

## RESEARCH ARTICLE

# Prevalence of Vitamin D Deficiency in Diabetes Mellitus and Its Correlation with Glycated Hemoglobin

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## ABSTRACT

**Introduction:** The modern-day lifestyle and industrialization has led to the deficiency of sunshine vitamin, i.e., vitamin D, in all age groups. Vitamin D deficiency has its implications in almost each system and has widespread manifestation. This deficiency has far more severe outcomes when associated with diabetes.

**Aim:** To evaluate vitamin D level in type II diabetes patients.

**Materials and methods:** One hundred diabetic patients will be screened for serum 25-hydroxyvitamin D level by enzyme-linked immunosorbent assay technique and the results will be statistically analyzed.

**Results:** In our study, vitamin D was deficient in 42%, insufficient in 40%, and normal in 18% cases. Deficiency was seen more in female diabetics. This study has significant correlation with glycated hemoglobin (HbA1c) level and vitamin D level, i.e., as HbA1c increased, so is the vitamin D deficiency.

**Conclusion:** Vitamin D was deficient in more than 80% of diabetic patients. Therefore, all diabetic patients should be investigated for vitamin D level.

**Keywords:** Diabetes mellitus, HbA1c, Vitamin D.

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## INTRODUCTION

Diabetes mellitus is a very common disorder. In the year 2000, the prevalence of diabetes stood up to 2.8% of the total population of the world and is expected to reach up to 4% by the year 2030. The total number is projected to increase from 171 million in 2000 to 366 million in 2030.<sup>1</sup>

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The most common complications of diabetes include renal, neurological, retinal, and vascular (micro- and macrovascular). The prevalence of vitamin D deficiency has reached a global proportion.<sup>2,3</sup> It has also been associated with metabolic syndrome. It has been estimated that there are at least 1 billion people deficient in vitamin D worldwide, mainly because of the insufficient exposure to sunlight and insufficient dietary intake of vitamin D.<sup>4</sup>

Although vitamin D deficiency is common, the discovery of pleiotropic effects has attracted the attention of clinicians toward its importance. Besides its association in the causation of hypertension, diabetes, tuberculosis, and various cardiovascular disorders as well as multiple sclerosis and stroke, it plays a pivotal role in the musculoskeletal disorder.

Type II diabetes mellitus has consistently shown an association with individuals with vitamin D deficiency. The condition is characterized by insulin resistance and alteration in insulin secretion due to associated defects in pancreatic  $\beta$ -cell functions. Obesity is the most important feature of type II diabetes mellitus. It shows that vitamin D gets deposited in body fat stores; after that it is no longer bioavailable for utilization by the body. This may be the explanation of significant deficiency of vitamin D in obese individuals.

## MATERIALS AND METHODS

### Place of Study

The study was conducted in the Department of Medicine, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan, India.

### Study Design

A hospital-based cross-sectional study was planned.

### Study Period

From the period of October 2015 to October 2017.

### Sampling Technique and Study Population

A total of 100 patients with type II diabetes mellitus with fasting blood sugar levels  $\geq 126$  mg/dL and HbA1c levels  $\geq 6.5$  were selected as cases using ion exchange chromatography techniques. Blood samples collected from the cases to measure the serum 25-hydroxyvitamin D<sub>3</sub>.

### Inclusion Criteria

- Cases of type II diabetes mellitus on insulin or oral hypoglycemic agent therapy or on diet control.
- Newly diagnosed cases of type II diabetes mellitus.

### Exclusion Criteria

Patients with the following conditions:

- Age <18 years.
- Patients with chronic renal failure, which corresponds to chronic kidney disease stages 3 to 5 (glomerular filtration rate <60 mL/min per 1.73 m<sup>2</sup>).
- Patients taking calcium supplements.
- Patients taking vitamin D and vitamin B12 supplements.

### RESULTS

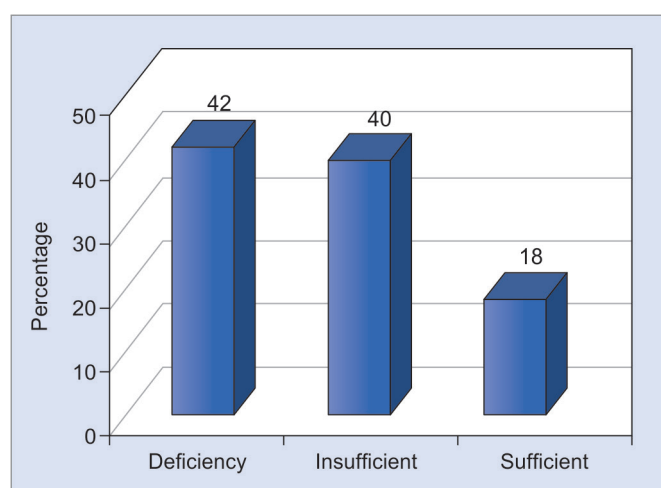
Our study had 44 female and 54 male patients in the age group 30 to 80 years.

