

# Vitamin D status in Type 2 Diabetes Mellitus in a Tertiary Level Hospital

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## Introduction:

Diabetes mellitus (DM) is now considered the most common global metabolic non-communicable disease with accelerated morbidity and mortality, highest load in low and middle-income countries.<sup>1</sup> This is most probably due to the rapid and progressive socioeconomic development in these countries that has resulted in urbanization of their lifestyle and westernization of their diets.<sup>2</sup> DM had reached 35.4 million cases worldwide in 2015, with the expectation that it will reach million by the year 2040.<sup>3</sup>

Vitamin D, also known as a “sunshine” vitamin, is one of the fat soluble vitamins, and is considered

## Abstract

### Background:

There is increasing evidence of a relationship between vitamin D status and type 2 diabetes. Diabetes has also been found to be associated with 25(OH)D (vitamin D) deficiency and the role of vitamin D has recently emerged, especially in preventing cardiovascular diseases and cancer and insulin resistance.

### Objective:

This study aimed to compare vitamin D deficiency between healthy and Type 2 Diabetes Mellitus (T2DM) patients.

### Methods:

This cross-sectional study was conducted from July 2021 to June 2022 in the Department of Physiology, Rangpur Medical College, Rangpur. For this study, a total number of 100 subjects were selected among them 50 non-diabetic healthy subjects were included as control and 50 Type 2 Diabetes Mellitus patients were included as cases. The subjects of control were selected from the surrounding community of Rangpur district and subjects of cases were selected from Diabetic Association and from Outdoor of Endocrinology Department, Rangpur Medical College and Hospital, Rangpur. For statistical analysis, an independent sample t-test was performed by computer-based software SPSS-23.0 version for windows.

### Results:

The mean vitamin D level was lower in the diabetic patients than in non-diabetic participants (14.1±8.3 ng/ml and 37.3±11.3, p<0.001).

### Conclusions:

Early screening for serum vitamin D level is recommended for T2DM patients. Hence, it is crucial to promptly address any deficiencies in vitamin D levels.

**Keywords:** T2DM, Vitamin D level

as a prohormone steroid.<sup>4</sup> It is documented that vitamin D has important functions in the endocrine, paracrine, autocrine systems, and has a significant role in sustaining calcium homeostasis and bone health. Around a billion people in the world have been estimated to be vitamin D deficient.<sup>5,6</sup>

1,25-dihydroxyvitamin D<sub>3</sub> [1, 25-(OH)<sub>2</sub> D<sub>3</sub>], also called calcitriol is the active form of vitamin D, was found to influence the β-cells in the pancreas, in addition to exerting some effects on insulin secretion.<sup>7</sup> The presence of vitamin D receptor (VDR), and the enzyme 1-α 27 hydroxylases in pancreatic β-cells contributes to the link between

vitamin D deficiency and insulin resistance.<sup>8,9</sup>

Vitamin D is crucial for glucose metabolism as it directly triggers the release of insulin from the beta cells in the pancreas. This process is dependent on calcium, and vitamin D can indirectly raise calcium levels by modifying calcium flow within the  $\beta$  islet cells. Elevated levels of intracellular calcium help in reducing insulin production and enhancing insulin sensitivity in muscle and fat cells. Furthermore, vitamin D and calcium work together to regulate insulin sensitivity by activating the insulin receptor and peroxisome proliferator-activated receptor.<sup>10</sup> Several studies had documented a possible link between vitamin D and pancreatic  $\beta$ -cells function in which vitamin D deficiency can lead to prediabetes, and even diabetes itself. In the Longitudinal Aging Study Amsterdam, a group of 1286 elderly Dutch participants with metabolic syndrome underwent assessment.<sup>11</sup> The researchers observed a correlation between vitamin deficiencies and a higher prevalence of metabolic syndrome. Consequently, they deduced that reduced levels of vitamin D were linked to diminished insulin sensitivity, heightened insulin resistance (IR), and elevated fasting blood glucose (FBG) levels.<sup>10,12</sup> In addition, a dramatic rise in vitamin D deficiency has been reported in the mena region despite the abundance of sunshine.<sup>12,13</sup>

