**Original Research Article**

# Correlation of Vitamin D levels in Indian diabetic population in comparison to non-diabetic controls

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International Archives of Integrated Medicine, Vol. 7, Issue 2, February, 2020.
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**Available online at http://iaimjournal.com/**
**ISSN: 2394-0026 (P)** **ISSN: 2394-0034 (O)**
**Received on:** 07-01-2020 **Accepted on:** 18-01-2020
**Source of support:** Nil **Conflict of interest:** None declared.
**How to cite this article:** Shruti Bhattacharya, Srinivas M. Correlation of Vitamin D levels in Indian diabetic population in comparison to non-diabetic controls. IAIM, 2020; 7(2): 35-40.

## Abstract

**Background:** Vitamin D (Vit D) is a fat soluble vitamin. Vitamin D plays an important role in glucose metabolism by acting on the pancreatic β-cells to improve insulin biosynthesis. It also increases insulin sensitivity by enhancing the expression of insulin receptors in target organs. Vitamin D deficiency is known to cause higher HbA1c levels, which is an indirect marker of long term glycemic control. In this study, we studied the correlation of Vitamin D levels in Indian diabetic population in comparison to non-diabetic controls.

**Materials and methods:** The present study included 102 known Type 2 diabetes mellitus (T2DM) patients and 330 controls in the age group of 20-80 years. The T2DM patients were divided into two groups–those with controlled sugars (HbA1c ≤7) and those with uncontrolled sugars (HbA1c >7) and vitamin D levels were studied in them.

**Results:** We observed that vitamin D levels were lower among the uncontrolled diabetics than the controlled diabetics. 21% of the uncontrolled diabetics had severe vitamin D deficiency compared to 9% of the controlled diabetics. Only 8% of the uncontrolled diabetics had normal vitamin D levels compared to 24% of the controlled diabetics.

**Conclusion:** As Vitamin D deficiency is associated with poor glycemic control, we concluded that in addition to achieving optimum BP control and lipid levels in diabetics, it should be made mandatory for all physicians to screen for Vitamin D levels and to aim for improvement of vitamin D status in them in order to achieve good glycemic control.

**Key words**

Vitamin D, HbA1c, T2DM, Type 2 diabetes mellitus.

## Introduction

Vitamin D is a fat soluble vitamin synthesized in the skin. 7-Dehydrocholesterol in the skin gets converted by UV radiation into cholecalciferol. Cholecalciferol hydroxylates in the liver to form 25-hydroxyvitamin D3 [25(OH)D, calcidiol] which in turn gets converted to 1,25-dihydroxyvitamin D3 [1,25(OH)2D, calcitriol] , the active metabolite of vitamin D in the Kidney [1].

It has been known that Vitamin D plays a major role in calcium and bone metabolism. Vitamin D has been found to have major implications in the neural and metabolic pathways, with its deficiency being linked to cardiovascular disease, cancer, stroke, dementia, psychosis, Alzheimer's disease and diabetes mellitus [2].

Vitamin D plays a major role in insulin biosynthesis by acting on Vitamin D receptors on pancreatic β-cells [3]. It also enhances the insulin receptor expression on target organs like the muscle and adipose tissue, increasing their insulin sensitivity and modulating the activation of PPARδ receptor, which is a key factor in controlling lipid metabolism in target organs like the adipocytes and skeletal muscles [4].

It has been found that Vitamin D deficiency is associated with higher HbA1c levels, increased incidence of type 2 diabetes mellitus and reduced sugar control in type 2 diabetics [5, 6, 7].

Here we have done a study on patients with type 2 diabetes mellitus, to know the relationship between Vitamin D status and HbA1c levels.

## Materials and methods

The present study was a case-control hospital based study which included 102 known type 2 diabetes subjects in the age group of 20-80 years attending the OPD in a tertiary care hospital in Bangalore. 330 age and sex matched controls with normal blood glucose levels were included in the study.

The study was conducted by Department of General Medicine at Rajarajeswari Medical College and hospital, Bangalore between August 2017 and October 2018.

