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ORIGINAL ARTICLE

Serum Calcium and HbA1c Levels in Sudanese Patients with Type II Diabetes mellitus: is there any correlation?

[1]Ibrahim Abdelrhim Ali, [2]Alia Ahmed Haroun, [3]Muaath Ahmed Mohammed

[1,2]Department of Physiology, Faculty of Medicine, the National Ribat University, Khartoum, Sudan.

[3]Department of Physiology, Faculty of Medicine,Ibnsina University, Khartoum, Sudan.

Corresponding author: mwawssi0@gmail.com

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Abstract

Background: By influencing the production and release of insulin from the pancreatic beta cells, calcium ions have a significant impact on glycemic control. Calculating calcium levels is crucial for tracking insulin secretion because hypocalcaemia in non-diabetic individuals is linked to impaired insulin release. The purpose of this study was to measure serum calcium levels and compares them to HbA1c levels in Sudanese patients with type II diabetes who reside in Khartoum State.

Methods: At the Al-Amal Diabetes Center, 60 Sudanese patients with type II diabetes were the subjects of a cross-sectional hospital-based study conducted between March and June 2021. Demographic information, the length of diabetes, the kind of treatment, and co-morbidity were all covered by a standard questionnaire. Using the Mindary B 300 device, the HbA1c and serum Ca2+ were measured. SPSS version 25 was used to analyze the data.

Results: The participants' mean age was 56.8±13 years. Of the participants, two thirds are men. The average duration of diabetes was 12.0±8.8 years. The results showed that the mean HbA1c was 8.2± 2.5 % and the mean serum Ca2+ was 8.5± 0.4 mg/dl. HbA1c and serum Ca2+ did not show any discernible correlation (r = 0.104 and P = 0.429). Serum Ca2+ levels did not significantly correlate with the participants' ages or the length of time they had diabetes mellitus.

Conclusion: The results of this study showed that neither the duration of the DM nor the HbA1c were significantly correlated with the serum Ca2+ level. These results need to be confirmed by a more extensive investigation.

Keywords: Type II, Diabetes Mellitus, DM, correlation, Serum Calcium, HbA1c.

Introduction:

Worldwide, type II diabetes mellitus (TIIDM) affects about 366 million people, and by 2030, that number is expected to rise to 552 million [1]. One of the main causes of morbidity and death is diabetes mellitus. Managing diabetes and its complications, like cardiovascular disease, is very expensive and time-consuming. As a result, it is now critical for public health to prioritize the primary prevention of TIIDM [2, 3].

Diabetes mellitus is a complex metabolic disease marked by elevated blood glucose levels over an extended period of time and poor metabolism of fats, carbohydrates, and proteins as a result of deficiencies in insulin action, secretion, or both. Diabetes mellitus has long-term consequences, including the progressive development of specific complications such as retinopathy, nephropathy, and neuropathy [4].

Individuals with blood glucose levels under control, face fewer and less severe complications. Consequently, it's imperative to assess glycemic control on a regular basis using HbA1c testing [5].

It is advised to diagnose diabetes using glycated hemoglobin (HbA1c), a marker of chronic hyperglycemia that is sensitive to the condition and its complications. It serves as a gauge for the mean blood glucose level over a three to four-month span and recent dietary, exercise, or medication changes have no effect on it [6, 7].

Understanding the function of calcium in the etiology of (TIIDM) has been the focus of recent research. It has been proposed that TIIDM is linked to a common abnormality in the metabolism of calcium [8]. Higher circulating calcium levels have been linked to an increased risk of TIIDM, according to a number of prospective studies [9–12].

Serum calcium concentration and markers of glucose metabolism, such as insulin resistance (IR), fasting plasma glucose (FPG), and HbA1c have not been extensively studied. The literature reported that increased calcium concentration was associated with increased HbA1c [13], IR [14, 15] and FPG [16].In contrast to all earlier research, the Lorenzo et al. found no relationship between serum calcium concentration and glucose metabolism indicators like IR, FPG, and HbA1c [10].

