

## Study of association between vitamin D levels and HbA<sub>1</sub>C levels in children with diabetes mellitus type 1.

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### Abstract:

**Aims and Objectives:** To evaluate the association between diabetes mellitus type 1 (T1DM) and vitamin D deficiency, to compare vitamin D deficiency and glycemic control in paediatric patients with diabetes. **Materials and Methods:** It's a cross-sectional study done at civil hospital, Ahmedabad over a period of 10 months from October 2016 to July 2017. A total of 45 patients having DM type 1 in age groups between 1 to 12 years of age were included in the study. Vitamin D and HbA<sub>1</sub>C levels were done in all the patients. Patients with malnutrition, liver disease and end stage renal disease were excluded from the study. **Results:** The incidence of vitamin D deficiency in 75.5% among patients with T1DM. 59% of the vitamin D deficient group showed poor control with HbA<sub>1</sub>C levels >9%.

**Key words:** Cholecalciferol, Diabetes mellitus type 1, Ergocalciferol, HbA<sub>1</sub>C.

### Introduction:

Vitamin D refers to a group of fat-soluble secosteroids responsible for increasing intestinal absorption of calcium, magnesium, and phosphate, and multiple other biological effects. In humans, the most important compounds in this group are vitamin D<sub>3</sub> (also known as cholecalciferol) and vitamin D<sub>2</sub> (ergocalciferol). Vitamin D is required for normal functioning of the body. The condition with vitamin D deficiency results in rickets in children.

There is strong connection noted between T1DM and vitamin D deficiency. It has been proven by research studies that the death of islet cells can be prevented by vitamin D. Also it has been mentioned in several studies that regulation of beta cells can be negatively affected by lower levels of vitamin D<sup>[1,2]</sup>. Decrease in levels of vitamin D leads to increased levels of blood glucose. Similarly, a low level of vitamin D is also related to increased levels of glycosylated haemoglobin.

### Aims and Objectives:

1. To evaluate the association between vitamin D deficiency and T1DM.
2. To compare vitamin D deficiency with glycemic control in patients with diabetes mellitus type 1.

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### Materials and Methods:

It is a cross-sectional study conducted in



civil hospital, Ahmedabad including 45 subjects over a period of 10 months from October 2016 to July 2017.

#### Inclusion criteria:

All patients of type 1 DM between age groups 1 year and 12 years and on insulin therapy are included in this study.

#### Exclusion criteria:

All patients less than 1 year of age; and those with malnutrition, liver disease and end stage renal disease are excluded from this study.

#### Method:

- a) For assessment of glyceimic control, the patients were divided in three groups according to HbA<sub>1</sub>C levels as
  - Good glyceimic control -  $\leq 7\%$
  - Moderate glyceimic control - 7.1-9 %
  - Poor glyceimic control -  $> 9\%$
- b) Blood samples for vitamin D<sub>3</sub> levels and HbA<sub>1</sub>C were drawn simultaneously at the time of admission along with routine blood sampling.
- c) Patients were divided in two groups according to their vitamin D levels as
  - Group 1- vitamin D deficiency  $< 49\text{nmol/L}$  ( $<20\text{ng/ml}$ ) and insufficiency 50-75 nmol/L (20-30ng/ml)
  - Group 2- normal vitamin levels  $\geq 75\text{nmol/L}$  ( $\geq 30\text{ng/ml}$ )
- d) Z-test was used for contrasting average values with each other. Furthermore, correlation analysis was also done during the analysis of data. Mean  $\pm$  SD was used for expressing the results. 95% confidence limit was taken for standard deviation, so value of Z score more than 1.96 is considered significant.

#### Observation and Results:

**Table 1- Distribution of total number of patients in according to Age**

Age (Years)	Group 1 (Vit d deficient / insufficient groups)	Group 2 (Normal Vit d levels)	Total
1-5	17(50%)	3	20(44%)
5-10	10	4	14
10-12	7	4	11

**Table 2- Distribution of total number of patients in according to Gender**

Gender	Group 1 (Vit d deficient / insufficient groups)	Group 2 (Normal Vit d levels)	Total
Males	10(29%)	9	19 (42%)
Females	24(71%)	2	26 (58%)

The study selected 45 diabetic children as the participants. Table 1, 2 and 3 is presents with complete information about the distribution of children with T1DM on the basis of age groups at the time of diagnosis, gender and glyceimic control on the basis of HbA<sub>1</sub>C levels.

**Table 3- Distribution of total number of patients according to their HbA<sub>1C</sub> levels**

HbA <sub>1C</sub>	Group 1 (Vit d deficient / insufficient groups)	Group 2 (Normal Vit d levels)	Total
<b>Good control (<math>\leq 7\%</math>)</b>	5(15%)	4(37%)	9
<b>Moderate control (7.1-9%)</b>	9	5(45%)	14
<b>Poor control (<math>&gt;9\%</math>)</b>	20(59%)	2(18%)	22

The findings of this study have also shown that around 76% of the diabetic patients were suffering from the condition of vitamin D deficiency/insufficiency. However, 24% of the diabetic participants had normal levels of Vit D. An appropriate relationship was also identified between HbA<sub>1c</sub> and the status of vitamin D among the selected diabetic patients (Table 4).