**Inclusion criteria**

- Adult males and females - 20-80 years old.
- Known cases of Type 2 diabetes mellitus

**Exclusion criteria**

- Subjects who were on drugs containing vitamin D.
- Subjects on corticosteroids and drugs interfering with vitamin D metabolism like carbamazepine, phenobarbital, sodium valproate, gabapentin, isoniazid, and calcitonin.
- Subjects with disorders other than diabetes like osteomalacia, osteoporosis and inflammatory rheumatism and chronic kidney disease were also excluded from the study.

For the purpose of the study, the patients were divided into two groups–those with controlled sugar (HbA1c ≤7) and those with uncontrolled sugar (HbA1c >7) [8].

These subjects underwent history, clinical examination, FBS, PPBS, HBA1C and Vitamin D estimation. On the basis of the Vitamin D levels they were further divided into those with severe vitamin D deficiency (<10 ng/ml), moderate deficiency (10-19.9 ng/ml), vitamin D insufficiency (20-29.90 ng/ml) and normal vitamin D levels (≥30 ng/ml). The data was analyzed by descriptive statistics and chi-squared test.

## Results

Vitamin D levels were examined in 330 non-diabetic controls - 110 males, 220 females. Among the controls we found that only ~10% had normal vitamin D levels. 45% had moderate Vitamin D deficiency, 33% had Vitamin D insufficiency and 12% had severe Vitamin D deficiency. No significant difference was observed between the sexes (**Table – 1, Figure - 1**).

**Table – 1:** Comparison of vitamin D levels among the controls.

| Vitamin D Levels | <10 ng/ml | 10 - 19.9 ng/ml | 20 - 29.9ng/ml | >30 ng/ml |
|---|---|---|---|---|
| **Normal Male** | 10% | 45% | 33% | 10% |
| **Normal Female** | 13% | 46% | 32% | 7% |
| **Total Controls** | 12% | 45% | 33% | 10% |

**Figure – 1:** Comparison of vitamin D levels among the controls- male and females.

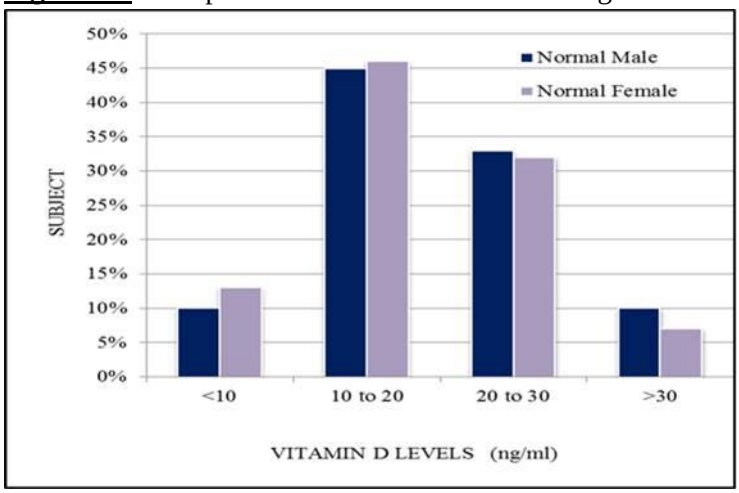
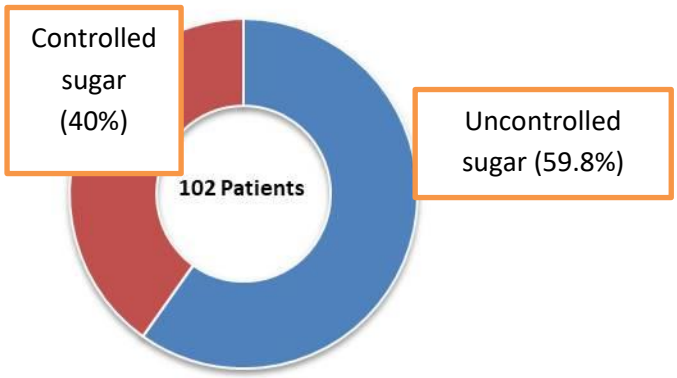



**Figure – 2:** Distribution of the 102 T2DM subjects into Controlled sugars (HbA1c≤7) and Uncontrolled sugars (HbA1c>7).