Two cross-sectional study in Arab Gulf (T2DM group=32; non-diabetics group=32) and the Makkah region, Saudi Arabia (328 patients with confirmed diabetes) revealed statistically significant association between vitamin D deficiency and T2DM and inverse relationship was observed between HbA1c levels and vitamin D deficiency.<sup>14,15</sup>

Vitamin D has a variety of non-skeletal functions including neuromuscular function to prevent psoriasis, multiple sclerosis, colorectal and prostate cancers, and to decrease the risk of cardiovascular disease, hypertension, dyslipidemia, and diabetes.<sup>3</sup> Multiple cross-sectional studies have indicated that a low circulating concentration of 25-hydroxy vitamin D (25-OH-D) is associated with higher fasting serum glucose, reduced insulin sensitivity, and an increased risk of type 2 diabetes. Although, interventional studies to investigate the effect of vitamin D supplementation on glycemic profile have had controversial results.<sup>11</sup>

Since, limited data are available regarding the association of vitamin D and type 2 diabetes mellitus (T2DM) in Bangladesh, especially the northern part, this study aimed to investigate the vitamin D deficiency between diabetic and non-diabetic patients.

#### **Methods:**

This was a cross-sectional study was conducted in the Rangpur Medical college, Rangpur during July 2021 to June 2022 to assess the status of vitamin D between T2DM patients and non-diabetic participants living in Rangpur.

For this study, a total number of 100 subjects were selected among them 50 non-diabetic healthy subjects were included as control and 50 Type 2 Diabetes Mellitus patients were included as cases. The subjects of control were selected from the surrounding community of Rangpur district and subjects of cases were selected from Diabetic Association and from outdoor of Endocrinology Department, Rangpur Medical College and Hospital, Rangpur. Individuals who are consuming vitamin D supplementations, patients with renal, liver or cancer diseases, patients with thyroid or parathyroid disorders, and individuals receiving any drug interacting with vitamin D and affecting their metabolism. steroids, orlistat, cholestyramine, phenytoin, and phenobarbital were also excluded from the study.

After obtaining the ethical clearance from the Ethical Review Committee of Rangpur Medical College and written consent, each participant fulfilled the demographic data using a structured questionnaire which contained variables included age, sex, BMI, sun exposure time were recorded from both groups.

The serum concentration of 25-OH-D was measured using electrochemiluminescence immunoassay method. The (25-hydroxyvitamin D) levels less than 20 ng/mL were considered as deficient, while levels between 20 and 30 ng/mL were considered insufficient, and levels greater than 30 ng/mL were considered sufficient.<sup>16</sup> FBS and 2 hours after meal serum glucose level was done by OGTT.<sup>17</sup> Data were expressed as mean (standard deviation) and frequency (percentage). Only descriptive statistics were used in the results. Data analysis was done using SPSS version 23.0.

**Results:**

A total of 100 participants were recruited in the study, subdivided into two groups, 50 T2DM patients and 50 non-diabetics. The mean age of cases and controls were  $48.5 \pm 11.9$  and  $44.0 \pm 10.5$  respectively. In both groups male were predominant. There was no statistically significant difference of BMI between the two groups. Most of the participants from both groups were exposed to sunlight from 11 AM to 3 PM for 15 minutes on daily basis and there was no statistical difference between the diabetic and non-diabetic group. (Table-I)

**Table-I: Sociodemographic characteristics and sun exposure time of the participants.**

Variables	Diabetic (n=50)	Non-diabetic (n=50)	p-value
<b>Sociodemographic characteristics</b>			
Age (mean $\pm$ SD)	$48.5 \pm 11.9$	$44.0 \pm 10.5$	0.69
<b>Sex- no. (%)</b>			
Male	35(70)	30(60)	0.87
female	15(30)	20(40)	
<b>BMI(kg/m<sup>2</sup>)</b>	$23 \pm 6.7$	$21 \pm 7.9$	0.36
<b>Sun exposure time- no. (%)</b>			
15 mins	26(52)	24(48)	
30 mins	16(32)	18(36)	0.79
1 hour	7(14)	6(12)	
More than 1 hour	1(2)	2(4)	

