



## A STUDY TO CORRELATE TOTAL CALCIUM AND GLYCATED HEMOGLOBIN IN TYPE-2 DIABETES PATIENTS.

<b>V Indhumathi</b>	MBBS III year Student, Sri Venkateshwaraa Medical College Hospital and Research Centre, Puducherry, India.
<b>M. Priyatharshini*</b>	Associate Professor, Department of Biochemistry, Sri Venkateshwaraa Medical College Hospital and Research Centre, Puducherry, India. *Corresponding Author
<b>P. Muraliswaran</b>	Professor, Department of Biochemistry, Sri Venkateshwaraa Medical College Hospital and Research Centre, Puducherry, India.
<b>S Dhanoushyaa</b>	MBBS III year Student, Sri Venkateshwaraa Medical College Hospital and Research Centre, Puducherry, India.

**ABSTRACT** **Background:** The risk for developing diabetic complications are related to glycemic control which is measured by estimating the glycated hemoglobin (HbA1c) level. Calcium increases the GLUT 4 activity. Change in calcium alters the insulin receptor phosphorylation, and decreases the activity of glucose transporter  
**Objective:** To find out the correlation between serum Calcium and glycated Haemoglobin in Type 2 Diabetes Mellitus patients.  
**Materials And Methodology:** A cross sectional study which included 100 type 2 Diabetes mellitus patients, divided into 2 groups based on HbA1c levels. Group 1 : Type 2 Diabetic patients with HbA1c more than 7 percent and Group 2 : Type 2 Diabetic patients with HbA1c less than 7 percent. Total calcium level was correlated with glycated hemoglobin level. Statistical analysis was done using unpaired t test.  
**Result:** The mean value of serum total calcium was lower in the diabetic group whose HbA1c was > 7 (p value – 0.000) when compared to the diabetic group whose HbA1c was <7. A strong negative correlation (r = -0.391) between calcium and HbA1c in the T2 diabetic patients with HbA1c >7 (p = 0.000) was observed.  
**Conclusion:** Alteration in calcium levels will have adverse effects on insulin secretion and release. Estimating the level of calcium becomes important to know the status of insulin in diabetic patients and correlating the levels of HbA1c and Serum Calcium in Type 2 DM patients, can monitor the levels of glycemic control and the risk of development of complications. Calcium supplementation to the diabetic patients can help in better glycemic control and prevent diabetes related complications

**KEYWORDS :** Type 2 Diabetes mellitus, Calcium, Glycated Hemoglobin (HbA1c), Insulin

### INTRODUCTION:

Diabetes Mellitus is a global epidemic disease affecting millions people around the world(1). The number of people with diabetes is increasing everyday with growth, age, urbanization and physical inactivity. The prevalence of diabetes for all age group worldwide was estimated to be 2.8% in the year 2000 and 4.4% in 2030. The number of people with diabetes is projected to rise from 171 million in 2000 to 336 million in 2030(2). According to the Diabetic Atlas 2006, published by IDF(International Diabetes Federation), the number of people with diabetes in India is around 40.9 million and is expected to rise to 69.9 million in 2025(3).

Glycated hemoglobin is a routine blood investigation that is done to monitor the glycemic control in diabetic patients. It is basically the non enzymatic addition of glucose molecules to the red blood cells. It indicates the mean glucose level of a patient over the past 10 – 12 weeks (4). It is not altered by diet, exercise or any drug intake(5). The risk for developing diabetic complications are related to glycemic control which is measured by estimating the glycated hemoglobin (HbA1c) level.

Calcium is a major constituent of bones and teeth and also plays an essential role as second messenger in cell signalling pathway. Calcium is required for intracellular processes in insulin responsive tissues like skeletal muscle and adipose tissue (6). It also increases the GLUT 4 activity. Change in calcium alters the insulin receptor phosphorylation, and decreases the activity of glucose transporter (7). Many studies have revealed a decreased serum calcium level in type 2 diabetes patients. Hence, the present study aimed to correlate the glycated hemoglobin level, a diagnostic marker of type 2 diabetes with serum total calcium level.