With a very narrow range of Ca2+ required for optimal insulin-regulated functions, calcium is crucial for insulin-regulated intracellular processes in insulin-sensitive tissues like skeletal muscle and adipose tissue; variations in Ca2+ in primary insulin target tissues contribute to variations in insulin action [17].

Reduced glucose transporter activity and compromised insulin signaling are the results of impaired insulin receptor phosphorylation, a calcium-dependent process. Ca2+ fluctuations affect adipocyte metabolism, which may encourage the buildup of triglycerides by increasing de novo lipogenesis and making it more difficult to inhibit insulin-mediated lipolysis, which results in the accumulation of fat. Patients with TIIDM have been found to have impaired cellular calcium homeostasis, which includes abnormalities in skeletal muscle, adipocytes, and the liver [17].

Calcium affects the production and release of insulin from the pancreatic beta cells, which is a crucial part of blood glucose regulation. When calcium levels are raised again, insulin secretion and glucose tolerance return to normal. Calcium estimation is crucial for the monitoring of insulin secretion because hypocalcaemia is linked to impaired insulin secretion in non-diabetic individuals [18].

In order to better understand the serum calcium levels of Sudanese patients with type II diabetes, this study correlated those levels with HbA1c levels.

Methods:

Study design, duration and setting

Between March and June of 2021, a cross-sectional analytical study was carried out in a hospital setting with type II diabetic patients who were attending follow-up diabetic clinics at the Al-Amal Diabetes Center in Khartoum state.

Study population, sample size determination and technique

The study only included patients who had been diagnosed with TIIDM. Conversely, patients with additional co-morbidities such as renal failure, type I diabetes, thyroid or parathyroid disorders, or surgery were not included. By means of non-probability convenience sampling, sixty participants were chosen.

Data collection and procedure

The researchers conducted an interview with participants to gather pertinent data, such as age, the length of diabetes, the type of treatment (diet, pills, or insulin), and other medications such as diuretics, Ca2+ channel blockers, or supplements.

Each participant had a 5-millimeter blood sample drawn using standard procedures, and the sample was placed in 2.5 ml heparinized and EDTA tubes for the purpose of measuring the HbA1c and serum Ca2+ levels using an auto-analyzer (Mindary B 300) machine.

Quality control

The accuracy of the analyzer was verified prior to each sample by utilizing controls for normal, abnormal low, and abnormal high values. Staff members with expertise verified any unexpected results. 10% of the sample was reanalyzed in the Blood Bank quality control laboratory using the same type of chemistry analyzer as part of an external quality control.

Data analysis: The statistical analysis was carried out utilizing the SPSS software, version 25. Kolmogorov-Smirnov and Shapiro-Wilk tests were used to check the normality of the data, and the results showed that the data were normally distributed. The data was presented as means (SD or SE) and percentages. To compare various variables, the t test and correlation (Person) analysis were employed. P values less than 0.05 were regarded as significant.

Ethical consideration: The Alamal Diabetes Center, National Ribat University, and the Faculty of Medicine all gave their ethical approval for this study. All participants provided written informed consent after being fully informed about the purpose of the study.

Results:

The purpose of the study was to look into the correlation between serum calcium and glycated hemoglobin.

Sociodemographic information

The means of age, DM duration, serum Ca2+, and HbA1c are determined, as table one illustrates. Men make up 37 (61.7%) and women make up 23 (38.3%) of the total participants (n = 60). The proportion of participants with a HbA1c level higher than 6.5% is over 50%. Figure 1.