Among the 102 diabetic patients, 40% had controlled sugars (i.e. HbA1c<7), while 59.8% had uncontrolled sugars (i.e.HbA1c≥7) as per **Figure - 2**. The diabetics were further divided into 4 groups based on their vitamin D levels (**Figure – 3, 4**).

Uncontrolled diabetics had significantly lower vitamin D levels than either controlled diabetics or normal population; this was statistically significant with P <0.05 (P=0.02). >20% uncontrolled diabetics had severe vitamin D deficiency (<10 ng/ml) while only 8% had Vit D sufficiency (>30 ng/ml). <10% of the controlled

diabetics had severe vitamin D deficiency, with approx. 24% having Vitamin D sufficiency. Although the percentages of the controlled diabetics appear to have better Vit D profiles than non-diabetic individuals it is not statistically significant (**Table – 2**).

**Figure – 3:** Comparison of Vitamin D Levels among the diabetics and euglycemic conrols.

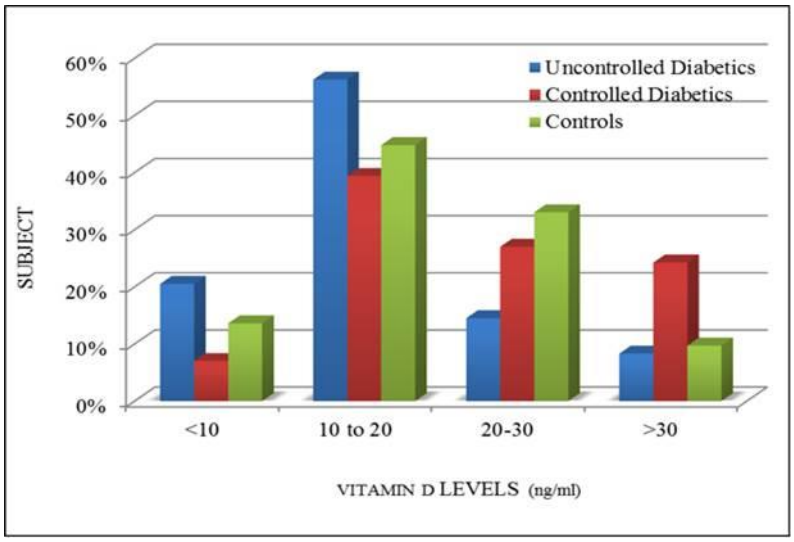



**Figure – 4:** Comparison of the T2DM subjects with controlled and uncontrolled sugars on the basis of their Vitamin D levels.