### METHODOLOGY:

This hospital based cross sectional study was conducted on type 2 Diabetes mellitus patients attending the General Medicine and Diabetology clinic of Sri Venkateshwara Medical College Hospital, Ariyur, Puducherry. 100 patients were included in the study. They were divided into 2 groups: GROUP I : Type 2 Diabetic patients with HbA1c more than 7 percent and GROUP II : Type 2 Diabetic patients with HbA1c less than 7 percent. An informed consent was given to the

patients to be filled. Institutional Ethical Committee clearance was obtained before the commencement of the study.

A proforma containing the general information of the patient like name, age, sex, socioeconomic status, and relevant history pertaining to diabetes mellitus like duration of the disease, complications if any, treatment taken was asked from the patient. Estimation of blood glucose (Fasting and post prandial), Glycated haemoglobin (HbA1c) and serum calcium was done using standard kits in an Autoanalyzer. Data were presented as arithmetic mean  $\pm$  S.D., with subsequent use of unpaired t test and Pearson's correlation to find the significance was done using SPSS version 23. Values P < 0.05 was considered significant.

### RESULT:

A cross sectional study was conducted with 100 type 2 Diabetic patients who were divided into 2 groups.

- GROUP I : Type 2 Diabetic patients with HbA1c more than 7 percent.(56)
- GROUP II : Type 2 Diabetic patients with HbA1c less than 7 percent(44)

**Table 1: The Baseline Characteristics Of The Study Groups**

	T2 DM patients with HbA1c >7 n = 56	T2 DM patients with HbA1c <7 n = 44
Age	49 $\pm$ 14.5	53 $\pm$ 13.7
Sex	M = 35 F = 21	M = 30 F = 14
Blood sugar	FBS = 175 $\pm$ 21.4 PPBS = 258 $\pm$ 44.1	FBS = 118 $\pm$ 19.0 PPBS = 185 $\pm$ 18.4
HbA1c	10.5 $\pm$ 2.5	5.9 $\pm$ 0.59
Total calcium	8.6 $\pm$ 0.7	9.7 $\pm$ 1.6

**Table 2: Compare The Mean Values Of HbA1c And Serum Calcium Between The 2 Groups**

	T2 DM patients with HbA1c >7 n = 56	T2 DM patients with HbA1c <7 n = 44	P value
HbA1c	10.5 $\pm$ 2.5	5.9 $\pm$ 0.59	0.000**

Total calcium	8.6 ± 0.7	9.7 ± 1.6	0.000**
---------------	-----------	-----------	---------

\*\* - highly significant (p value - <0.001)

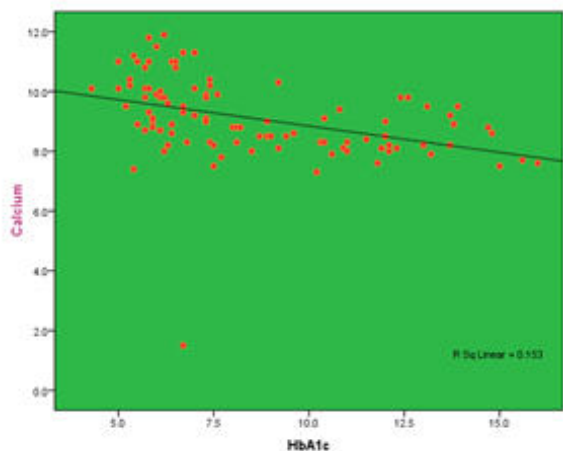
Table 2 shows that the mean value of serum total calcium was lower in the diabetic group whose HbA1c > 7 (p value = 0.000) when compared to the diabetic group whose HbA1c < 7

**Table 3: Correlation Between HbA1c And Total Calcium**

		Serum total calcium
HbA1c	Pearson's correlation	-0.391**
	Sig 2 tailed	0.000
N		100

\*\* - Correlation is significant at the 0.01 level (2 tailed)

Table 3 shows Serum calcium has a strong negative correlation (r = -0.391) with HbA1c in the T2 diabetic patients with HbA1c > 7 (p = 0.000)



**Figure 1:** Scatter diagram showing correlation between HbA1c and total calcium

### DISCUSSION:

The present study was conducted with the aim to correlate the total calcium with the glycated haemoglobin in type 2 diabetic patients. The diabetic patients were divided into 2 groups. Group 1 comprised of type 2 diabetic patient with HbA1c level more than 7. They were 56 in number with 35 male and 21 female patients. Group 2 consisted of type 2 diabetic patients whose HbA1c was less than 7. There were 44 patients with 30 male and 14 female patients.