Table (1):- Descriptive statistical data of serum Ca^{2+} and HbA_{1c}

Variables	Mean	Std. Deviation	Minimum	Maximum
Age in years	56.8	13.2	27	81
DM Duration in years	12.01	8.8	1	40
HbA_{1c} %	8.26	2.51	4	14
Serum Ca^{2+} mg/dl	8.52	0.47	7	9.6

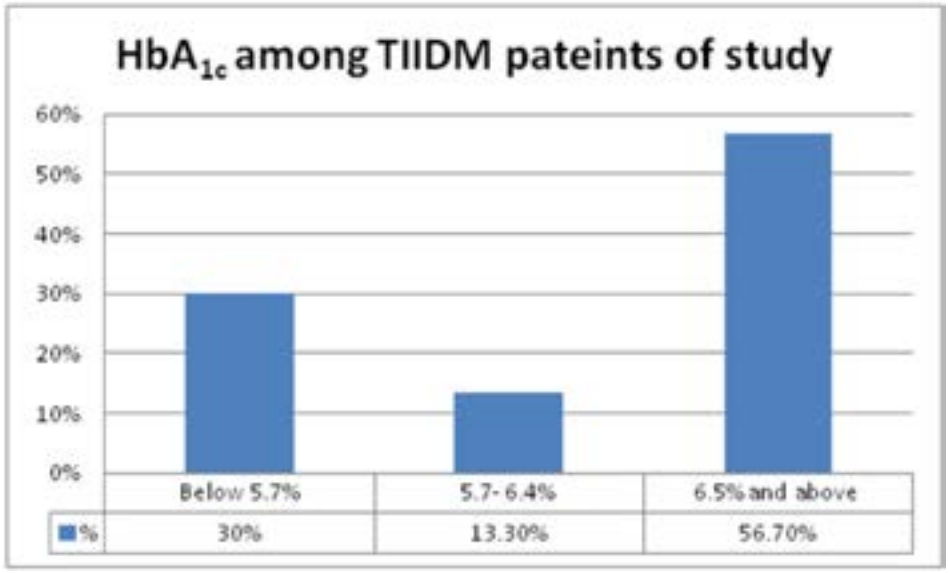

Figure (1): Descriptive statistical data of HbA_{1c} among participants (n=60)

Relationship between HbA1c and serum Ca^{2+}

There was no statistically significant correlation between serum Ca2+ and HbA1c, according to correlation (person) analysis (r=0.104, Pvalue0.429). Figure 2.

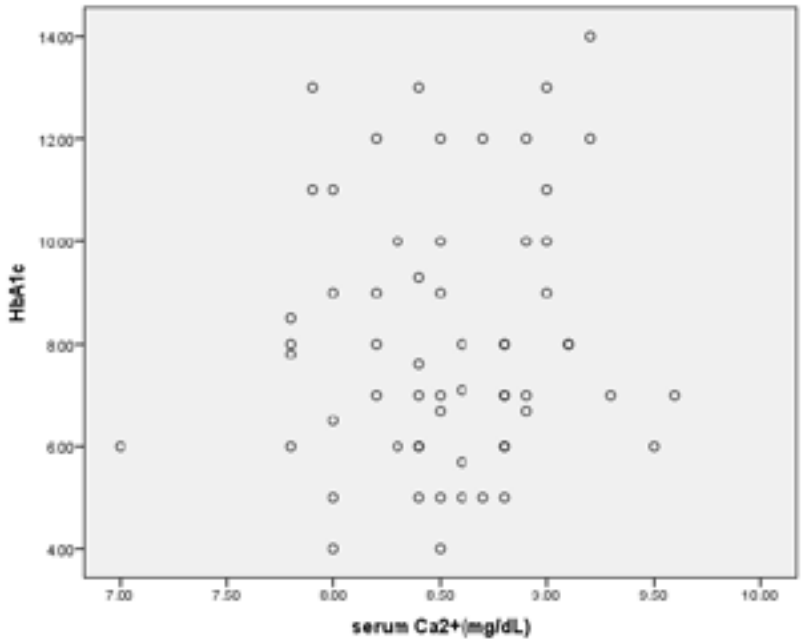

Figure (2): Correlation between serum Ca^{2+} and HbA_{1c} among TIIDM patients (n=60)

Serum Ca2+ and DM duration did not significantly correlate with participant ages, according to the t test (P values = 0.961 and 0.344, respectively). Similarly, patients receiving Ca2+ channel blockers for concomitant hypertension did not significantly alter their levels of HbA1c or serum Ca2+ (P values = 0.361 and 0.898, respectively). Moreover, gender did not appear to have an impact on either of these parameters in type II DM patients. Table2.