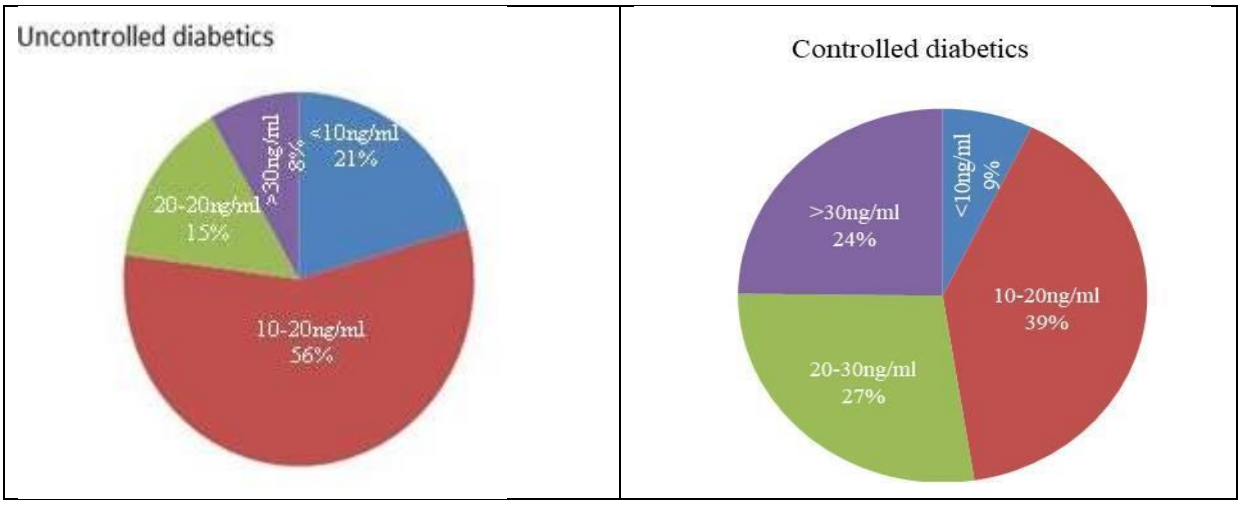



**Table – 2:** Comparison of the T2DM subjects with controlled and uncontrolled sugars on the basis of their Vitamin D levels.

| **Vit D (ng/ml)** | **<10** | **10-20** | **20-30** | **>30** |
|---|---|---|---|---|
| **Uncontrolled Diabetics** | 21% | 56% | 15% | 8% |
| **Controlled Diabetics** | 9% | 39% | 27% | 24% |
| **Controls** | 12% | 45% | 33% | 10% |

## Discussion

In our study, we found that Vitamin D deficiency was more among the uncontrolled diabetics than the diabetics with good glycemic control. We also found most of the non-diabetic controls in our study had Vitamin D deficiency. However, the prevalence of Vitamin D deficiency was more among the uncontrolled diabetics than the euglycemic controls.

The global prevalence of vitamin deficiency is estimated at 30-87% [9]. Diabetes is a rising world epidemic [10] which affects around 40.9 million people in India. It is set to rise to 69.9 million by the year 2025 [11].

Lately a number of studies have shown a positive correlation between vitamin D deficiency and poor glycemic control among diabetics.

In a study done in Pakistan by Iqbal K, et al. (2016), on 141 subjects, 58.7% patients with poor glycemic control had Vit D deficiency while 30.6% patients with good glycemic control had Vit D deficiency, which correlates with our study [12].

The study on 'The prevalence of vitamin D abnormalities in South Asians with type 2 diabetes mellitus in the UK' concluded that hypovitaminosis D is a major public health issue in the Asian population and is exaggerated in patients with T2DM [13]. Our study is in concurrence with this observation, showing lower Vit D levels among the non-diabetic controls, which is amplified in the T2DM with uncontrolled sugars. This is probably due to altered vitamin D metabolism caused by increase in 25-OH D, 24 hydroxylase activity (the rate limiting enzyme in Vit D metabolism) which is responsible for low 25-OH $D_3$ concentrations in Asians. Thus, it appears that Indians may have a genetic predisposition to vitamin D deficiency [14].

Studies have also noted racial differences in the correlation of Vit D deficiency with Diabetes, with Caucasians showing no correlation and African Americans showed significant correlation of Vitamin D deficiency with Diabetes [15]. From our study, we see that the euglycemic controls shows correlation of Vit D deficiency with uncontrolled type 2 diabetes mellitus.

A study done in Nigeria showed that Vitamin D3 supplementation in persons with T2DM and Vitamin D deficiency resulted in a significant improvement in glycemic control [16]. This needs to be tried as a corollary to the results of our study to check if the Asian Indian population responds in a similar manner.

## Conclusion

In our study two key observations were made:

- Uncontrolled T2DM patients had lower Vitamin D levels than the controlled T2DM patients.
- Euglycemic patients taken as controls had lower vitamin D levels, however prevalence of vitamin D deficiency was more among the uncontrolled T2DM patients.

As Vitamin D deficiency is associated with poor glycemic control, we conclude that in addition to achieving optimum BP control and lipid levels in diabetics, it should be made mandatory for all physicians to screen for Vitamin D levels and to aim for improvement of vitamin D status in them in order to achieve good glycemic control.

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