On comparing the mean values of total calcium and the HbA1c level, there was a high significance as revealed by the p value 0.000. The 2 groups were correlated for glycated haemoglobin and total calcium level. It indicated a statistically significant negative correlation (r value = -0.391), which meant that the serum total calcium level was decreased with an increase in HbA1c level. These findings were in accordance with the study done by Mythili et al in 2018 where there was a significant correlation between serum calcium and HbA1c (8). Similar findings were observed in other studies done by Kanchana et al (7) and Safaa Abed et al (9) respectively.

As mentioned earlier, calcium plays an important role in insulin secretion via insulin receptor phosphorylation as well as increases the glucose transporter activity. A decrease in calcium level especially in poorly controlled type 2 diabetic patients is mainly due to excretion of calcium through urine in proportion with glucosuria (8). This indirectly affects the calcium homeostasis in the blood and an increased bone resorption activity leading to various bone disorders like osteoporosis especially in poorly controlled type 2 diabetic patients (9). Similarly, changes in calcium alters adipocyte metabolism and promotes triglyceride accumulation (7).

### CONCLUSION:

Calcium is required for insulin secretion. It mediates the intracellular processes in insulin responsive tissues like skeletal muscle and adipose tissue. Alteration in calcium levels will have adverse effects on insulin secretion and release. Estimating the level of calcium becomes

important to know the status of insulin in diabetic patients and correlating the levels of HbA1c and Serum Calcium in Type 2 DM patients, can monitor the levels of glycemic control and the risk of development of complications. Calcium supplementation to the diabetic patients can help in better glycemic control and prevent diabetes related complications as well as bone ailments.

### Acknowledgement:

The authors take this opportunity to thank Department of General Medicine for their whole hearted support for this study.

### Conflict of Interest: None

Source of funding: ICMR, 2019

### REFERENCES:

- World Health Organisation, Global Report of Diabetes. WHO, Geneva 2016, <http://www.who.int/about/licensing/copyright-form/index.html>.
- Sarah W, Gojka R, Anders G, Hilary K, Richard S. Global prevalence of Diabetes-Estimates for the year 2000 and projections for 2030. *Diabetes care*. 2004; 27 (5): 1047 – 1053
- Mohan V, Sandeep S, Deepa R, Shah B, Varghese C. Epidemiology of type 2 Diabetes: Indian scenario. *Indian J Med Res*, 2007; 125: 217 – 230
- Nathan DM, Singer DE, Hurxthal K, Goodson JD. The clinical information value of the glycosylated haemoglobin assay. *Eng J Med* 1994; 310: 345.
- Gandhi, M.; Venkateshwari, R.; Swaminathan, S. A Study on the association between plasma glucose, glycosylated hemoglobin and macro metals Calcium and Magnesium in Diabetes mellitus. *Experimental Sciences*. 4, (1): 16-21. 2013
- Ojuka EO. Role of calcium and AMP Kinase in the regulation of mitochondrial biogenesis and GLUT 4 levels in muscle. *Proc Nutr Soc* 2004; 63: 275-278.
- Kanchana N, Saikumar P. Serum Calcium Levels In Type 2 Diabetes Mellitus. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*. 2014; 13 (8): 01-03.
- Mythili C, Marshnil RW. Correlation of serum calcium levels with glycated haemoglobin in type 2 diabetes patients – A comparative study. *International Journal of scientific research*. 2018; 7(8): 04-06.
- Safaa Abed ELRH, Wigdan ARE, Nazik IAR, Nabel ME. Serum Calcium Levels in Correlation with Glycated Hemoglobin in Type 2 Diabetic Sudanese Patients *Advances in Diabetes and Metabolism* 2016; 4(4): 59-64.