The incidence of vitamin D deficiency in 75.5% among patients with Type 1 DM; among them 59% were females against 41% males. Among the vitamin D deficient group, the incidence is more in the age group between 1-5 years(50%). 59% of the vitamin D deficient group showed poor control with HbA<sub>1C</sub> levels  $>9\%$ , whereas only 15% showed good control, in contrast with the normal vitamin D level group, wherein only 18% showed poor control.

**Table 4- Mean and standard deviation of HbA<sub>1C</sub> levels in studied groups**

HbA <sub>1C</sub>	Mean	Standard deviation	95 % Confidence limit	
			Lower limit	Upper limit
Group1 (Vit D deficient/insufficient)	10.4 [X <sub>1</sub> ]	2.3 [SD <sub>1</sub> ]	9.9	10.8
Group 2 (Vit D normal)	8.8 [X <sub>2</sub> ]	1.7 [SD <sub>2</sub> ]	8.3	9.2

At 95% confidence limits, Z score value of more than 1.96 is considered significant; and as the Z score of 2.48 is more than 1.96, the result of the present study is significant.

### Discussion:

Several studies have assessed and discussed the rate of incidence of Vit D deficiency among the masses. A comprehensive study was conducted in Saudi Arab, who explored the relationship between deficiency of vitamin D and diabetes mellitus. The results of this study yielded the same results as the present study estimated. It has been evaluated that 84% of diabetic participants were also having Vit D deficiency. This study has mentioned that 75.5% of the diabetic patients had impaired levels of Vit D. The past study claimed that 76% of the participants had 25OHD levels  $<30$  ng/ml<sup>[4]</sup>. Similar study was conducted in the healthcare institutes of Qatar where the diabetic patients were selected for the study. This study also focused on the increase in the incidence rate of the Vit D deficiency in the selected participants. The results showed that the deficiency rate of Vit D was found to be 90.6%. A Swiss study was conducted, which have shown the incidence rate of Vit D deficiency equal to 60.5% among diabetic patients. The incidence rate of Vit D deficiency is Australia, Italy, and North America 43%, 25% and, 15% respectively<sup>[4,5,6]</sup>.

The study conducted by Riachy R et al evidently described that Vit D prevents the death of islet cells<sup>[7]</sup>. Similar study done by Boucher et al and Chiu KC et al also showed the association among dysfunctioning of beta cells, hypovitaminosis D, and resistance towards insulin<sup>[8,9]</sup>. Study conducted by Lind L et al showed that the connection between HbA<sub>1</sub>C and vitamin D can also occur because of influencing Vit D outcomes on insulin from beta cells, systemic inflammation, and actions of insulin<sup>[8]</sup>.

Present study has identified a major connection between vitamin D and HbA<sub>1</sub>C among the participants. 53.3% (22 subjects) of current study had poor control (HbA<sub>1</sub>C>9%), out of which, 91% (20 subjects) had lower levels of vitamin D. Two investigational projects viz. Svoren BM et al and Tunc o et al have also revealed that reduced serum 25(OH) D levels had a close relationship with improper metabolic control among diabetic patients<sup>[4,10]</sup>.

This study disclosed that 44% (20 subjects) of the participants were between the ages of 1-5 year, of which 85% (17 subjects) were having decreased levels of vitamin D. This research study discovered that the boys have high levels of vitamin D as compared to the girls. Present study reveals that 10 out of 19 i.e., 53 % of the boys were Vit D deficient, whereas 23 out of 26, i.e., 88% of the girls had inadequate amounts of Vit D. Results of a similar past study affirmed that the girls have more tendency of coping up with the deficiency of Vit D in comparison to the boys<sup>[11]</sup>.

Augmented intake of Vitamin D by infants diminished the threat of developing the condition of type 1 diabetes. EURODIAB study conducted among children with T1DM in 1999 showed that around 33 percent reduction was observed in childhood-onset T1DM, in those receiving the vitamin D supplementation in comparison to those who did not receive supplementation<sup>[12]</sup>.

### **Conclusion:**

The present study concluded that there is significant association between the vitamin D<sub>3</sub> levels and HbA<sub>1</sub>C levels in patients of T1DM, with vitamin D sufficient groups having comparatively better HbA<sub>1</sub>C levels than deficient/insufficient groups. Vitamin D plays a significant role in regulating various processes of a human body. Deficiency of vitamin D can lead to serious complication in a human body, both in adults and children. It has been deduced by the study that people suffering from diabetes have high occurrence rate of vitamin D deficiency, as the occurrence of vitamin D is directly related to glycemic control. Increased level of glucose in blood can be controlled by taking various supplement of vitamin D. Therefore, it can be concluded that gauging the level of vitamin D deficiency in diabetic patients is very critical.

### **Limitations:**

Some limitations of the study are impaired frequencies of calcium rich diet, and exposure to sunlight (duration). The main limitation of the study consists of its cross-sectional design. Due to low education status and social and financial constraints in families of the patients enrolled in the present study, follow-up percentage is low (40%), so further effect of vitamin D<sub>3</sub> therapy on glycemic control could not be evaluated. It was difficult to

compute population based rates and the number of selected Type 1 diabetes participants was small. Lastly, variations in intake of vitamin D due to different seasons can also be regarded as a limitation to this study.

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