Table (2): Effect of Gender in serum Ca^{2+} and HbA_{1c} among type II DM patients

Test	Gender	N	Mean	Std. Deviation	P Value
HbA_{1c}	Diabetic males	37	7.8	2.6	0.767
	Diabetic females	23	8.8	2.6	
serum Ca^{2+}	Diabetic males	37	8.6	0.38	0.144
	Diabetic females	23	8.3	0.60	

Discussion:

This study aimed to estimate serum Ca2+ level in relation to HbA1c and other variables in Sudanese patients with type II diabetes mellitus.

The study's data analysis revealed that the minimum and maximum values of serum Ca2+ were 7.10 mg/dl and 9.60 mg/dl, respectively, while the mean value was 8.5 ± 0.47 mg/dl. According to other research, people with type II diabetes mellitus typically have lower serum calcium levels than people in the general population [19]. A larger study is required to verify the results of this investigation because there was a discrepancy between the findings of this study and those of other studies.

It was discovered that the mean serum Ca2+ levels in diabetic men and women were 8.6±0.38 mg/dl and 8.3±0.6 mg/dl, respectively. The mean serum Ca2+ levels in males and females in the consistency study conducted by Ayat et al. on healthy Sudanese were 7.2±.12 meq/dl and 8.95±0.8 meq/dl, respectively [20]. Additionally, the values in men and women are roughly 8.84±0.11 and 8.91±0.12, respectively, based on studies by Safa et al [21]. This indicates that, in comparison to the study by Ayat et al., the serum Ca2+ level in men with type II diabetes in this her study is lower, whereas it is nearly identical to the study by Safa et al.

Regarding HbA1c, the lowest and highest values were 4% and 14%, respectively, with a mean value of 8.26% ± 2.5 SD. Also the mean HbA1c levels in diabetic men and women were 7.8±2.6% and 8.8±2.6%, respectively. According to Elmokashfi et al. the mean HbA1c for individuals with newly diagnosed diabetes was 12.88% ± 0.4 SD for men and 13.26% ± 0.6 for women and On the other hand, the mean HbA1c in individuals with diabetes for an extended period of time was discovered to be 7.69% in males and 9.17% in females [22].. Furthermore, the mean values of HbA1c were found to be higher in females (4.6 ± 0.9% versus 4.5 ± 1.0% in males) in the finding of Ibrahim et al. [23].

The current investigation demonstrated that, in addition to the duration of diabetes mellitus P value (0.961), there was no significant correlation between HbA1c and serum Ca2+, where the P value is (0.429). A study conducted by Murtadha et al. confirmed this result by reporting that TIIDM and biochemical evidence of vitamin D deficiency, which is thought to be a reliable marker of Ca2+ homeostasis, did not correlate [24].

Moreover, there was no discernible relationship between the participants' age or sex and serum Ca2+ levels. This supports a locally conducted study in Sudan {21}. However, this study was refuted by Ibrahim et al. that found a significant correlation between gender and HbA1c [23].

Limitations

The results of the study may not be as generalizable as they could be because of the small sample sizes.

Conclusion

The data analysis of this study showed that, regardless of the length of the disease, there is no significant correlation between serum Ca2+ level and HbA1c. More research is required to confirm those results and future research, measuring insulin in relation to serum Ca2+ is advised.

Acknowledgement

Thanks to everyone who took part in this study.

Abbreviations

DM: diabetes mellitus

HbA1c: Glycated haemoglobin

Declarations

Availability of data and material

This manuscript includes the data that were used and further analyzed during this research. Any other datasets available upon reasonable request from the corresponding author.

Conflict of interest

Not Applicable.

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Author Contributions:

Concept – all authors – Data Collection and/or Processing – all authors , Analysis and/or Interpretation – all authors Literature Search – all authors; Writing Manuscript– all authors; Critical Reviews– all authors and Supervision – IA.

All the authors have read and approved the final manuscript

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