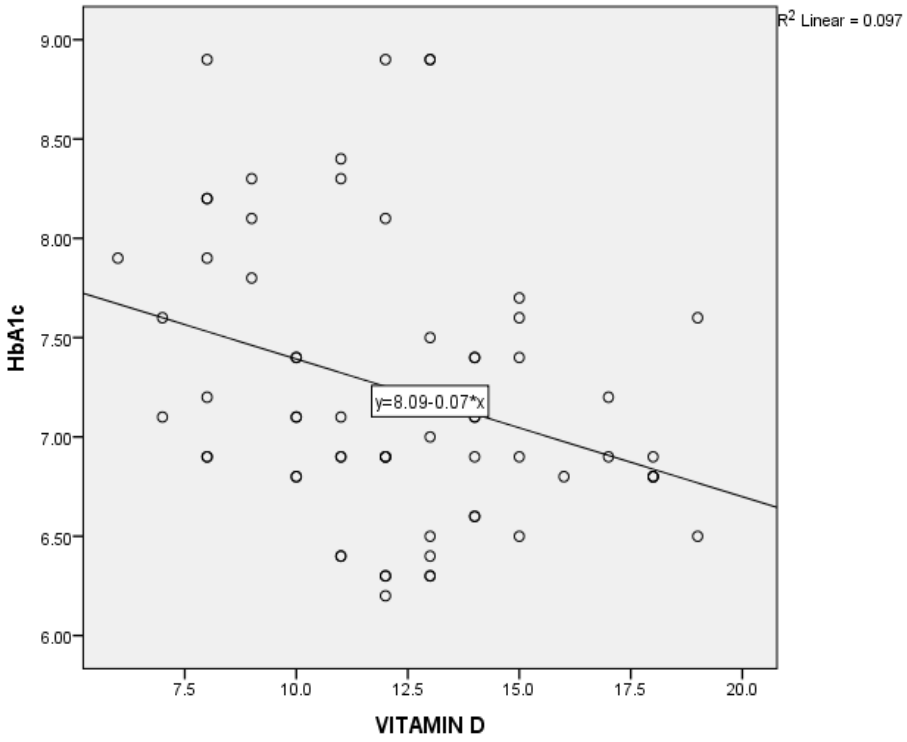


**Figure 1 : Inverse relationship between HbA1C and 25(OH) Vitamin D3**

## RESULTS

Among the 63 subjects, 47 years was the mean age, mean HbA1c observed was 7.2349 % and mean 25(OH) Vitamin D3 levels were 12.27ng/ml among the diabetes mellitus type II patients.

While studying the association between the HbA1C and 25(OH) vitamin D3 levels among the type 2 diabetic patients, Pearson's correlation r value obtained was r= -0.311 which shows an inverse relationship between the two variables. P value of 0.013 was obtained, where p value of equal to or less than 0.05 was considered to be significant one.

## DISCUSSION

In the present study, it was noted that the Diabetes mellitus type II patients have decreased levels of vitamin D and also observed a significant inverse correlation between HbA1c and serum 25(OH) vitamin D3 levels, suggesting a possible connection between glycemic control and vitamin D metabolism.

Decreased levels of Vitamin D could be one contributing factor for the causation of hyperglycemia in them. The mechanism of action of vitamin D in type 2 diabetes is thought to be mediated not only through regulation of plasma calcium levels, which regulate insulin synthesis and secretion, but also through a direct action on pancreatic Beta-cell function. [(11)]

The presence of vitamin D receptors (VDR) and vitamin D binding proteins (DBP) in pancreatic tissue and the relationship between certain allelic variations in the VDR and DBP genes with glucose tolerance and insulin secretion has lead to the hypothesis that it plays a very important role in glucose metabolism. [(12)]

In animal studies, mice lacking functional VDRs exhibited impaired insulin secretion. [(7)] Furthermore, vitamin D supplementation was able to induce insulin biosynthesis in the pancreatic islets of rats. [(8)]

Vitamin D may directly enhance insulin sensitivity by stimulating the expression of insulin receptors and/or by activating peroxisome proliferator-activated receptor (PPAR-δ), a factor implicated in the regulation of fatty acid metabolism in skeletal muscle and adipose tissue. Vitamin D may also affect insulin secretion and sensitivity indirectly via its role in regulating extracellular calcium concentration and flux through cell membranes in the beta cell and peripheral insulin-target tissues. [(13)]

For type II diabetes to develop, impaired pancreatic beta-cell function, insulin resistance and systemic inflammation are often present; evidence support vitamin D influences all these pathways. [(14)]

The other hand it can also be also postulated that poor glycemic control among diabetes mellitus type II patients has effect on vitamin D metabolism leading its deficiency in them.In the formation of vitamin D the first hydroxylation process takes place in the liver and forms 25-hydroxyvitamin D3 (25(OH) D3) and the second hydroxylation step in which the final active metabolite 1, 25-Dihydroxyvitamin $D_3$ (Calcitriol) occurs predominantly in the kidney. These reactions are brought about by 25-hydroxylase in the liver and 1- ∝ -hydroxylase in the kidney, and they belong to the cytochrome P450–dependent steroid hydroxylases. [(11)] Two enzymes in the liver, one in microsomal fraction and the other in mitochondria, catalyze the 25-hydroxylation of vitamin D. [(15)]

A study carried out on rats with experimental diabetes found that the low levels of serum 25(OH) D found in diabetic animals could be attributed to a reduction of 25-hydroxylase activity in the liver. [(16)] In addition, the observation that the correction of acute hyperglycemia determined an increase in serum 25(OH) D levels [(17)] could suggest that hyperglycemia may interfere with the activity of the 25-hydroxylase.