The mean Vitamin D level in diabetic were significantly lower than that of non-diabetics ( $14.1 \pm 8.3$  ng/ml vs  $37.3 \pm 11.3$  ng/ml, p-value  $< 0.001$ ). (Table-II)

**Table-II: Vitamin D level in both group**

Vitamin D level	Diabetic (n=50)	Non-diabetic (n=50)	p-value
	no. (%)	no. (%)	
Deficiency ( $< 20$ ng/ml)	22(44)	10(20)	
Insufficient (20-30 ng/ml)	18(36)	15(30)	$< 0.001$
Sufficient ( $> 30$ ng/ml)	10(20)	25(50)	
Mean $\pm$ SD (ng/ml)	$14.1 \pm 8.3$	$37.3 \pm 11.3$	

**Discussion:**

The mean 25(OH)D levels were significantly low ( $14.1 \pm 8.3$  ng/ml) in diabetes compared to controls ( $37.3 \pm 11.3$  ng/ml) in our study (p-value  $< 0.001$ ). This observation was supported by the study conducted by Bachali S et al, revealed the mean 25(OH)D level was low (20.09 ng/ml) in type 2 diabetes compared to controls (23.89 ng/ml) (p=0.02).<sup>18</sup> Data from an Australian diabetes, obesity and lifestyle study suggest that 25(OH)D levels were low in diabetics and that there was an inverse association between 25(OH)D and type 2 diabetes risk in the general population.<sup>19</sup> Vitamin D deficiency can be caused by inefficient synthesis in the skin due to improper exposure to sunlight or type of skin or other factors,<sup>5</sup> though in this study, there was no statistical difference of sunlight exposure between the diabetic and non-diabetic group (p=0.79), 15 minutes and 30 minutes sunlight exposure in diabetic and non-diabetic group were 52% vs 48% and 32% vs 36% respectively. A previous study revealed that, in patients with type 2 diabetes, 31.3% were exposed to sunlight for 30 minutes daily, compared to 34.4% in the non-diabetic group, and 53.1% versus 34.4% exposed to sunlight for 15 minutes. However, there was no significant difference in the duration of sun exposure between the diabetic and non-diabetic groups (P=0.4).<sup>14</sup>

Moreover, majority of T2DM patients were vitamin D-deficient ( $< 20$  ng/mL) indicating that vitamin D deficiency was significantly higher in the diabetic group than the non-diabetic, were possibly due to the presence and distribution of vitamin D receptors in the  $\beta$ -cells of the pancreas as well as in the adipose tissue and skeletal muscle. There are also several theories that have clarified the relationship between vitamin D deficiency and incidence of T2DM.<sup>20</sup>

The latest systematic review and meta-analysis concluded that hypovitaminosis D carried an increased risk in the incidence of T2DM in older individuals.<sup>21</sup> A case-control study conducted by AlKadi, 2014; in Jeddah, Saudi Arabia, to evaluate the vitamin D levels of Saudi women T2DM patients. Although the results did not reach statistically significant difference, which is not similar to this study.<sup>22</sup> Krul-Poel et al performed a double-blinded RCT on 275 T2DM adult patients in Netherlands in 2015 to evaluate the impact of vitamin D on the blood glucose control in T2DM

patients. The authors have observed that for every 25 nmol/L (or 10 ng/mL) decrease in calcitriol level, type 2 diabetes mellitus risk was 1.01(95% CI 0.75–1.36; P= 0.94). They have also stated that vitamin D deficiency was highly prevalent in this population which is consistent with this study.<sup>23</sup>

**Conclusion:**

Vitamin D deficiency was significantly higher in patients with T2DM than in non-diabetics. Therefore, early detection and treatment of vitamin D deficiency is recommended. People with a high risk of diabetes, i.e. prediabetes, should be given additional vitamin D to prevent the disease from occurring. The medical and scientific sectors, as well as other sectors such as the media, should highlight and raise awareness of the importance of vitamin D and the severity of its deficiency.

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