Table 1 shows that maximum cases (82%) were having vitamin D level lower than normal (Graph 1).

Females had 45.45% deficiency, whereas males had 39.28% deficiency (Table 2). Chi-square statistic is 8.114; p-value is 0.017301. The result is significant.

**Table 1:** Distribution of the cases according to vitamin D

Vitamin D	Number (n = 100)	Percentage
Deficiency (<15)	42	42
Insufficient (15–30)	40	40
Sufficient (>30)	18	18
Total	100	100



**Graph 1:** Distribution of the cases according to vitamin D

**Table 2:** Distribution of cases according to sex and their respective vitamin D levels

Sex/vitamin D	Deficient	Insufficient	Normal
Female	20	20	4
Male	22	20	14
Total	42	40	18

**Table 3:** HbA1c and its association with vitamin D

HbA1c/vitamin D	Deficient	Insufficient	Normal
<7	8	24	12
7–10	31	15	6
>10	3	1	0

Table 3 shows that no patient had sufficient levels of vitamin D whose HbA1c was above 10 and 75% cases had deficiency in this category. Chi-square statistic is 17.4157; p-value is 0.001605. The result is significant.

### DISCUSSION

In our study, out of 44 female diabetic patients, 20 had vitamin D deficiency, i.e., 45.45%, and out of 56 male diabetic patients, 22 had vitamin D deficiency, i.e., 39.27%. So our study shows that females have more preponderance for vitamin D deficiency than males. One study conducted by Mahmoodnia et al<sup>5</sup> had no difference in vitamin D deficiency in male and female diabetic patients. One study conducted by Shaikh et al<sup>6</sup> showed that females (23%) had more deficiency than males (20%).

The HbA1c had a positive significant correlation with vitamin D deficiency in our study. Out of 4 patients (HbA1c >10), 3 had vitamin D deficiency and the remaining 1 had insufficient levels of vitamin D. This study showed that as the HbA1c level increased, it led to decreasing levels of vitamin D. This signifies that poor glycemic control has more vitamin D deficiency. Similar study conducted by Akshay Kumar et al<sup>7</sup> in Puducherry found no statistically significant relation between HbA1c and vitamin D level (p-value 0.741).

In this study, we found that 82% cases had vitamin D levels lower than normal (<30 ng/dL), 40% cases were in insufficient category (15–29.9 ng/dL), and 42% cases were in deficient category (<15 ng/dL). A study conducted by Mauss et al<sup>8</sup> showed that severe 25-hydroxyvitamin D deficiency (<10 ng/mL) was present in 13% of all participants in their study; 33% of participants had moderate deficiency (10–19.9 ng/mL).

Another population-based German study by Hintzpeter et al<sup>9</sup> reported a 16% prevalence of severe deficiency in individuals aged 18 to 79 years. A similar study conducted by Dalgård et al<sup>10</sup> showed that in age group <45 years, there were 9 patients of which 6 had low vitamin D levels (2 deficiency and 4 insufficiency). In the age group 45 to 55 years, there were 18 patients, 14 had low vitamin D levels (2 deficiency and 12 insufficiency). In the age group >55 years, there were 23 type II diabetes mellitus patients in which 18 patients had low vitamin D level (14 deficiency and 4 insufficiency). Thus, they found low level of vitamin D in 38 patients out of 45 patients (84%).

Pancreatic  $\beta$ -cells have vitamin D receptor and they express the 1- $\alpha$ -hydroxylase enzyme. So vitamin D binds

at this receptor and facilitates insulin secretion. Thus, vitamin D has a significant contribution in pathogenesis of diabetes. Positive role for vitamin D in the modification of the  $\beta$ -cell function has also been reported. This role is mediated through many different pathways, including the direct stimulation of secretion of insulin by vitamin D and the vitamin D receptors on pancreatic  $\beta$ -cells and their expression of 1- $\alpha$ -hydroxylase enzyme. Vitamin D also activates the transcription of the gene of human insulin and plays an important role in the secretion of insulin.<sup>11</sup>

## CONCLUSION

Diabetes mellitus is a chronic disorder and involves a lot of complications. Most of the complications are well known. Owing to the lifestyle and work culture, vitamin D is found to be deficient in all age groups. In our study, only 18% of patients had sufficient levels of vitamin D. Over 80% had subnormal levels of vitamin D. Based on our study, we would recommend going for vitamin D levels even in asymptomatic diabetic patients. When it is not feasible to have vitamin D level, owing to the cost, it is recommended to give vitamin D prophylactically in such patients. In the end, we would like to say that diabetes is a disease which will progress with time and will bring lots of complications. These complications are inevitable with age, but good glycemic control can prevent most of these complications including vitamin D deficiency.

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