With the above discussion it is can be stated that Vitamin D is required for controlled release of insulin and maintenance of optimal glucose levels in the blood. Likewise, good glycemic control among the diabetics has to be maintained to obtain the ideal levels of vitamin D as it has many potential effects on skeletal and extra-skeletal tissues in the body.

With the results obtained in the study Vitamin D levels need to be evaluated in every diabetic individual and maintain a controlled glucose levels in the body to prevent further micro vascular and macro vascular complication of the disease.

## CONCLUSION

Vitamin D deficiency leads to hyperglycemia and in turn hyperglycemia leads to vitamin D deficiency further wherein both act as syndemic disease interrelated to each other. The growing incidence and prevalence of diabetes highlights the need for innovative approaches for the management and prevention of the disease. By the results obtained in the study, Vitamin D levels need to be maintained in optimal levels in the diabetic type II patients by adding vitamin

D supplementation along with their diabetes treatment regime for attaining the euglycemic levels in blood. A good glycemic control is very essential for maintaining optimal levels of vitamin D in diabetes mellitus type II patients as well.

## REFERENCES


1. World Health Organization (2013) Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013-2020.Geneva: WHO
2. Kraiser AB, Zhang N, Van Der Pluijm W. Global Prevalence of Type 2 Diabetes over the Next Ten Years. Diabetes. 2018;67(1)
3. Wang Y, Zhu J and DeLuca HF: Where is the vitamin D receptor? Arch Biochem Biophys 523: 123-133, 2012
4. Qaseem A, Wilt TJ, Kansagara D, Horwitch C, Barry MJ, Forciea MA Clinical Guidelines Committee of the American College of Physicians, corp-author. Hemoglobin A1c targets for glycemic control with pharmacologic therapy for nonpregnant adults with type 2 diabetes mellitus: A guidance statement update from the American college of physicians. Ann Intern Med. 2018;168:569–576
5. Hutchinson MS, Figenschau Y, Njolstad I, Schirmer H, Jorde R. Serum 25-hydroxyvitamin D levels are inversely associated with glycated haemoglobin (HbA(1c)). The Tromso Study. Scand J Clin Lab Invest. 2011;71(5):399- 406.
6. Lau, S., Gunton, J., Athayde, N., Byth, K. and Cheung, N. (2011) Serum 25-hydroxyvitamin D and glycated haemoglobin levels in women with gestational diabetes mellitus. Med J Aust 194: 334–337
7. Zeitz U, Weber K, Soegiarto DW, Wolf E, Balling R, Erben RG. Impaired insulin secretory capacity in mice lacking a functional vitamin D receptor. FASEB J. 2003;17:509–511.
8. Bourlon PM, Billaudel B, Faure-Dussert A. Influence of vitamin D3 deficiency and 1,25 dihydroxyvitamin D3 on de novo insulin biosynthesis in the islets of the rat endocrine pancreas. J Endocrinol. 1999;160:87–95
9. Alvarez JA, Ashraf A. Role of vitamin D in insulin secretion and insulin sensitivity for glucose homeostasis. Int J Endocrinol. 2010:351-385
10. Zittermann A. Vitamin D in preventive medicine: are we ignoring the evidence? Br J Nutr 2003;89:552–572.
11. Palomer X, González-Clemente JM, Blanco-Vaca F,Mauricio D. Role of vitamin D in the pathogenesis of type 2 diabetes mellitus. Diabetes Obes Metab.2008;10(3):185-97
12. Lee S, Clark SA, Gill RK, Christakos S. 1, 25-dihydroxyvitamin D3 and pancreatic β-cell function: vitamin D receptors, gene expression, and insulin secretion. Endocrinology 1994; 134: 1602-10
13. Dunlop TW, Vaisanen S, Frank C, et al. The human peroxisome proliferator-activated receptor delta gene is a primary target of 1alpha,25-dihydroxyvitamin D3 and its nuclear receptor. J Mol Biol. 2005; 349: 248–260
14. Ogunkolade BW, Boucher BJ, Prahl JMet al. Vitamin D receptor (VDR) mRNA and VDR protein levels in relation to vitamin D status, insulin secretory capacity, and VDR genotype in Bangladeshi Asians. Diabetes 2002;51:2294–2300
15. Hosseinpour F, Ibranovic I, Tang W, Wikvall K (2003) 25-Hydroxylation of vitamin D3 in primary cultures of pig hepatocytes: evidence for a role of both CYP2D25 and CYP27A1. Biochem Biophys Res Commun 303: 877–83.
16. Stefanov MV, Apukhovskaia LI (1996) Features of vitamin D3 metabolism in liver cells in experimental diabetes mellitus. Ukr Biokhim Zh 68: 66–72.
17. Metin Aksu N, Aksoy DY, Akkaş M, Yilmaz H, Akman C, et al. (2013) 25-OH-Vitamin D and procalcitonin levels after correction of acute hyperglycemia. Med Sci Monit 19: 264–8.


How to cite this article: Juhi A. Association of vitamin D and HbA1c in type II diabetes mellitus patients. International Journal of Research and Review. 2019; 6(7):152-156.

******